Maryke van Staden
Francesco Musco
Editors

ADVANCES IN GLOBAL CHANGE RESEARCH 39

Local Governments and Climate Change

Sustainable Energy Planning and Implementation in Small and Medium Sized Communities

Springer

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Editors

Local Governments and Climate Change

Sustainable Energy Planning and Implementation in Small and Medium Sized Communities

Springer
Province of Rovigo
Fondazione Cassa di Risparmio di Padova e Rovigo

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Foreword

Global warming is changing the world as we know it. Climate change can have catastrophic impacts in numerous cities across the world. It is time for us to react – quickly and effectively.

The European Community (EC) has been leading the fight against climate change, making it one of its top priorities. We have introduced the most ambitious targets of their kind, known as the "20/20/20 by 2020" initiative within the "Climate Action and Renewable Energy Package." As a result, European Member States have taken on a commitment to curb their CO_2 emissions by at least 20% by 2020. These targets are indeed commendable; however, they are only the start if we are to avoid the consequences of global warming.

Whilst top level coordination from the European Institutions and Member State governments is vital, the role of mitigating and adapting to climate change at local level must not be forgotten. In fact, here cities, regions and their citizens play a significant a role. It is therefore vital they become directly involved in the climate change challenge. The European Commission therefore launched in 2008 a new initiative, the Covenant of Mayors, which brings together a network of European mayors in a voluntary effort to go beyond the European Union's already ambitious targets.

Half of our greenhouse gas emissions (GHGs) are created in and by cities. 80% of the population live and work in cities, where up to 80% of energy is consumed. The relevance of addressing energy efficiency and renewable energy at the "local dimension" is therefore obvious. Mayors can often influence the running of their city and they can address the challenges we face in a coherent way, be it in the field of development of alternative energy or pollution control, energy management or a change of behaviour by public authorities and citizens. Cities are the privileged places where it is possible to find multicultural, cross-sectoral solutions and where the necessary balance between private and public interests may be found.

Tackling the climate crisis challenge demands a holistic, integrated and long-term approach, based on citizen participation. I am convinced that local governments must become the leading actors for implementing sustainable energy policies, and they must be supported in their effort.

I am therefore very pleased to present this ICLEI publication, especially given the European Commission's recent initiative on the Covenant of Mayors launched in January 2008. Since then over 80 cities have signed up to the Covenant, over 160 have expressed their interest to join. The enthusiastic response by Mayors across Europe has convinced me that we are undoubtedly on the right track.

Adris Piebalgs
Commissioner for Energy at the European Commission (EC)
Brussels, Januray 2009

Nowadays the commitment to climate change and renewable energies is still too often considered as a prerogative of national governments and international agencies, with the perception that mayors need to focus on defining proper environmental policies. Unfortunately, or maybe rather fortunately, the reality is different and every community can play a fundamental role in these areas before the ecosystem is destroyed.

In this debate, where the launch of the Rovigo Outreach in 2008 played a fundamental role, it is necessary to promote a comparison on innovative climate protection approaches. It is also the best time and an opportunity to define common strategies and outline roles of local authorities. The involvement of many Italian and other cities, as well as a wide range of environmental movements underlines the importance to define a shared policy models to protect environment.

This book introduces a wide range of experiences promoted by small and medium sized local authorities in the field of environmental and climate protection. It represents a valuable handbook for policy and decision makers.

Tiziana Virgili
President of Rovigo Province

It is a fact that the prevalent urban model in Europe, especially in Italy, is represented by small and medium sized towns: an urban model with fewer environmental stresses than those faced by larger metropolitan areas, but with a fundamental role in defining environmental policies.

The idea to promote a wider international agreement among small and medium sized local authorities came to me during the ICLEI Stockholm Conference in 2006 and also as an outcome of Rovigo Province's activities in the Aalborg Commitments. The main purpose of the Rovigo Conference, as one among a series of important events of the Climate Roadmap, was to discuss the role of smaller local authorities that are often at the very edge of operative climate debates.

I still remember the excitement when I heard that the proposal to organise the conference in Rovigo was accepted. It was a confirmation that our attention towards innovative environmental protection and energy policies, as well as our willingness – as a medium sized local authority – to contribute to the climate protection debate has been positively considered by the EC with support coming from the Intelligent Energy Europe programme to ensure high quality implementation and results.

I wish to extend my sincere thanks to ICLEI, the editors of this publication, and the expert team that elaborated the *Rovigo Outreach.* I hope this book could help local authorities to define a balance point between development and protection, to give a sense to our present as part of the world and humanity.

Federico Saccardin
President of Rovigo Province
Rovigo, January 2009

Preface

This book is for everyone who lives, works, studies – and yes, who loves – cities and towns. Most of us live in urban areas, and enjoy the many comforts offered by urban living. We invite you to gain an insight into relevant developments for local governments from an energy and climate protection perspective.

Why are we looking at communities and climate change? And why are we in particular looking at smaller sized communities?

We are now standing at a cusp point. This is a time when decisions are being made that will shape our future, and that of the world. The cusp point is linked to two prominent facts, namely that the climate is changing and that global natural resources are dwindling. Humans are consuming global resources at an unprecedented tempo, and directly contributing to the acceleration of climate change through the way we generate energy and use resources. These are two key aspects which require a rethink – what has to change to influence the direction at this cusp point.

Humans must change their lifestyle in order to survive in a 'whole' environment and to enjoy a reasonable 'quality of life'. This means taking on responsibility for our actions and our choices, as well as looking at the impact these have beyond today. Despite the obvious (and not so obvious) threats, there are also opportunities at this time, in this changing climate. We can approach this situation from a financial perspective, a technological perspective, and a solutions perspective. Yet what we need is a systems change, and a coherent sustainable and suitable response. We also need to consider the scale of the climate challenge, which has a huge dimension probably not yet fully understood by most people.

The focus of this publication is on how small and medium-sized communities have effectively responded to climate change, both in the areas of mitigation and adaptation. There is a particular concentration on the use of different approaches towards sustainable energy planning and implementation by the cases selected. These responses were the result of different (and often combined) motivations – some taking on their responsibility to protect the environment, others to specifically reduce greenhouse gas emissions (GHGs) and so mitigate their communities' impact on climate change, some to improve urban air quality, others to improve the resilience of their communities, and most of them keen to make use of opportunities for sustainable local development.

This book, although not a conference proceedings per se, is one of the main outcomes of the European Rovigo Climate Conference 2008 that addressed "Climate protection and renewable energy: medium and small communities facing the challenge".[1] The event was jointly organised by ICLEI – Local Governments for Sustainability and the Province of Rovigo, Italy, in April 2008, to highlight that effective climate protection action can, and is addressed by smaller cities and towns, sometimes also working in cooperation clusters. Some of the excellent examples presented in Rovigo are included in this publication, together with other good practice cases that illustrate the wide variety of approaches used. There are of course many other options available – and communities need to select those that will work for them.

We will share with you the reasoning and potential to change at a community level, giving you an insight into recent fascinating developments that are shaping the future of our communities. Local governments around the globe, and particularly in Europe, have taken on the role to lead and drive change in their communities. In addition to briefly looking at the history of community climate protection, in particular through ICLEI's international Cities for Climate Protection™ (CCP) Campaign, important recent developments relevant to climate change mitigation and adaptation at a community level are also presented. These include the international Local Government Climate Roadmap – a process started in Bali in December 2007 at the United Nations Climate Conference to draw attention to the crucial role of local governments (LGs) in climate protection. The City Climate Catalogue is another global tool used to highlight the vital role communities are playing in climate protection, and to focus on collective achievements. This is part of an ongoing process that will culminate in calling for improved support and framework conditions from national governments and international actors, in the post-2012 phase. Other developments such as the European Covenant of Mayors play an important role at a regional level, and some of these developments are also presented.

Kindly note that some issues are not explicitly addressed, yet provide a context for this book. These include: the global population explosion, the migration of people towards urban centers, the exponential growth in resource consumption and consumerism, the uncertainty about future availability of resources, and anticipated aggression regarding resource ownership.

Although the above mentioned issues seem to be global problems these are also relevant to urban areas. Consider from an energy perspective: Is the energy infrastructure robust enough if there is a change in the population (e.g. incoming masses of seasonal tourists)? How can a local government effectively plan for inevitable fuel price rises, if it remains dependent on imported fossil fuels? Is it perhaps more financially sound, more efficient and safer to become independent from energy 'imports'? What will the impact of climate change be on the community, the

[1] www.iclei-europe.org/rovigo2008

infrastructure, the local environment over the next 10, 20, 50 years? Is the local government planning for this? How can the local government plan for the increasing variability in climate and increasing violence of natural phenomena (precipitation, storms, droughts)? All of these questions should be considered in local strategies, urban planning, energy planning and other areas potentially impacted.

Nobody (as of yet) is using words such as ‘crisis’ or ‘emergency’ when looking at climate change and resource depletion. Yet this is essentially the status we have to face. Certainly it is a challenge to respond appropriately and promptly. It is time to take on our responsibilities. At community level, where the impacts of climate change are already visible and will continue to manifest, there is increasing recognition that action is required and there is a vast potential for local climate action – by every individual, by local leaders, by businesses and industry – in many different areas. Here local governments can literally move the world – with ICLEI’s motto ‘Local action moves the world’ a pointer to today’s realities.

Through this publication we wish to provide some ideas on how to reach a sustainable energy future, sharing examples from smaller communities that have started on the road of transition and have achieved measures of success. Our premise is that it is possible to reach and maintain a level of quality of life that all can enjoy, using resources in a sustainable manner and limiting our impact on the environment. We hope our leaders will use the current international post-Kyoto climate negotiations to provide clear direction and a support framework for action. Yet, we will in any case take up our own responsibility, even show them the way this can look at a local level.

We invite you to read on, gain ideas for your own community, and join us in this process of energy transition towards a sustainable future, aiming to stay beyond the climate change tipping point if this is still possible.

Maryke van Staden
Francesco Musco

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The successful European Rovigo Climate Conference 2008 “Climate protection and renewable energy: medium and small communities facing the challenge” provided the impetus and extensive contents for this publication.

The event, jointly organised by ICLEI – Local Governments for Sustainability and the Province of Rovigo, Italy – which a participant in ICLEI’s European Cities for Climate Protection™ (CCP) Campaign – was held in April 2008. It highlighted that smaller communities, working alone or in clusters, can very effectively address climate protection, the roll-out of renewable energy and the implementation of energy efficiency. The editors, who were the conference programme coordinators, express their sincere appreciation and thanks to the speakers, participants, event supporters and endorsers, as well as the financial contributions from the Intelligent Energy Europe Programme of the European Commission Directorate-General Energy and Transport (DG TREN)[1] and the Veneto Region (Regione del Veneto[2]), for their support and input.

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[1] http://ec.europa.eu/energy_transport/index_en.html

[2] www.regione.veneto.it

[3] www.fondazionecariparo.it

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Chapter 1
Introduction

Maryke van Staden and Francesco Musco

Abstract The reality of the human impact on climate change is now widely accepted, with the extent and potential catastrophic magnitude increasingly recognised by scientists and politicians, also by business people and citizens. Scientific climate observations, the development of scenarios on which planning and decisions can be based, studies on the economic impact of climate change, and monitoring actual impacts – at the macro (world) and micro level (community) – all point in a specific direction: humans must change towards sustainable energy solutions and change their lifestyle. As the urban population continues to grow, the centres of human life require a drastic rethink in terms of energy and the use of resources, also from a climate change mitigation and adaptation perspective. People are looking to their governments to respond appropriately. They are waiting for courageous leadership, guidance, motivation and direction – they need to know that a more coherent climate protection response is being developed. Expectations in this regard are particularly directed towards national government, but all other levels as well. Citizens are also looking towards their local governments, with the local impact of climate change requiring a local response, with plans for community based adaptation and local climate change mitigation. This publication addresses local governments and climate change, with a specific focus on smaller sized communities and renewable energy solutions.

Keywords Climate protection • climate change mitigation • climate change adaptation • energy • lifestyle • local climate action • local governments • population growth • sustainability

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1.1 Global Challenge, Global Trends

The most recent reports by the Intergovernmental Panel on Climate Change (IPCC), the Stern Review, and other reputable documents, provide concise summaries and detailed scientific information and arguments on the impacts of climate change and recommended responses. According to the most recent IPCC report, the Fourth Assessment Report of the IPCC released in 2007, climate change has accelerated and its visible impacts include temperature increases, more intense and frequent precipitation, more heat waves, more intense and longer droughts, to mention but a few observed developments. Scientific comprehension of the phenomena has significantly improved in recent years, and the IPCC concluded in 2007 that reaching a lower carbon dioxide (CO_2) emissions global scenario was still realistic.

Yet the timeframe for effective action is shrinking, and to stabilise emissions it is necessary to act categorically and effectively over the next 7 years, according to Dr. Rajendra K. Pachauri, chairman of the IPCC.[1] Should it not be possible to achieve substantial reductions in this timeframe we are likely to reach the tipping point of irreversible, spiralling and catastrophic climate change.

Cities and towns – places where people tend to cluster and where the impact of climate change is already visible and expected to worsen – are where an urgent yet coherent response is needed to these challenges. Looking at the global population trends, according to the 2008 Revision of the official United Nations population estimates and projections, the world population is projected to reach seven billion in 2012, up from the current 6.8 billion today, and it will surpass nine billion people by 2050 (UN 2009). What is important to consider is that in 2008, for the first time, half the world's population lived in towns and cities, and by 2030, the urban population is expected to reach five billion (UNFPA 2007). Already today in Europe around 80% of the population lives in cities, and 80% of the greenhouse gas (GHG) emissions in Europe come from the energy sector (EEA 2008).[2] Considering that urban settlements are increasing steadily, with cities continuing to sprawl, causing land use stresses and social inequities, climate change will certainly add another dimension to the existing array of challenges facing urban areas. This will be exacerbated by expected mass migration from areas that become unliveable.

These trends clearly show that the community level is, out of necessity, ideally suited to address both climate change mitigation and adaptation. However, addressing these challenges also need to be considered from a holistic perspective, with sustainability

[1] Dr. Pachauri was a keynote speaker at the international conference on 'Climate change as a security threat – strategies for policy-makers, science and business' held in Freiburg im Breisgau, Germany, in November 2008, organised by the Federal Foreign Office of Germany. Further information available on: http://www.freiburg-konferenz.de/home_en.htm and http://rkpachauri.org/speech.php

[2] Energy-related greenhouse gas (GHG) emissions remain dominant, accounting for 80% of the total emissions, with the largest emitting sector being electricity and heat production, followed by transport.

at the core to ensure that the results do not have a negative impact over the long term, leaving other problems for our descendants. In the 'State of the World Population 2007 – Unleashing the Potential of Urban Growth' (UNFPA 2007) the need for long-term sustainability is highlighted when considering the growth trend: "Cities also embody the environmental damage done by modern civilization; yet experts and policymakers increasingly recognize the potential value of cities to long-term sustainability. If cities create environmental problems, they also contain the solutions." This is certainly the case from a climate protection and sustainable energy perspective.

1.2 Courageous Leadership Is Needed

The international focus on climate change is increasingly concentrating the attention of all levels of government on the need to respond to climate change and to deal with the causes within the short timeframe available. The international climate negotiations and in particular the outcomes (and what is not addressed here) that are made during the 15th Conference of the Parties (COP15) in Copenhagen in December 2009 are drawing the interest of people from around the world. Certainly courageous leadership is needed at this level, and putting aside certain restrictive diplomatic and political approaches that have gone hand-in-hand with previous negotiations. This is a test for the global leaders of today.

The challenge humanity faces today from the climate change perspective is twofold:

– We need to radically change the way we live, use resources much more effectively and with minimal to no waste, and drastically mitigate our impact on climate change through a variety of actions. We know what these are and how we should do this.
– Secondly we need to adapt to inevitable climate change. Adaptation is a more complex issue, and requires on the one hand the recognition that non-adapting is not an option, but also that this requires a coherent cross-sectoral, cross-disciplinary, cross-community approach – far beyond just taking a political decision to respond. Responses are needed that address climate change, not only as an environmental challenge, but as a socio-economic, political, environmental and security challenge.

Today the mitigation element is still largely missing, while adaptation is lagging behind even more. This delay is dangerous and action is urgently needed right away. We know what actions can be taken from a mitigation perspective. We know the technology currently available is effective, and will improve in the coming years. Yet only limited action is being taken and there remains a perception that the technology is not yet adequate. Why is this the case? Some reasons will be briefly explored in this publication, especially those relevant to the community level. The main focus is however on sending a message that we need to break away from this passive 'not-my-problem' approach, with a call on everyone to engage, and in particular with ideas to inspire community leaders to become active in local climate action.

The first step in both climate change mitigation and adaptation is largely a political one. Political leaders need to engage, and recognise that this is a priority for their community. Political leaders need to take courageous action, and look beyond their own political elected timeframe (in democracies this is usually about 3–5 years) when planning and taking decisions. Those choices they make that impact on the community, the environment and the world. We need choices that last beyond a political lifetime. Ideally the aim should be for certain topics to be above party politics – human survival and climate protection should definitely be on the list.

With climate change, the urban growth trend, the corresponding increased demand for energy and other services, and (unrestricted) consumption of resources – issues of grave concern – citizens should look to both their national and local leadership for solutions. These are certainly aspects that ought to be motivating factors for clear-thinking community leaders when reassessing their approach to policy, structures and realising urgent and effective actions. After all, the 'community' should aim at the *commune bonum* – Latin for 'the common good'.

1.3 Main Purpose of This Book

The main purpose of this publication is to focus on climate protection and energy from the sustainability perspective, considering the roles of local government, and showing how small and medium-sized communities have responded effectively to current challenges. It further provides an insight into current issues impacting on local governments.

This book is aimed at political decision-makers at all levels, but in particular local leaders and people who work with or in the local level of government, including municipal administrators and staff – from the administration head to the person managing the budget, from energy/transport/waste managers to partners of municipalities. It is also a useful reference for scholars, graduates and post-graduate students learning about environmental planning, urban development, sustainable energy and relevant policies.

1.3.1 Why Focus on Local Governments?

The role of local government[3] (also referred to a local authority, municipality, council, administration, etc.) – as the level of government closest to citizens, is critical in the context of climate protection and the transition to sustainable energy.

[3] A governing institution which has authority over a subnational territorially defined area. This territory refers to below federal substate or state provincial levels, i.e. the lowest level of government. Local government's authority springs from its elected basis. This there is considerable variation in its behaviour and mandate between and within countries (ICLEI and http://www.answers.com/topic/local-government).

Local governments are usually (country specific) responsible for defining and implementing local policy, developing and maintaining structures that provide services and handle administration, providing a range of services to local inhabitants (this again differs from country to country but can include policing, health services, education, social services, energy-, transport-, water- and sanitation services). Further to this they often own or manage infrastructure such as buildings, roads, electricity grids, etc. In all of these cases local governments can thus shape and guide local action of inhabitants, businesses and their own activities. And they can motivate and lead a change of direction. These are three areas where local climate action is possible and with vast potential for achieving success.

At the local level there is a tendency that either the political leadership of one or a few individuals is the driving force for action, or else ad hoc activities take place – the latter often through brief externally funded projects (not seen as a negativism but the impact tends to be short term). Only in the smallest number of cases around the globe, when considering how many local governments there are, has a comprehensive and regularly updated Climate Action Plan been compiled, a regular GHG inventory been conducted, a review of local renewable energy resources been performed, and/or a community climate vulnerability and opportunity assessment been conducted. These actions and processes need to be in place to coherently address climate change mitigation and adaptation at the community level.

1.3.2 Why Focus on Small and Medium-Sized Communities?

The majority of communities around the globe are small to medium sized, while the mega-cities tend to dominate the news. Smaller local governments tend to remain outside the debates on climate change and energy consumption, with a larger focus on their actual mandate, i.e. local issues. Energy is often a centralised issue as is climate protection – thus not falling in the mandate of the smaller city. On the other hand ‘international politics’ tends to be more in the interest and domain of metropolitan areas and larger cities with growing, multi-cultural populations, leading to a more sophisticated political role in national and international politics. Also smaller communities have more limited capacity, i.e. staff and finances, to engage in external political discussions or international processes. This also means that there may be a more limited awareness of the potential local impact of climate change. Typically this debate tends to be more vociferously discussed in closed scientific circles rather than in the areas where the actual impact is expected. This is a trend that has to change as citizens will be looking towards their local leaders for guidance, planning and support.

Yet smaller communities have greater flexibility to be ‘revolutionary’, to test cutting-edge technologies and new approaches. This tends to be the case when there is recognition on the need to change, where there is courageous leadership, and where the community can be interested in new ideas. As such there is a wide variety of good practices implemented in smaller towns and cities. These experiences: developing new policies and strategies, applying new technologies and materials, devising interesting approaches to community involvement and financing, to name but a few, are worthwhile sharing and in particular worthwhile analysing to determine lessons learnt and replication possibilities. These experiences can inspire, give new ideas, and motivate all communities that face similar challenges – whether large or small. In fact, quite often larger cities learn from smaller communities, and replicate elements they identify as tested and proven to be effective.

The Rovigo Outreach[4] – a main result of the Rovigo 2008 Climate Conference – feeds into the international Local Government Climate Roadmap (see Chapter 2). It encourages small and medium-sized communities to engage in climate and sustainable energy actions, despite tremendous (perceived and real) obstacles. The Rovigo Outreach also calls on higher level governments – be they supra-regional, national/federal, state or provincial – to improve framework conditions and actively support local governments with their climate and energy activities. Furthermore it calls on larger and more experienced cities to support and lead regional clusters, guiding their smaller counter-parts through this process, sharing their own expertise and also learning from them. Brainstorming and motivation are required to move forward swiftly.

1.3.3 Publication Structure

The publication has been divided into two parts, with Part I addressing the context local governments need to consider, from the science of climate change, energy security issues, an international economics framework and the strategic role of planning policies towards a sustainable development. Part II contains a number of case studies that show the broad range of approaches used, including strategies and policies and various actions in different fields. The selected cases focus on European examples, many of whom were shared during the European Rovigo Climate Conference 2008.

Following the introductory *Chapter 1*, the rest of the publication is split into two parts:

1.4 Part I: A Focus on Climate, Energy and Local Governments

Part I consists of Chapters 2–5, focusing on a range of aspects and developments that impact on, or can support, local governments in their local climate and energy action.

[4] www.iclei.org/rovigo2008

Chapter 2: Motivation for Local Action starts with an overview of climate change mitigation and adaptation, and the relevance to communities. Linked to this and sharing economic arguments, is a paper on the impetus generated by the Stern Report in defining the economic framework of climate change. Finances and energy play an important role in energy security, with many issues highlighted as relevant, in particular paying attention to reducing dependence on imported fossil fuels and looking after community interests from a variety of angles that also either directly or indirectly support sustainable energy, climate protection and sustainable development. Energy security, reflecting on sufficient energy, affordable energy and having power to shape the energy future at the local level, is a new concept for many local leaders to consider, whether we are rational in taking decisions, is a legitimate question posed from the energy efficiency perspective. Finally, this chapter explores the link between climate protection policies, urban sustainability and involving citizens through the Local Agenda 21 (LA21) process – aspects that are highly relevant to local governments today.

In *Chapter 3: Strategic Framework Supporting Local Action*, a number of key developments are highlighted that are relevant to local governments in their climate work. The international Local Government Climate Roadmap is providing impetus and visibility to the role of local governments in climate change mitigation and adaptation, in particular in the current post-2012 climate negotiation process. The development of the Covenant of Mayors in Europe is shared as an interesting initiative developed from the interest of cities in a coherent framework, linked to and building on the work of many local government networks in Europe. Finally a number of tools are briefly shared, including the City Climate Catalogue, which is a collection of climate mitigation targets of communities around the globe. This will be used by the City of Copenhagen, host city of the 2009 Conference of the Parties (COP), and other actors to present a substantial argument of local climate action and calling for greater support in the post-2012 climate agreement. As a practical framework for action, ICLEI's Cities for Climate Protection ™ (CCP) Campaign is presented, with its logical methodology supported by the first international Local Government Greenhouse Gas Emissions Analysis Protocol developed as a tool for all local governments around the globe to move towards a standardised approach towards conducting emissions inventories.

Chapter 4: Local Action – Planning and Implementation shows how local climate and energy action means bringing together strategy and policy, the implementation of technology and measures, and considering how to engage the community, looking at people and changing lifestyle. All three these areas require action, with a coherent concept linking them to achieve effective results. The papers presented focus on some essential issues, including the need for urban renewal – a particular challenge in European cities, where new land is at a premium and old building stock requires urgent energy efficient refurbishment. Moving from energy efficiency to renewable energy – the European Renewable Energy Roadmap is a particular highlight, showing that the European renewable energy industry could deliver much more than 20% by 2020. The wide range RE potentials should also be explored by local governments, considering local RE resources, identifying added benefits when switching to RE such as job creation and energy security. Communities need a vision – ideally a vision of becoming fossil fuel free (with examples of these in Chapter 6), As a practical conclusion to this chapter, the ethical perspective in financing sustainable energy and environmentally friendly solutions, is presented as a successful model. Considering the financial crises and aspects that contributed to this, the financial sector can certainly benefit from including ethical considerations in their financing schemes and support the faster roll-out of urgently needed sustainable energy solutions.

Chapter 5 focuses on a few *Framework Conditions and Support Mechanisms* that highlight the importance of decisions taken at the national/federal level of government that impact on local climate and energy action. Much has happened in this area over recent years, not all developments positive. Considering the urgency for effective climate protection and the huge potential for developing or improving enabling framework conditions at the national/federal level (also other levels of government), decisions are needed that support and encourage many different actors to engage in climate protection and the transition to a sustainable energy future. The positive impact of the German Renewable Energy Act is one example that highlights the impact of a fair remuneration tariff when implementing a feed-in law, providing security for investors and even making it attractive for the average citizen to invest. A critical look at the relationship between climate change, economics and the perspectives of local governments under the former US administration is shared. The third example focuses on the new national reporting requirements on local climate action for local authorities in the United Kingdom.

1.5 Part II: Local Climate Action Case Studies

The cases shared Chapter 6 deal with the implementation of initiatives, policies and instruments by local governments or in communities. These include several examples shared during the Rovigo Climate Conference, but also interesting cases where other levels of government, different organisations or the business sector play a role in motivating or driving change in communities. Replicable factors are highlighted, and, in many cases, the reader will be presented with a diverse range of actions are implemented with different motivations – with the message that all communities can engage, need to consider their own situation, and respond in their own unique manner.

The case studies are loosely grouped according to a thematic perspective, although there is obviously an overlap and the approach is not strictly categorised:

– *Policy and comprehensive strategic approach,* focussing on the role of councils to promote and implement innovative policies for climate protection. The examples show that there is a focus beyond short term political aims, and show different approaches used in the exemplary communities of Växjö (Sweden), Güssing (Austria), Tilburg (The Netherlands), Almada (Portugal) and Woking (UK).

- *Technology and measures,* introduces the management and implementation of technical solutions by local governments from a sustainable energy and resource scarcity perspective – from photovoltaics to heating/cooling of buildings and proper waste management. The cases presented include Gelsenkirchen (Germany), Varvarin (Serbia), Freiburg im Breisgau (Germany), Heerlen (The Netherlands) and the Province of Rovigo (Italy).
- *People and lifestyle* remain central to success in energy and climate action. Examples illustrate different approaches used in communicating with people, policy options that were implemented, and how the responsibility of citizens plays a fundamental role in local initiatives, especially in a number of small, advanced communities, namely Malmö (Sweden), San Sebastián (Spain), Casalecchio di Reno (Italy), Viernheim (Germany), Stockholm (Sweden), and the Veneto Region (Italy).

The range of cases presented in this book represents a selection of initiatives by local governments that can be regarded as a 'third industrial revolution', or perhaps a 'revolution of necessity', opening a new era of substantial change in the relationship between the global and the local level. Certainly over the last few years communities have gained in prominence in the global climate dimension, yet their value and important role has not yet been formally recognised.

The book concludes with a glossary of the main used terms and abbreviations used, with an index of names and subjects, as well as annexes of relevant documents.

Maryke van Staden *holds degrees in Political Science (1989) and International Politics (1991) from the University of Pretoria, South Africa. Currently she is the Coordinator of the Climate & Air Team of the European Secretariat of ICLEI – Local Governments for Sustainability, an association which works with local governments on issues across the spectrum of community sustainability. The Team addresses climate change mitigation and adaptation, as well as improving air quality. In addition to daily project work Maryke also coordinates ICLEI's European Cities for Climate Protection ™ (CCP) Campaign (www.iclei-europe.org/ccp), working with more than 170 cities, towns, counties and provinces in 19 countries across Europe, the Middle East and the former Newly Independent States (NIS). In the field of adaptation she works with a multi-disciplinary team, helping to ensure that this complex theme is recognised as important and adopted by local governments across the spectrum of community structures, systems and services, from a climate perspective.*
Prior to working at ICLEI, Maryke led the Scientific Projects Unit of the International Solar Energy Society (ISES) (www.ises.org), the global association for solar energy – a scientific organisation that supports the transfer of solar energy science into implementation. From the ISES international headquarters in Freiburg, Germany, she worked on international renewable energy projects addressing policy, education, business and sustainable development. She also acted as Global Liaison for the ISES network of 52 National Sections and four Regional Offices. Before turning to sustainable energy Maryke did a 9 year stint working for the South African

government where she headed an analysis division focusing on national security policy. Currently Maryke is a board member of ISES e.V.; a Committee Member of the United Nations Economic Commission for Europe (UNECE) Committee on Sustainable Energy; a REN21 Network Member, and contributes advice and input to thematic publications such as the UN guide to climate neutrality – Kick the Habit, published by the United Nations Environment Programme (UNEP). Today, with more than 10 years working experience in the field sustainable energy and climate protection, she remains particularly interested in community energy security, sustainable development and climate resilience.

Francesco Musco*, holds a degree in Architecture with honours (2002) from the University IUAV of Venice and an international PhD in Analysis and Governance of Sustainable Development from the School of Advanced Studies in Venice, Italy (www.isav.it). Currently he is a researcher and lecturer at the Faculty of Urban and Regional Planning of University IUAV of Venice, where he teaches 'Environmental Planning' for Masters Degree students in Planning and Environmental Policies, an international Master program promoted together with the Universitat Autonoma de Barcelona (Master in Planificacio i Politiques Ambientals) and University of Sassari. From the academic year 2007/2008 he also started teaching as external professor 'Urban Policies' at the University of Parma, Faculty of Economics and 'Environmental Ethics' at the University of Bologna, Faculty of Engineering.*
Francesco has concluded research on the relationship between urban planning and sustainability, with special attention to two research paths, namely 'Urban regeneration as sustainability policy' and 'The instruments to apply sustainable urban policies in local context'. Within the first research path, he verified that a number of European cities have developed urban regeneration policies with particular orientation to sustainability, promoted integrated regeneration programs with the support of their national governments. The second research path has been oriented towards bottom-up policies to support the definition of sustainable development scenarios in limited extension areas. The main topics connected with this research are Local Agenda 21 (LA21) processes, Strategic Environmental Assessment (SEA), conflicts and energy policies, climate change and land use implications, strategic planning.
He was a visiting scholar at the Department of Geography of the Universitat Autonoma de Barcelona, also at the University of Louisville, Kentucky, Center for Environmental Policy and Management, and at the Department of Real Estate and Planning, University of Reading. Francesco is an expert member of the European Urban Research Association (EURA) and Expert Leader of URBACT, the European Programme for Urban Sustainable Development. He is a consultant to local authorities and associations in the area of urban, environmental and sustainability policies. Currently he is also the scientific coordinator of the Environmental Territorial Lab for Sustainable Development (La.Terr.A.) of the Province of Rovigo, Italy, and he has held a similar position as scientific coordinator of Local Agenda 21 of the City of Venice from October 2004 to July 2007.

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Part I
A focus on Climate, Energy and Local Governments

This book is divided in two main part: the first focuses on the role of local governments in energy and climate policies definition with particular attention to small and medium sized local authorities.

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Chapter 2
Motivation for action

Chapter 2.1
Communities, Mitigation and Adaptation

Maryke van Staden

Abstract With scientific evidence showing an unprecedented rate of climate change – a rate much faster than anticipated a few years ago – more active climate protection engagement is needed around the globe. In this context individuals and the community level play a vital role, and there are also considerable expectations by citizens that national governments will take the lead. Yet engagement is slow, and this raises questions regarding the motivation for action and how to get widespread engagement, particularly at the local level. Some issues that have motivated action include experiencing the local impact of climate change and a realisation that it has a security impact (from many different perspectives – from climate migration to socio-economic impacts). Studies that address the cost of action and inaction have placed climate change on the political map, and community leaders that have engaged from various angles such as improving air quality have gained multiple benefits for the community and the environment, as an indirect approach to local climate action. This chapter explores why the local level urgently needs to engage, and what its representatives – political leaders, staff and citizens – need to know about what they are dealing with, and why they should deal with it.

Keywords: Carbon dioxide (CO_2) • Global warming potential (GWP) • International Panel on Climate Change (IPCC) • local governments • 'local to global' • mandate • methane (CH_4) • responsibility • society

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2.1.1 Facing the Reality of Climate Change

Climate change occurs at a global scale, and has an impact on the whole world – humans and nature alike. The main characteristics of climate change include rising temperatures, changes in rainfall patterns, melting of glaciers and sea ice, sea level rise and an increased intensity and/or frequency of extreme weather events. These changes in physical processes have impacts on biological and socio-economic factors, for example, shifts in crop growing seasons; changes in disease vectors, increased rates of extinction for many species, severe water shortages, and heavy deluges and flooding. In addition, rising sea levels will increase the risk of storm surges, inundations and wave damage to coastlines (Joint Liaison Group 2008).

When considering the last time an event or occurrence which affected all of humanity and nature, the previous ice age comes to mind. There have been (and are) devastating wars, economic recessions and depressions, ecological devastation caused by humans (e.g. the Chernobyl nuclear disaster), and natural disasters (e.g. floods, droughts, volcanic eruptions), but these usually only affect a relatively 'small' area and/or 'limited' numbers of people compared to the possible implications of global climate change.

Yet, this time the global phenomena – the climate that is again changing – will affect many more humans, as we number in the billions today. The impact is also already visible around the globe to a larger or lesser extent. In addition to this reality, there is also the possibility (albeit not yet a 'likelihood', according to the International Panel on Climate Change – IPCC) of abrupt climate change – meaning another ice age could happen quite suddenly should certain preconditions be met, such as a change in the ocean currents circulating around the earth.

Climate change can be a natural phenomenon, but humans are clearly impacting the process, according to scientists. We now know that climate change is being accelerated by humans through the way we live and use energy, releasing vast amounts of additional greenhouse gas emissions (GHGs) into the atmosphere and thereby changing natural processes. Reputable climate scientists, economists, politicians, oceanologists, and many others around the globe have concurred that this is the case.

For the first time, in 2007, scientific agreement at the international level was attained and presented in the most recent IPCC report, namely the Fourth Assessment Report (4AR).[1] In addition to the IPCC extensive report there is also a useful summary for policy makers (IPCC 2007a), which is also relevant to local policy and decision-makers. There are also newer scientific studies that confirm the ever-increasing tempo of climate change, with new developments showing that changes are moving in the upper ranges of the scenarios presented by the IPCC. The IPCC reports are of interest as these are consensus agreements, meaning that there is a general unstated recognition that there have been political influences on the contents, which in turn means the substance was 'watered down'. Only in 2007 was there so much overwhelming evidence that could not be disputed

[1] http://www.ipcc.ch/ipccreports/ar4-wg1.htm – consisting of three working group reports and a Synthesis Report

(by 'rogue' scientists and people with a different political-economic agenda) and a consensus could be reached. In general, what a layperson should know is that the message is very grave, the timeframe for an appropriate response is shrinking, and the global response has thus far not been adequate – to put it mildly.

A basic reality is that climate change remains a rather abstract concept for many people, leading to a 'not-my-responsibility' attitude. Citizens tend to leave it to their national governments to solve. The confusion created by the long and often deliberately misleading debates on whether it is a real problem or not, has added to the effectively delay in addressing it as a global challenge. Today the challenge is considerably more substantial, and addressing it will be more difficult.

The response to climate change requires climate protection, and quite extensive action in many different fields. Climate protection can be defined as the range of direct and indirect policies that address climate change mitigation and adaptation, and the purposeful implementation of measures and technologies to achieve results that minimise the impact 'on' climate change (mitigation) and 'of' climate change (adaptation) on people and the environment we live in. The more mitigation is handled, the less there is a need to adapt. More extensive and faster mitigation efforts are required from today onwards, and there is also a need to respond to existing and anticipated changes by adapting to a changing climate.

2.1.2 Now Is a Good Time to Change Our Impact

Climate change is clearly relevant to the community level. This is where people conglomerate. It is also where people jointly contribute to the release of vast amounts of greenhouse gases (GHGs), thereby contributing to the acceleration of climate change. This is also where the impact of climate change is visible – higher temperatures, changing rainfall patterns, more intense storms – with infrastructure, people, fauna and flora more often not coping with these changes. Humans are not the only contributors to climate change, but play a major role and through this can cause catastrophic change if there is not a significant change in releasing human caused GHGs.

The aim identified by many industrialised nations is to limit global warming to 2°C above pre-industrial average temperature levels. This is said to be the 'tipping point' – a threshold identified beyond which climate change will reach dangerous levels. Beyond this point scientists predict that a 'snow-ball effect' is achieved and the changing system can no longer be stopped. Yet already with temperature changes seen today, there are already impacts on the environment, and with every new degree of change there is a larger corresponding natural change that could well have a devastating snow-ball effect. For example, higher temperatures have already led to the increased escape of methane released from melting ice-fields in the tundras of Russia and Canada – this is a very high-impact development that is unstoppable, except through lower temperatures that would cause the permafrost to solidify again. Such natural processes are accelerated by the human impact on the system. So now is a good time to change that human impact to try and save the system.

2.1.2.1 Climate Change Mitigation

How do humans contribute to the release of greenhouse gases? Every day we use energy (mostly generated from fossil fuels or nuclear) for electricity to light our homes, cook food and cool our rooms, or we use oil or gas for heating and cooking. Energy is used for cleaning and pumping water to buildings, and for waste management. Industrial processes require energy to make products and materials – to mention but a few actions. When looking at our daily energy needs and current behaviour we have a huge impact on climate change, every day. It is clearly time to seriously consider – and to reconsider – how we live and to make appropriate changes to reduce our impact on the climate and environment, moving towards a more sustainable approach.

In the urban area, two major GHGs that are released – carbon dioxide and methane – are highlighted here.

Carbon dioxide (CO_2) is emitted when fossil fuel-based energy (including electricity derived from the burning of fossil fuels) is used by households, institutional and commercial buildings, vehicle transportation, and industry. This gas is relatively easy to monitor, contributes to a high percentage of urban GHGs, and is the GHG that probably receives the most visibility in the media (people tend to refer to a 'low carbon lifestyle' or 'carbon neutral buildings'). CO_2e is an abbreviation of 'carbon dioxide equivalent' and is the internationally recognised measure of greenhouse emissions. Each GHG has a different capacity to heat the atmosphere, which is referred to as their global warming potential (GWP). CO_2 is the standard for GWP – it has been assigned a GWP = 1.

Moving to the next GHG, methane (CH4) is a gas with a very high GWP. It is emitted in urban areas as waste decomposes in landfills and from wastewater and sewage treatment processes. Methane is also linked to agriculture and the way we grow food crops and the animals we maintain, so again linked to choices and lifestyle. As it is a very potent gas, reducing it is crucial – something that can very effectively be done at community level by moving away from landfills, use existing landfill to capture leaking methane for 'waste-to-energy' and by changing our diets in particular to avoid high emissions contributed by food production.

2.1.2.2 People Power

When considering empowerment, one aspect that tends to be neglected is that many people on this planet can contribute to climate change mitigation. This is linked to choice and behaviour. This aspect does not exclude people in developing countries, where energy is also wasted or not optimised in terms of efficiency. The concept of climate justice will not be explored here, but climate change mitigation is certainly a global solution that requires all able people to respond. Energy is valuable and should be valued as such. We can wield the 'power for change' on an individual basis, in the context where we live, work or study. It is also a power for change that we can apply to the community scale where energy is generated, distributed and used.

The challenge is to move to a more sustainable manner of living as a daily priority, which requires some effort to analyse own actions and (re)consider the choices we make (or do not make) from a mitigation perspective. To become empowered one needs to know what the problems and the solutions are. There are many tools available to identify where personal emissions come from, and tools that support local governments in identifying community-wide emissions. The use of these needs to become the norm. There are already discussions on allocating personal CO_2 allotments to each individual per year. We need to see where these discussions take us, but the direction is towards a system that addresses equality and responsibility.

2.1.2.3 Climate Change Adaptation

Mitigation is not the 'only' problem we must respond to. Climate change adaptation is also essential. Adaptation does not mean 'giving up' on climate change mitigation. Rather it is our response to unavoidable climate change and as such goes hand in hand with climate protection. We need to be realistic about inevitable change – the climate has already started to change and will continue to do so. Thus adaptation should become a co-priority, together with mitigation. Where possible, efforts to address mitigation and adaptation should be combined or at least integrated, to gain double or multiple benefits.

According to the IPCC (2007b) adaptation means the 'Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory, autonomous and planned adaptation'. A range of inter-sectoral response is needed, often also requiring cross-border and integrated approaches. This is a very complex issue when viewed from a macro perspective. Adaptation can include different strategies designed and operated by different levels of government. It should also be considered by other actors that will be impacted, but government is highlighted as the actor responsible for the welfare of its citizens and geographical area, and developments impacting on both. National governments need to develop a national adaptation plan, preferably with input by key actors, including local governments that will need to deal with the local impacts of a changing climate.

Considering that climate change is non-linear in character it means impacts are delayed. We are already today observing the impacts of our actions of 'yesterday', and will witness the impact of our current lifestyles over the next few decades. The GHGs we release today will certainly up the ante in terms of 'levels of aggression', with increasingly intensive changes in temperature, storms, floods, droughts, etc. expected. Our children and their descendants will have to cope with the majority of the impacts – in part also based on what decisions we take from now on. We now also need to start adapting. Responding to climate impacts is a complex field of action, requiring first an idea about the expected impact of climate change (developing scenarios), then to make decisions based on the most likely estimates, and plan accordingly (e.g. higher temperatures need different building styles and standards), also thinking in terms of decades. This is needed at the community level, where the impacts of climate change are manifesting.

2.1.3 Local Communities in the Spotlight

2.1.3.1 Top-Down or Bottom-Up?

The increasing challenges in the energy sector (fossil fuel depletion, rising costs, energy security concerns) and the acceleration of climate change with its impact, require a response. Having to become active in climate change mitigation is the price we pay for our current lifestyle. By adapting our energy systems and mode of living we can ameliorate our impact on climate change, and we will incur costs. These costs are offset in the middle to long term by significant economic, environmental and energy security benefits. We will also have to change our definition of 'quality of life', as the current high standard many of us are living in can no longer be maintained, and is in fact unsustainable.

Typically challenges of this dimension require national governments to engage, yet there has been a very slow response to date. The Kyoto Protocol is the main international instrument guiding GHG reductions until 2012, with targets set for those countries that have ratified the Protocol (it does not include major GHG emitters such as the USA and China). Many national climate change plans – commonly developed around the time the Kyoto Protocol was adopted (1997) and finally entered into force (2005) – do not yet reflect the urgency of the climate and energy situation, which increases year by year. The pressure is rather noted at community level, where the impact of climate change is increasingly becoming visible. National frameworks need to be 'translated' into and implemented at the local level, as explored by Lundqvist and Biel (2007) in *From Kyoto to the Town Hall.* Yet in most cases the national framework does not specifically support the local level despite developing pressures that are emerging here.

Time is ripe for a growing distributed bottom-up system to achieve effective GHG emissions reductions and climate change adaptation. This 'local to global' approach would mean the involvement of communities, but also enterprises and institutions. These are starting to engage (many started as early as the 1990s, especially cities – see Chapter 3), and in some cases take the lead in exploring new territory. To address this challenge a joint effort by all is needed, with as many existing ideas, technologies and measures implemented, combined with new, untested concepts that have a high impact potential – to make a major impact in a short time.

2.1.3.2 Local Governments as Key Actors

In communities, basic conditions are created for living, working and commuting. Bearing in mind the large percentage of GHGs generated and energy needed here, this is where change can and has to take place. Communities are led by local governments, as the political and/or administrative bodies that have a responsibility to ensure a healthy, safe environment and functioning society. When considering the question of what would motivate local governments to act, some interesting answers were found, also looking at the above mentioned issues as key aspects when considering local climate action. A liveable community, with high quality of life is what many local governments strive for – to keep their populations and make their cities or towns attractive places to live and work in.

When considering the role of local government in local climate action, these can broadly be grouped into three categories:

- Guiding the community: Depending on the legal mandate or authority of the local government, this could include developing and implementing local policy and regulations, as well as developing and maintaining structures that support planning and implementation processes. A local government can also, for example, set standards that move beyond the national standards, or challenge target groups in a community to engage in a particular manner (e.g. school energy competitions).
- Acting as service provider and manager and/or owner of infrastructure: Acting by example in many different areas where the municipality has an influence, such as improving energy efficiency in buildings (municipal offices, health clinics, etc.), vehicle fleets (waste trucks, public transport, etc.), electricity grids and utilities, waste facilities, etc., as well as in areas where services are provided or administration is handled. The range of services provided to local inhabitants differs from country to country, but can include policing, health services, education, social -, energy -, transport -, water – and sanitation services).
- Providing leadership: Not only through its own exemplary action, but also by sharing information on experiences and examples (either good or bad) with others, – both in and outside the community – can local governments help to raise awareness, improve the level of knowledge (options, pitfalls to avoid, and what make actions replicable), motivate and encourage others – thereby leading a change of direction. Bringing together the concept of culture, climate protection and sustainable energy is a key element resorting under this category.

The local government, or municipality, is in turn led by a Council comprised of local leaders – in a democratic society these tend to be elected leaders (there are exceptions to this with political appointments also possible). Local climate action implies the need for local leaders who are courageous. Why courageous? They need to look beyond their political tenure and take decisions that can be uncomfortable, as change tends to be uncomfortable. Leaders are needed who will really direct their communities and guide change as needed, potentially even drastic change which could be required when addressing climate protection.

Intrinsic to a democratic system dramatic change is not wanted as it means instability. But as climate change will also lead to uncontrolled instability, controlled change should be preferable.

Citizens – especially voters in a democratic society – can influence direction by making choices when electing the ‘right’ local leaders. Typically climate protection is not yet on the agenda of many local elections, but this could change in the near future. Yet, ideally climate protection should be a topic that is above party politics, recognised by all as a priority (Sadly, only in the fewest cases this has been done – but these are the good examples). City councils, municipal staff, citizens, businesses and industry – all can help to shape developments in their local communities. They can wield power to empower the right kind of leadership, with leaders to take decisions that will benefit of the community as a whole and positively impacting on the global dimension. This could mean a new era of local politics is due.

2.1.3.3 Motivations for Local Climate Action

In most countries local climate protection remains a voluntary activity. In many cases where local climate action was started, it was the result of one person or a few key people in the community realising there is a need to act – i.e. to take on responsibility to reduce local GHGs and/or to protect the community, often the combination of idealism and realism. Here the potential impact of local action was not seen as insignificant, regardless of the size of the community, as the ‘local to global’ approach refers to the multitude pooling resources and achieving a major impact. With the growing number of communities engaging, this hypothesis is validated (Fig. 2.1.1).

However, in many cases often other benefits, such as sustainable urban development or job creation, were the starting point, with some level of climate protection achieved and then seen as an ‘added benefit’. For example in cities with a severe air quality problem, the improvement of air quality and subsequent reduced GHGs also addressed climate protection, as there restrictions were placed on the use of polluting vehicles. The entry point a community or local government chooses, is to some extent irrelevant. What is essential is to act. The best results will be achieved by acting in a well considered, coherent manner – and this would be real climate protection action. Ad hoc actions can be useful, but the impact is likely to be nominal if it is not part of a larger plan such as a Local Action Plan (e.g. a climate, energy or transport plan), and maintained over a longer period. Several examples presented in Chapter 6 illustrate starting points, plans, actions and benefits for different communities.

In a number of cases the potential to save money by being less wasteful with energy and materials is often a starting point, triggering other actions once savings have been made – energy savings leading to financial savings, which in turn frees up funds that can be reinvested into other energy efficient measures and clean technologies. The entry point through energy makes sense, and the term

Fig. 2.1.1 Adaptation measure: a rainwater infiltration area below a building in Tilburg. A wadi *(Arabic word meaning dry riverbed that contains water only during times of heavy rain*) offers a way to deal with heavy rainfalls by buffering overflowing water and reducing the risk of flooding. In addition the wadi cools the area and offers a nice environment for plants, animals and insects (Photographer: Maartje Ansems) (see *Color Plates*)

'sustainable energy' is used to portray a three-pronged concept. Sustainable energy can be defined as energy, in the production or consumption of electricity, heating and cooling, which has no or limited impacts – compared to fossil fuels or nuclear energy – on human health, the functioning of local and global ecological systems and the environment. Sustainable energy is the combination of energy savings, energy efficiency measures and technologies, as well as the use of renewable energy sources, such as solar energy (passive and active use, e.g. solar thermal, photovoltaics), wind -, bio-energy, geothermal energy, small hydro power, wave and tidal power, as well as hybrid systems. Its objective is to provide energy security (sufficient, safe, affordable) for the present and future generations.[2]

Moving into a more specific energy approach that is very relevant to the community level, is the term Local Renewables. As used by ICLEI, Local Renewables means the use of local renewable energy resources, in combination with energy efficiency, for the community. The short-sightedness of importing energy at ever increasing costs, the lack of information and awareness about the potentials of renewables, and the wide range of co-benefits when addressing Local Renewables, led to the development of eight brief arguments (ICLEI 2007) to encourage communities to change to local renewables:

[2]As used by ICLEI Europe in its energy-related projects.

(i) Renewable energy sources (RES) are mature, available and ready for use today. There is a continuing misconception that RE technologies (RETs) are untested, 'too new', and not yet ready for large-scale roll-out. Many communities using RES and RETs are proving this wrong, and some are even successfully moving into the 100% RE range to cover their energy needs. There is a vast untapped potential still to be explored by communities in most countries.

(ii) Using local resources to produce energy locally establishes a solid foundation for decentralised, secure energy supply – thereby making communities more resilient. The local generation and local use of energy means reducing dependency on others for energy (e.g. oil or gas imports). Energy independence and keeping cash in the community are increasingly recognised as important issues by Councils, and will me a major motivating factor for action in the near future.

(iii) Financial benefits are inherent – both in terms of saving money and generating an income over the short to long term. By reducing energy demand (saving energy) costs can be saved, and by producing RES locally, for own use and potentially expanding it to sell energy to other communities in the region, an income can be generated. Countries with good feed-in tariffs provide ideal enabling framework conditions for communities that switch to local renewables.

(iv) A steady transition from fossil fuels to Local Renewables will reduce CO_2 emissions and contribute to climate protection. This can be valuable both for mitigation and adaptation, with the latter meaning adapting energy supply and demand, as well as improving the resilience of energy infrastructure.

(v) Switching to Local Renewables supports local job creation and stimulates the economy. Renewables are of particular for the small and medium-sized enterprise sector, with smaller companies providing locally needed services and materials. Here the focus is also on keeping local money paid for services in the local economy.

(vi) Local Renewables give an impulse to sustainable urban development, and encourage technical and social innovation. The integration of RES and EE into the community building, energy, transport, waste and water sectors leads to the application of innovative technologies and measures, often with positive socio-economic impacts – especially as seen from examples in renovating rundown areas. The improvement of quality of life is certainly a benefit citizens are interested in.

(vii) Local action is critical in achieving national and international targets on sustainable energy and climate protection. In each country there are many different actors that need to engage to reach the national climate targets, made up of people living in communities. It is clear that without communities, nations will not be able to reach their targets, and without communities around the globe engaging in this challenge, a global solution will not be achieved.

(viii) Local Renewables imply the involvement of local stakeholders, using synergies to create change. Proven success examples show that many different community actors need to be on board, from the planning to the implementation phase, to achieve success. These include citizens, non-profit organisations, chambers of business, etc. All have a stake in the local community, and a role to play in Local Renewables.

What is interesting is to see how actors can influence one another at the local level. A municipality can act as a good example and run 100% on green electricity and reduce energy demand by switching to energy efficient appliances, thereby inspiring citizens as energy users to change their own behaviour. A change here will also force a change from the side of energy utilities (e.g. responding to an increasing demand for green electricity). The 'responsibility' trigger will usually not work in isolation. People tend to need more than one reason to change with the idealistic motivation not a strong one in many cases. So there is a need to continuously highlight different reasons and options, repeatedly reinforcing messages, using easy language and ideas that capture the imagination. We need to 'market' climate protection better.
Motivation for local action – some benefits for communities:

– *Save money by saving energy and using energy more efficiently:* By reducing the use of electricity (e.g. switching off lights that are not needed or using a movement sensor in corridors or garages) and the need to heat or cool space (e.g. through well-insulated walls, roofs and windows) – one can significantly reduce GHGs and save on skyrocketing energy costs.
– *Build the local economy and create jobs:* Decreased energy costs and the provision of new energy services and technologies (e.g. energy efficiency and renewable energy) give local government and private firms a competitive edge. Demand for energy efficient products and services and for new or alternative energy technologies expands local business and creates local jobs. It is a sector that in particular supports the development of small and medium sized enterprises (SMEs).
– *Improve air quality and public health:* Reducing global warming pollutants also helps cities comply with federal air quality regulations and preserves federal funding for local projects. These strategies ultimately create less air pollution, which results in fewer air quality-related public health impacts, such as asthma and other respiratory ailments.
– *Improve community liveability:* Cutting global warming pollution includes measures that also reduce auto dependency and traffic congestion, clean the air, and contribute to more efficient land use patterns and walkable neighbourhoods. In combination, these types of measures can help build a more liveable community.
– *Connect cities and towns with national, European and international leaders:* The expanding CCP network of communities committed to advancing climate protection and the Covenant of Mayors, as well as the World Mayors Agreement provide a valuable framework for action. By joining these, local governments unify and so strengthen their position.

– *Create a legacy of leadership:* Taking action on climate change provides tangible benefits for citizens today – and ensures that future generations will have access to the resources that support healthy, prosperous, and liveable communities.

2.1.4 Summary

In conclusion, people can and need to change, especially in the way they generate, distribute and use energy, but also in the way they use natural resources in general. There are no unlimited resources. Efficiency is a keyword that needs to become part of daily life. Less polluting fuels are also needed, with the use of natural local resources, such as solar, wind, and water, but a few of the more logical solutions available. By harnessing RES and using the energy locally – Local Renewables – a community can improve its resilience and gain socio-economic benefits that would make it a liveable community, increasing the quality of life.

Leaders and citizens are increasingly seeing the need to improve the resilience of their community against a changing climate, with more frequent storms, heavy rainfall, longer droughts, and many other phenomena impacting on their lives, environment and infrastructure. With more than half the global population now living in urban areas, and more migrating towards these, this is where the climate challenges will manifest. People want a secure environment to live in. They will look to their leaders to provide this.

Climate change mitigation and adaptation need to be co-priorities for all levels of governments. They must find ways to motivate and engage citizens in the short transition process. Local government, as the level of government closest to citizens, have to take the lead in this process at community level – shaping regulations, developing policy, guiding change, acting by example, changing the way they provide municipal services, and motivating others to follow suit. The primary motivation for them to act is clear – providing a safe, healthy and viable environment for their citizens, making sure the community is 'liveable'. Without people there is no community and no need for a local government.

Engaging in local climate action, communities can gain multiple benefits. Motivating a whole community to act, means moving beyond the purely idealistic point of view to one that is 'closer at home' – talk about money, talk about the cost of action and of inaction. There are short to long-term investments that are worthwhile to make in this field. And these will be done in many communities around the globe, working to their own benefit, as well as for the global common good. The starting point is often to reduce expenses – saving money by reducing energy use. There are many examples of where local governments and other actors have started to use energy more efficiently, by applying a combination of energy efficiency (EE) products and measures, and by changing to renewable energy sources to avoid steadily increasing prices of fossil fuels (oil, coal, natural gas). From here it is a logical step to generating energy locally from local resources, and to become more efficient by reducing the need for (and cost of) extensive energy transmission and distribution networks that have extensive associated waste. It boils down to regarding energy as a valuable resource.

With increasing public awareness on the need to reduce harmful GHGs, rising fossil fuel prices, and with more options to improve energy consumption behaviour, the transition to a sustainable energy future has started. What is needed are climate neutral and climate resilient communities, which are nice to live in. Now the question remains, can we achieve this in time?

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Chapter 2.2
Global Action: The Case for Rapid Mitigation in the Stern Review and the More Recent Evidence from the IPCC AR4*

Michele Pittini

Abstract The scientific evidence of climate change, among others presented by the International Panel on Climate Change (IPCC), has drawn attention of policy makers and, among others, led to economic studies being conducted. One of the most influential and comprehensive was the 2006 Stern Review which considered the economics of climate change, and the cost of immediate action and delayed action. It had a major impact on the policy debate, not only in the UK, but internationally.

Keywords: Climate stabilisation • economic argument • policy debate • Stern Review (SR) • transition to a low carbon economy

2.2.1 Introduction

The Stern Review (SR) (Stern 2007) reported in October 2006 and had a major impact on the policy debate on how to respond to the threat posed by climate change. The SR called for early and decisive action to reduce emissions of greenhouse gases, but the main novelty it brought to the debate was that this key conclusion was explicitly based on an economic argument, i.e. the finding that investing now to achieve an early, deep reduction in global emissions could avoid much

*The views expressed in the paper are those of the author and do not necessarily reflect those of the Committee on Climate Change.

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greater damage costs from unmitigated climate change as well as curbing the risk of facing truly catastrophic impacts. The Stern case for action has been reinforced by the broader evidence base summarised in the IPCC Fourth Assessment Report (AR4) (IPCC 2007a). The latter pointed to the risks of unmitigated climate change while also showing that climate stabilisation at the levels recommended by the SR is feasible and achievable at comparable costs. This contribution to the ICLEI publication reflects material presented at the ICLEI conference Rovigo 2008. It quickly reviews the SR arguments for early action on climate change and the extent to which they are supported by the IPCC findings and other evidence. Moving from the international to the national level, it then summarises recent UK analyses showing that the transition to a low carbon economy is challenging but feasible provided the policy framework is right. Finally, the paper addresses possible links between action at a global and national level and action at the level of individuals and communities, suggesting that this has an important role to play as part of an effective and efficient policy framework.

2.2.2 The Economic Case for Early Action in the Stern Review and Further Evidence from the IPCC Fourth Assessment Report

The Stern Review (SR) was commissioned by the United Kingdom (UK) Chancellor of the Exchequer in 2006 with the remit to assess the evidence and build an understanding of the economics of climate change. The science was the starting point of the SR, reflecting the view that the scientific understanding of climate change – a global, long term environmental problem involving risks and uncertainties and potentially major and irreversible change – ought to shape the economics.

One of the first steps in the Stern narrative was to characterise the risks that the world would face if global mean temperatures were allowed to increase above certain thresholds. The conclusion reached by the SR was that adverse climate change impacts in a number of domains should be expected even for moderate degrees of warming and over relatively short time scales. Furthermore, the risks would intensify as temperature rises. The AR4 essentially reinforced this message. According to its review of impacts global mean temperature increases of about 2.5°C above pre-industrial times would be accompanied by an increasing number of key impacts, such as widespread losses in biodiversity, decreasing global agricultural productivity, and commitment to widespread deglaciation of Greenland and West Antarctic ice sheets, while changes greater 4.5°C would lead to major increases in vulnerability exceeding the adaptive capacity of many systems (IPCC 2007b). Global mean temperature has already increased by about 0.6°C compared to pre-industrial times and should any further warming in excess of 2–3°C occur we would be experiencing climate change on a scale that is unprecedented in the course of human history.

The SR then moved on to set out a case for early action based on an economic and risk assessment of the potential major risks from climate change and the feasibility and costs of mitigation. The approach involved assessing what could happen to concentrations of greenhouse gases (GHGs), temperature and impacts on a business as usual emissions scenarios and then looking at the implications for eventual temperature increases of different levels of stabilised stocks of GHGs.

At present GHG concentrations are at around 430 parts per million (ppm) and raising at 2 ppm/year. Business as usual would see this rate of growth increase further could result in around or well beyond 750 ppm by the end of the century. Despite the uncertainty that characterise the relationship between amounts of greenhouse gases in the atmosphere and global mean temperature, according the SR it was clear that if no action was taken to reduce emissions the global climate would be entering very dangerous territory. Furthermore, the SR pointed to the risks associated to delaying action. Stabilising GHG concentrations above 550 ppm would virtually commit the world to a temperature increase of 2°C above pre-industrial times and imply a greater than 50% probability of exceeding an ultimate temperature increase of 4–5°C, with a significant share of this increase (about 2–4°C) to occur by the end of this century or early in the next century.

By contrast, the SR emphasised that stabilising GHG concentrations between 450 and 550 ppm or below would considerably reduce the risk of witnessing truly catastrophic climate changes. The scientific evidence on these relationships keeps evolving but if anything points to greater climate change risks for similar levels of concentration. For instance it is now widely accepted that stabilising at 550 ppm would not be sufficient to produce a reasonable probability of meeting the EU aspiration of limiting the increase in global mean temperature to 2°C above pre-industrial times.

If one accepts that in principle there are very large benefits from early action aimed at keeping GHG concentrations at 550 ppm or below, the next consideration ought to be the feasibility of emission reduction scenarios consistent with this objective. Both the SR and the AR4 that stabilising at between 450 and 550 ppm would involve strong and early action, with global emissions peaking in the next 10–20 years and then falling at a significant rate thereafter. Stern concluded that global emissions of GHGs should be at least 25% below current levels by 2050 to stabilise below 550 ppm, while depending on the scenario the AR4 points to a level of CO_2 emission reductions of about 30–50% on 2000 levels by 2050 as consistent with GHG stabilisation at around 500 ppm. Both Stern and the AR4 (the latter with 'high agreement and much evidence') also suggest that these stabilisation objectives can be achieved by deploying a portfolio of technologies that are either currently available or could become commercially available in the coming decades, provided that appropriate policies are in place. The size of the technological challenge and policy shift required cannot be underestimated. The International Energy Agency (IEA) Energy Technology Perspectives 2008 (IEA 2008) suggests that targeting a 50% reduction in global emissions by the middle of the century would need to be supported by far reaching new policies and by investment in research and development (R&D) and deployment of low carbon technology equivalent to about US$1 trillion or 1.1% of global Gross Domestic Product (GDP) per year between now and 2050. But while the policy and technological challenge of stabilisation cannot be underestimated, the overall message of the IEA is consistent with the SR and the AR4 in arguing that achieving deep cuts in emissions by the middle of the century is feasible.

Stern also tried to quantify the costs and benefits of action through various modelling approaches. The damages from business-as-usual were estimated to be equivalent to at least 5 and up to 20% of consumption a year, depending on the types of risks and effects included in the estimates. By contrast the costs of removing most of that risk, getting to 550 ppm or below, are around 1% of GDP per year, within a range of ±3/cent. These costs are not insignificant in absolute terms, but would not undermine long-term economic growth. The SR's findings on the global costs of mitigation are broadly consistent with the conclusions of the AR4, but both reports also point to the fact that delaying emission reductions will significantly constrain the opportunities to achieve lower stabilisation levels.

In presenting a summary of the SR conclusions on the case for early action one has to mention that the cost benefit analysis undertaken by the SR proved to be rather controversial in economist circles. A key criticism of the SR calculations related to the choice of discount rate that Stern used in his analysis, i.e. the rate at which current and future costs and benefits should be traded against each other. This was regarded by many of Stern's peers as being too low, thereby lending artificial support to the SR case for early mitigation, which would involve investing resources in the next few decades to pre-empt impact spanning several decades if not centuries. The debate is complex and it cannot be properly summarised here, though it is worth mentioning that Stern and his team have responded to their critics from the pages of World Economics (Dietz et al. 2007). Notwithstanding disagreement on the SR approach to the cost benefit analysis the evidence put forward by the SR and supported by the AR4 and other analyses points to the existing but rapidly fading opportunity to buy a significant reduction in the risk of facing very large, unpredictable climate change impacts for a relatively small price. Against this background those advocating a slow global policy response to the climate change threat should be upfront about the risks this strategy would imply, even if the main bearers of those risks are likely to belong to future generations. The strong ethical dimension associated implied by different choices around discounting and other elements of cost benefit analysis (e.g., approach chosen for valuing human life) would then become explicit.

2.2.3 Country-Level Action: Highlights from a UK Analysis of the Costs of Transition to a Low Carbon Economy

If global scenario analysis points to GHG stabilisation at low levels as being challenging but feasible, various analyses carried out for the UK also suggest that a rapid and cost-effective transition to a low carbon economy is a realistic aim provided the policy framework is right, that emissions reductions are delivered from those sectors of the economy where it is most cost-effective to do so and that government, business and individuals each play their part. In particular, modelling work in support of the Energy White Paper 2007 and of the draft Climate Change Bill suggests that the long-term costs of meeting reduction in UK CO_2 emissions by between 60% and 80% on 1990 levels by 2050 are not prohibitive, well within the Stern range of global costs.

Analysis for the Energy White Paper 2007 based on the UK MARKAL-Macro model (BERR 2007) pointed to long-run costs of a 60% CO_2 reduction by 2050 of about 0.3–1.5% of UK GDP, while additional analysis for the draft Climate Change Bill (Defra 2007) found costs in the region of 1.1–2.6% of UK GDP in 2050 for an 80% CO_2 reduction.

But the fact that these long-term costs are a small percentage of future GDP should not be taken to imply that decarbonisation is somehow easy – it's not, it is a major departure from the business-as-usual (BAU) scenario in terms of how we produce, transport and use energy, and will also involve action on waste and land and land use changes. If we look at the technological scenarios for the UK transition to a low-carbon economy we see for example that by 2050 all sectors contribute (fairly equally) to emission reductions although relative timings of contribution differs. The electricity sector is a key sector for realising emission reduction targets, almost fully decarbonising by 2050 through a combination of carbon capture and storage, nuclear and renewables. In the 80% reduction scenarios surface transport is also largely decarbonised, with second generation biofuels playing a significant role. The recent King Review of low-carbon cars pointed to electric vehicle technologies (King 2008) relying on near zero carbon power generation as playing a major role in decarbonising the transport sector given constraints on the sustainable supply of biofuels. Essentially however it confirmed that in the long term the transport sector needs to shift away from dependency on fossil fuels and become essentially carbon-free if deep cuts in emissions are to be achieved.

It is also worth mentioning that while long-term costs are likely to be a very small proportion of GDP in the short and medium term (up to 2020), costs could be higher. For example macroeconomic modelling for the Energy White Paper shows that costs up to 2020 could be 0.8–1.6% of GDP (Oxford Economics 2007). But such costs are highly dependent on the choice of transition path and policy mix. In the short term the capital stock is less malleable and mitigation policy can bite harder if it is not efficient or if it is introducing major shocks to the system. Continued emphasis on trading within the EU and internationally is key to mitigate short-medium costs and risks. But in order to achieve these goals it is also essential tat all opportunities for cost-effective energy savings within the economy are taken up.

Different studies looking at building marginal abatement cost curves for the UK economy (relating incremental units of GHG abatement to incremental unit costs per tonne abated) have consistently shown that there is significant potential to reduce emissions through relatively inexpensive measures. For instance, analysis by consultants McKinsey for the Confederation of British Industry (CBI) Climate

Change Taskforce report (CBI 2007) has suggested that there are just over 40 Mt CO_2e of emission reductions that could be achieved by 2020 at negative cost, largely from increases in the energy efficiency buildings and appliances but with contributions from other sectors (e.g., with fuel economy improvements in commercial vehicles). In other words, significant savings could be achieved through measures that require an upfront investment but over time can more than pay back the initial outlay, thereby saving money as well as reduce emissions. Some cost elements (e.g., hassle factor, disruption or other transactional costs such as costs of management time) are not explicitly included in these calculations, as the CBI acknowledges in its report, but even so unlocking the potential for negative or low cost measures to deliver emission reductions should be a policy priority.

Tapping into the significant potential for low cost emission reductions requires addressing a complex mix of market failures and barriers that have so far prevented this potential from being realised. These essentially range from genuine market failures (e.g. restricted access to capital, lack of information and split incentives between landlords and tenants) to barriers that are of a predominantly behavioural nature. The latter include bounded rationality (i.e. the inability of individuals and organisations to adequately process information and make the right investment decision) but also simple inertia and gaps between individual attitudes towards the environment and actual adoption of pro-environmental behaviours.

2.2.4 Action at the Level of Individual and Community: How It Fits Within the Picture

If global and national level analyses support the message that deep cuts in emissions are feasible at costs that are not prohibitive, they also consistently agree on the message that policy matters if this goal is to be achieved.

The SR argues that effective action on reducing GHG emissions must include three elements:

- Pricing of carbon implemented through tax, trading or regulation
- Policy to support innovation and the deployment of low-carbon technologies
- Remove barriers to energy efficiency and to inform, educate and persuade individuals about what they can do to respond to climate change

Taking for granted that no significant progress is going to be possible without a satisfactory global deal and clear commitment of key national states and groups of states, is there a role for individual and communities in pursuing this policy agenda? Or is it entirely up to central governments and big business to deliver, respectively by designing and implementing effective policy levers and by responding through investment and innovation?

To answer this question it is useful to consider SR policy pillars in turn. The first pillar, carbon pricing, is likely to remain the realm of international agreements and regulatory interventions at the level of national states or supranational organisations such as the European Union. Proposals to bring carbon pricing and emission trading to a household or individual level through personal trading schemes have been put forward for consideration and could see communities engaging in piloting the concept. Such schemes are not technically unfeasible and may present some attractive features in terms of engagement, but public acceptability and implementation costs mean they are unlikely to represent viable option (Defra 2008).

In terms of innovation – the second pillar in the SR framework - action at the level of communities and local authorities can often offer very useful case studies of diffusion of niche low carbon technologies (e.g. photovoltaics [PV], biomass-fuelled district heating schemes, carbon neutral buildings, waste-derived biofuels, etc.) and more generally of planning for sustainable energy and transport infrastructure at the municipal scale.

But arguably it is the third of these pillars – removal of barriers, awareness and persuasion - where community action can really help making a difference. A starting consideration is that in developed countries the amount of emissions that individuals control tends to be a significant share of the total. The CBI Taskforce report (ibid.) highlights that individuals and households directly control as consumers more than one third of emissions through personal decisions about how they heat and light their homes, the electrical appliances they use and the transport choices they make (the report also notes that combining the emissions that individual and households directly control with those that they influence through their purchasing choices, they can affect around 60% of UK emissions). Furthermore, analyses based on marginal abatement cost curves suggest that there are significant abatement opportunities associated to everyday individual decisions: simple things such as turning down thermostats by one degree, choosing more efficient appliances and fuel efficient vehicles, insulating homes better. At the same there are entrenched barriers that need to be overcome in order to unlock behavioural changes and hence tap into this potential for low cost emission reductions. Individuals are often not aware of the links between their everyday choices and climate change, and even when they are they may lack the necessary information (or the ability to process information) to choose the most efficient technologies and adopt behaviours that are consistent with pro-environmental attitudes.

Against this background, leadership at the community level can not only increase awareness about causes and the scale of the climate change challenge (thereby increasing the level of general consensus on the need for action), but more importantly it can put forward simple and positive messages on everyday actions and choices that can help make a difference in terms of emissions and achieve financial and other benefits.

In summary (and quoting the SR), “dangerous climate change cannot be avoided solely through high-level international agreements; it will take behavioural change by individuals and communities, particularly in relation to their housing, transport and food consumption decisions”.

2.2.5 Summary

The economics of risk underpins the Stern conclusion that we should aim to stabilise atmospheric concentrations of GHG somewhere between 450 and 550 ppm to achieve a significant reduction in the risk of witnessing truly catastrophic climate change impacts, and technology scenarios point to the required deep cuts in emissions as being feasible if challenging. While the AR4 did not provide explicit recommendations on stabilisation targets that would be needed to avoid dangerous climate change (in recognition that defining these thresholds would require value judgements and would go beyond its scientific remit) the evidence it gathered lends further support to the evidence on which Stern based its conclusions.

UK analyses show that a rapid and cost effective transition to a low carbon economy is feasible provided the policy framework is right, and that the significant potential for low or even negative costs emission reductions (predominantly through improvements in energy efficiency) is fully realised. This however requires addressing entrenched barriers to pro-environmental behavioural change.

Individuals and households directly or indirectly control a significant share of emissions in developing countries. As part of a global solution, there is a key role to play for individuals and communities, particularly in tackling barriers to behavioural change. Leadership at the community level can put forward simple and positive messages on everyday actions and choices that can help make a difference on emissions and achieve financial and other benefits.

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The Committee on Climate Change (CCC) is an independent body established under the Climate Change Act to advise the UK Government on setting carbon budgets – legally binding ceilings on the level of allowed UK emissions over 5-year periods – and to report to Parliament on the progress made in reducing greenhouse gas emissions. The 2008CCC report 'Building a Low Carbon Economy' recommended that the UK should aim for an 80% reduction in GHG emissions on 1990 levels by 2050 and advised on the level of the budgets for 2008–2012, 2013–2017, and 2018–2022. The analysis supporting the Committee recommendations updates in several respects the analysis summarised in this paper. It covers climate change policy targets, technology scenarios and assessment of macroeconomic costs and other impacts of emission reduction targets. It also identifies opportunities to cut emissions across different sectors of the economy – transport, residential homes, aviation, industry and electricity – and provides further evidence on the importance of tackling barriers to behavioural change from households and individuals in order to unlock potential for cost effective emission reductions. To download the CCC's 2008 report, subsequent annual reports and special reports, go to their website at: www.theccc.org.uk.

Chapter 2.3
Urban Energy Security

Rian van Staden

Abstract The realisation of a sustainable energy regimen in the urban environment requires a compelling understanding of the energy balance, environmental modalities and socioeconomic realities of the area in question. Cities are complex: communities offer manageable abstractions in homogeneity and purpose that serve as excellent starting points for understanding the greater complexity of cities. However, the introduction of such a sustainable energy regimen into communities also requires a profound understanding of the potential and impact of available technological, social and economic solutions. Only with both sides of the coin do we achieve a currency with which we may buy a better future for coming generations.

Keywords: Energy security versus secure energy • energy sufficiency • ethics • external energy demand • geopolitics • unpredictable prices • value chain

2.3.1 Introduction

We have an instinctive feeling for what is meant by energy security. It is a multilateral, geopolitical issue, thorny and uncomfortable, encumbering relations between sovereign nations, far away and with some luck, somebody else's problem. Unfortunately, from a human settlement perspective, this comfortable position holds little water.

It turns out – much to our chagrin, for those of us working on the issue of ensuring that our cities and settlements keep functioning for the next several generations – that energy security is something that involves us intimately, and further calls out for a redefinition that finally integrates the demands of international, national and local politics.

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'Energy Security' is often reduced to that most basic tenet – security of supply. Interestingly, even in its geopolitical context, it is much, much more than that. At an urban level, it fills the horizon, touches everything we do, and becomes a basic principle, which dictates our policy, our economics, and ultimately our lives.

2.3.1.1 Topsy-Turvy

In the urban context, the innate relevance of energy security can best – perhaps most comfortably – be redefined if we recast it as 'Secure Energy'. Surely this would represent our most basic need, encompassing concepts like sufficiency (having enough – which dominates reality and in return determines our economic health), as well as safety (of which we all strive for in our energy regimen, for the sakes of ourselves and our children) and, at its most fundamental level, sustainability, in the sense of bitter, bared-teeth survival.

Secure energy means, far more transparently than a term such as 'Energy Security', that we have what we need, that it does not conspire to kill or harm us, and that it remains available over time. Energy Security, in the urban context – indeed, the human settlement context – becomes secure energy. Secure energy is energy we understand, energy we command, energy we control, energy we can guarantee, energy we can afford, and energy we can live with. At heart, this is the truer – and more immediate – definition.

The application of this definition becomes most harsh when we hold it up against what passes for energy supply in the current paradigm. Conventional energy is energy we only temporarily had enough of, which we never controlled, which we can no longer afford, and which we find increasingly morally and ethically difficult to live with, much less guarantee.

2.3.1.2 Complexity

As with most real-world issues, this idea of secure energy is more complex than we might comfortably believe. Perhaps this is the key reality in the area of urban energy supply, as it promises to become uncomfortable from today onwards.

It touches on social issues, economics, peaceful co-existence, growth, the social contract that cities have with their inhabitants, and the promise politicians claim to represent to their constituencies. It becomes, at heart, an urban issue, and one we can no longer comfortably ignore.

2.3.1.3 In a Nutshell

In short, the challenge of servicing the needs of an urban populace is one of resources, daubed with a dose of fairness and a veneer of civilisation. While many resources may, could or should become scarcer, one scarcity is of foremost importance – that of energy. We have grown our cities, from the early days of the industrial revolution, on the premise of cheap energy. We have paid a heavy price for it, environmentally, socially, and economically. For the economic high, we have paid with dependence, an argument we would never countenance if the issue was substance abuse on a personal level, but one we stomached gaily because the cost seemed distant and the high immediate and universal.

The time has come for an accounting, and the price to pay is the world as we know it. A down no amount of uppers in the traditional sense can alleviate.

In what follows, we examine the urban aspect – the urban pathology, if you will – of what we have done, and the remedial actions that are required to ensure the survival of that mechanism most at stake – urban civilisation. We will do so in terms of those aspects most familiar to those of us who deal with urban ills, ailments and alleviates on a daily basis – economics, social issues, comfort, persistence, and growth.

2.3.1.4 Foremost

Let us begin by examining that core issue that we currently understand under the concept of energy security – sufficiency. We most widely discuss energy efficiency, but we live by sufficiency – our ability to supply enough energy to fuel our urban economies and lifestyles, and maintain acceptable levels of growth.

If we tend to think of energy security as a national issue, let us cast it in that context. What happens, in real terms, if security of supply can not be guaranteed at a national level? A significant threat to "Energy Security", in the traditional context, is the monopoly held over supply by a minority of countries and organisations. Russia's Gazprom in its (massive) area of influence, for example, decides, based on issues that have little foundation in rationality and responsibility, who gets how much energy and why. Typically, it supplies a country with a need – indeed, an organic dependency – of N units of gas, with N units of gas. What happens if it decides to supply only $N\text{-}M$ units (where M is some unpredictable amount)?

The answer is complex, and has to do with those two key aspects of economic reality: money and power. But let us (democratically) assume that where each citizen had access to $n = N/$population units, we now have a per-capita availability of $(n\text{-}m) = (N\text{-}M)/$population units. What does this mean in the urban, rather than the individual, context?

The answer lies in the demand. If, in our particular urban context, we have a per-capita need of x units, where x is larger than $n\text{-}m$ $(x>(n\text{-}m)$, in mathematical terms) we have significant problems of sufficiency. On the other hand, if in our city, we have a per-capita need of y units, where y is smaller than $n\text{-}m$ (n being a national average), thus a situation where $y < (n\text{-}m)$, we have a theoretical maintenance of sufficiency. Even in a more real-world situation, where we calculate an additional loss of q units to those with greater power to effect their demand, if $y < (n\text{-}m\text{-}q)$, we are still able to maintain sufficiency within the urban context, and remain unaffected.

The key outcome of the above is that not all cities are equal. But of course, we know that. The question is, how does that inequality come about, and how do I ensure that I am in the latter, rather than the former, type of city?

2.3.1.5 Supply and Demand

Winners – cities that can weather this most basic of impact from the “Energy Security” equation – are those that are able to best manage the demand. Not, specifically, energy demand as a whole, but rather external energy demand – the demand for energy from outside resources.

In the past, a heavy external energy demand did not tax cities to any great extent, as the energy was cheap and supply exceeded demand. In times where prices are volatile, tending to be high, and supply is beginning to fall behind demand (and yes, the two are obviously, though incompletely related), cities become net exporters of money (not to mention jobs, and a certain degree of autonomy). This is the price for being a net importer of energy in the new world reality we all face. Unless you have a coal mine in your municipal park, an oil platform in the municipal lake or an oil well in your municipal parking lot, you are pretty much an energy importer in the conventional energy mix model.

There are ways out of this (potentially catastrophic) cycle of dependence. Some are directly energy related (generating your own from local resources, or reducing your net energy demand). Others are more indirect. But they exist, and they exist today, as is explored below.

2.3.2 Issues to Consider

2.3.2.1 A New Philosophy of Measurement

To make matters worse, cities and communities generally seriously underestimate their actual energy footprint. Is it enough to measure how much electricity, gas and oil you import? (in case you’re unsure, the answer is “no”). As such, having methodologies in place that allow you to measure your dependence (both real and ethical) on external energy sources is a key requirement on getting to terms with your addiction – but more on this later. For the moment, let it suffice to say that if you buy a refrigerator from China, your responsibility extends to the way the power was produced that went into manufacturing that refrigerator.

2.3.2.2 The Human Aspect

In the urban context – a context that has at its source the agglomeration of large numbers of people in one place – there is a pronounced human aspect to the whole energy issue. Primarily, it is one of expectations. The broader populace in the polis has a set of expectations that those who manage – either as elected or appointed officials – would do well to adhere to. In addition to the obvious one – fulfilling the basic need for energy sufficiency – there are several others that inform our response to the new energy challenges we face. They include expectations about the environment (that it will not go completely hostile just so that I can have enough energy), health (that my energy sources will not try their best to kill me, my family and my community), that of price (especially business use requires a degree of stability and predictability to facilitate budgeting that we can no longer guarantee), and many others. There are ways of fulfilling these requirements. None of them involve adhering to the energy status quo.

2.3.2.3 The Benefit of Inequality

The expectations of people also drive the benefit of being different. Being better than other cities – being in the latter group of cities as outlined above – is a valuable characteristic that fuels economic and social growth.

Take the possibility of attracting business. Where energy supply is assured, and pricing guaranteed, business feels far more at home than in a context of insufficiency and price volatility. On average, businesses are happy to pay more for energy if the price can be guaranteed over time, rather than less today and a lot more (unpredictably more!) tomorrow. Cities that are able to provide such an environment perform better economically over the long term than those that cannot.

On the level of the individual, nothing makes for an uncertain social environment like the uncertainty of services, especially those taken for granted, such as electricity, heating, water and the like. In South Africa, where electricity has been cheap and plentiful for decades, no topic currently provides for as many (generally unfavourable) headlines as the discontinuous energy service provision (energy outages) that plagues that country. If such a situation can be avoided – and it can (and in the case of South Africa, it could have) – it certainly should be.

2.3.2.4 Climate Change

We all contribute to the anthropomorphic CO_2 emissions that are the driving force speeding up natural climate change. Where people conglomerate, emissions do as well. Hence cities are focal points in the battle to ameliorate climate change, even if rarely acknowledged as such. Slowly but surely, the message that cities are key players in realising national targets in CO_2 reductions are being absorbed by – on the whole – reticent national authorities. It is clear that urban CO_2 emissions targets, while connected to national targets in convoluted ways, are becoming necessary, even unavoidable.

Interestingly, the measures needed to de-couple ourselves from external energy dependence align nicely with those needed to ameliorate climate change. It therefore follows that national resources will increasingly become available at a local government level to implement such measures. It is rare that local and national policy requirements – CO_2 reduction at a national level, and increasing the independence from imported energy sources – align so perfectly. This will play a key role when we consider the cost of secure energy.

2.3.2.5 The Direct and the Indirect

In terms of directly influencing the amount of "foreign" energy required (and yes, your neighbouring city qualifies as foreign in this context), the measures that can be applied tend to fall into two broad categories – energy efficiency and local renewable energy sources. If these sound expensive, in terms of requiring the real expenditure of budget, they certainly are. But, as with any investment, the net benefit should be seen as a whole, both in terms of direct and indirect benefits.

Every kilowatt-hour produced locally, and every kilowatt-hour of use avoided locally, benefits both directly through avoided cost of imported energy at unpredictable prices, and indirectly through a number of indirect benefits that in many cases manage to overshadow direct benefits. Such a statement needs examples. Let us compare a kilowatt-hour of electricity provided by a power plant somewhere else, using fuel imported from, say, another country blessed with more natural petrochemical resources than you are, with a kilowatt-hour produced from photovoltaic (PV) panels locally manufactured from locally produced cells (but with, for the sake of argument, imported silicon), installed by local installers on a local roof.

The net benefit of the former is that it required no up-front investment. In every other way – the flow of value, job creation, control, guaranteed supply, emissions for which you are responsible, and so on – it has negative impacts, known as externalities.

The latter, where a significant portion of the value chain lies within your back yard, the fuel cost is nil, and the up-front investment is recouped as the energy is used to fuel your local economy, has mainly positive externalities – guaranteed price, job creation, value flow within the local economy, your ability to export both product and know-how. Is it more expensive? In terms of the actual generation cost, for the moment, yes. In terms of the value of all externalities? Hardly. Add to that your ability to leverage local investment with national measures now generally in place, and it becomes a very compelling proposition.

The time has come to look beyond the now.

2.3.2.6 Responsibility

Public administration is largely about responsibility – cost plays a role, but only as enabler. The population places upon its administration – note the choice of words – the task of providing the infrastructural and administrative requirements it demands for the execution of everyday life – social and economic – in return for following certain rules and providing the financial resources to do so through levies, taxation and other financial mechanisms.

What are the responsibilities so conferred? They obviously go beyond the immediate need for infrastructure and order (tactical issues) to those strategic issues that ensure that those services can be maintained over time. This includes education, strategic action (action with a long-term benefit, generally longer than a 4-year elected term) and the maintenance of the moral and ethical norms of the community, all according to the community's expectations.

When we compare the expectations we examined earlier with the promise of a business-as-usual energy approach as modelled by the International Energy Agency (IEA) and others, it becomes rather graphically clear that it is not possible, by any stretch of the imagination, to wait and see (a normative piece of public policy more common than one would like to imagine). Rather, following those scenarios that lead to and fulfil public expectations demand the implementation of a transitional path – one away from dependence and conventional energy policies. That transitional path is described clearly in documents as varied as the Stern Report, the reports of the International Panel on Climate Change (IPCC), and elsewhere, and they all have one thing in common – the fact that that transitional path starts today (well, technically yesterday, but in case we didn't manage …). The movement demanded is uniformly one towards energy efficiency and local, sustainable energy sources.

The prime strategic responsibility of city officials then is the immediate initiation of a transition path that incorporates the elements discussed above. It supersedes all others, as all others – continued provision of services, maintenance of the environment and the economy – are dependant on this prime responsibility.

Is it possible to be aware of this and act otherwise, within an acceptable ethical framework? No.

2.3.2.7 Payback

Such an undertaking represents perceived risk, mainly to the political fortitude of officials who are concerned that not all agree, that costs may be high, that technologies are not mature.

Here one word to the wise – the technologies needed are here today. Yes, they will get better. But they are in most cases more than mature enough. What is missing is the political will to implement against ingrained lobbies, and numbers – the economies of scale. Scale that can only be achieved through implementation. What are in place are the policy measures and methodologies to move forward, boldly.

What is also clear is the enormous payback timely implementation of such policies bring with them. Some immediate, some long-term – but all-in-all, the payback overshadows investment by a significant amount. That payback – in terms also of fulfilling the long term needs and expectations of the citizenry – conforms fully to the strategic responsibility of officials.

2.3.2.8 Options and Actions, Costs and Benefits

What are our options? How do we implement secure energy, that urban interpretation of energy security? Let us break the challenge down into specific elements, examine the challenges they pose, the measures we can use to address them, and some of the benefits we gain.

We have already split the challenge into two parts, energy efficiency and local renewable energy sources. This provides a natural overall framework.

Energy efficiency is a complex topic. It has to do with more than "just use less". It can be usefully divided into end-use efficiency, and economic efficiency. In the former, the focus is on the point of use – light or heat in the private household, for example. In the latter, it has to do with the units of energy needed to produce a unit of national product – energy use in manufacturing, transport in industry, and related areas.

End-use energy efficiency has everything to do with personal values, the ability of an urban unit to influence those values in its citizens, and the technologies and legislative guidelines made available to make it possible. Education and price represent two excellent tools in managing the position of the individual to his or her energy use.

Education is a key tool. It can take time to reach its full potential, sometimes a generation or more, but in combination with other tools is the most effective long-term approach. Leading the young to an inborn energy frugality is a wonderful investment that produces many times its cost in benefits. Making end-users aware of the measures and technologies they can employ to reduce their own energy footprint (and hence cost) must be the number one social responsibility of any urban administration. At the same time, protecting the consumer from the consequences of their actions by buffering against price increases is decidedly contra-indicated. The principle of the carrot and the stick – however politically incorrect in modern educational thinking – holds true in this instance.

Of course, it is important to prevent an excessive burden on those least able to carry it – the poor, the elderly, and so on. But even here, there are mechanisms to ensure that any financial support serves its intended purpose. As an example, rather than a cash rebate (which might be spent on something else), or lower energy prices that discourage frugality, supplying low-income households with low-energy appliances (energy-intensive refrigerators are a prime target here) lowers the energy-cost burden while at the same time ensuring lower energy use. At the same time, measures like this can support a local industry, ensuring (that) value stays within the community (make your refrigerators in our city, and we will buy N per year off you to give to the poor). The avoided cost more than compensates for the expenditure, and the externalities can be very positive indeed.

In other measures, the same applies – make sure that any subsidisation strikes home. Cheap loans to put solar hot water systems (a wonderful peak-energy-use-shaver) on rooftops should be combined with legislation making it mandatory to have such a system on a house if you wish to sell it, or on a new building if it is built. The result is a willingness to spend money for something that facilitates a windfall, easing the pain. Combined with an incentive scheme, all opposition tends to fade – and a healthy local installer industry is created. Economic incentives (now affordable due to avoided cost for the most expensive kind of energy) for a solar hot water system manufacturer to set up shop in town, makes the equation perfect.

An energy-efficient industry makes it possible to compete well in international circles, while at the same time making possible a whole host of additional measures. Germany – a generally expensive industrial location – is world leader in exporting high-added-value manufactured goods – cars, machines and the like. This is only possible because the amount of energy required to manufacture such a product in Germany is less than elsewhere, because industry in Germany is highly efficient in its use of expensive energy. Making available energy at stable prices – process heat as a by-product of co-generation based on local biofuels, for example – means that the energy can be a bit more expensive, as industry is ingenious at finding more efficient ways of doing things, given stability and the time to do so. Being able, on the world market, to use less energy per unit of gross domestic product – and having those units of energy come from local sources – is a recipe for successful competition in this age of globalisation.

At an urban level, it attracts industry, and facilitates the development of local energy sources. Which is a smooth transition to our second topic, using local sustainable energy sources. Cities are all different, and the local energy sources they have differ considerably. Yet most cities have an entire palette to choose from. Here, the need to see urban, per-urban and rural areas immediately adjacent to cities as a unit in dealing with energy issues informs the way we think about issues such as land-use and forest management, and the legislation that govern those issues.

In Freiburg, Germany, we have the pernicious situation that the decision to allocate land immediately surrounding the city for wind-energy development rests with the federal state of Baden-Wuerttemberg, and not with the city itself. State politicians have little or no understanding of local issues and the local political climate, and are based in a city that is both far away and that faces a completely different set of energy challenges. The legitimate wishes of the citizenry in Freiburg to develop the wind-energy resources in their immediate peri-urban environment, is blocked by the inability of state politicians to understand the issues that face Freiburg. This sort of impasse must bow to the pragmatic need to see the city and its surrounding forests and agricultural resources as part of an integrated energy plan.

Energy crops can, for example, if well managed and sensibly nurtured, add value to the agricultural potential of areas surrounding cities, contribute significantly to reducing energy dependence in the cities they serve, and avoid excessive urbanisation from an impoverished countryside. Once again, this requires a unified model of energy management that extends the energy cycle of the city into the surrounding countryside in a constructive and well-managed way.

A city surrounded by forests has a strong energy interest in those forests as a source of, for example, waste wood for local conversion into wood-pellets used to heat homes and other buildings in a sustainable manner. To facilitate this, however, the city needs a direct say in how those forests are used and managed – often not the case today, and a reason why sustainable forestry as being discussed as part of the post-2012 framework is also an important issue for local governments.

Other resources require a re-think of direct urban legislation. For effective, ubiquitous use of solar energy in the urban context, it is key that suitable roofs of public buildings be developed in a way that benefits the citizenry – if a good feed-in tariff exists, for example, it behoves the city government to exploit the available roof space through communal photovoltaic installations that everyone can buy shares in, as not everyone owns a roof, or owns a suitable roof, to install PV on the own residences. Also, it is key to ensure that solid solar access regulations are in place, and that national support programmes are known and familiar to its citizens to leverage local measures.

An active programme of evaluating the potential of such technologies as require larger institutional support – geothermal, for example – should have a high priority.

In this way, ensuring that the legislative, financial and practical mechanisms are in place can ensure the successful utilisation of local resources. For every single kilowatt-hour so produced, the avoided import cost and beneficial externalities accumulate to create an energy regime that is safe in every sense of the word – true energy security in the urban context.

2.3.3 The Old, and the Whole

2.3.3.1 Dealing with the Old World

Of course, the shift in focus outlined above does not alleviate the immediate need of fulfilling the demands of the urban populace for energy using conventional resources during the period of transition.

As with most elements of governance, control plays a key role, and we see a trend towards ownership of or influence in local and regional utilities by cities – the reverse of what happened in the seventies and eighties. Increasingly cities see benefit in a higher degree of control in the utilities that service them, both in terms of influencing pricing and procurement strategies, but also in guiding and influencing the transition to sustainability.

Influence in or ownership of the local or regional utility also implies input into deciding what is an acceptable bottom line. While the only good bottom line for the average major utility is much profit at the expense of the consumer, and to the benefit of its shareholders, this need not be the case where cities can demand a socially responsible pricing regimen during the period of transition that we find ourselves in, freeing capacity for the end-user to invest in alternative technologies and energy efficiency. Such a strategy also keeps money in the region – another key benefit.

2.3.3.2 Systemics

Within the city as a system, energy underpins the majority of processes, but is seldom seen as a critical component. As such, the building, gardening or public order departments rarely think or see energy in what they do. It is key to ensure that energy runs like golden thread through the thinking of all parts of the system, and that systemic inefficiencies be eliminated in this way.

'Waste' heat from incineration by the refuse department should never be wasted, and organic 'waste' is too valuable ever to throw away.

Gardening is a cost, and an effort, but one that produces organic waste as a side effect that is not waste but an important energy commodity for any city.

Administration is a cost centre and an energy sink, but it often generates hot air (in the literal sense) through the cooling of server farms and related equipment. That heat can be used to drive anything from cooling rooms to heating water – no waste here.

In these and dozens of other ways, the systemic flow of energy touches everyone and must be chained in ways that achieve maximum systemic efficiency in that greatest system of all – the modern city.

2.3.4 Conclusion

The transition to a sustainable, efficient, locally-fuelled (as far as possible) energy system in the urban context simultaneously leads to a large set of positive externalities that align perfectly with the responsibilities city administrators have to their populations. Ergo, doing everything to facilitate that transition means you're doing the right thing.

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Chapter 2.4
Rational and Efficient People? Sometimes We Are

Nils Borg

Abstract People, choices and energy are a complicated mix in today's society. The article below briefly highlights aspects that are important in decision-making, yet not always considered when addressing the transition to a sustainable energy future. A key element in this is the perception of financial cost in deploying energy efficiency measures versus what are called 'synergy effects', i.e. having a wider perspective on additional issues beyond the cost of single measures.

Keywords: Cost efficiency and synergy effects • energy efficiency • energy policy • energy security and security of supply

2.4.1 Introduction

This article is written in the early 2009 when Europe just faced – and came through – yet another energy crunch. The flow of Russian gas suddenly stopped in the middle of winter and energy security was on everyone's lips, again. Often, energy security and security of supply are used as synonyms. In fact, they are not. Although related, 'energy security' is much wider than 'security of supply' and it is much more important to worry about the broader term. Why?

We can apply the analysis on several energy policy, energy security and climate related areas, and it is really quite simple. The less energy we use for a given service, the greater our freedom will be to choose what energy to use and where from. With less energy use, the cost per unit of energy gets less significant.

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The thinking applies just as well to gas and oil from Russia or Iran as it does to investments in renewables. We need to build a future based on renewable energy supply. But that doesn't mean that we should put all efforts into renewables, on the contrary. If we keep wasting energy, the additional renewable energy supply will just be fed into wasteful energy use and the economics of renewable energy supply really depends on efficient use. This may seem obvious, but even with the relatively limited resources that have been channelled to so-called sustainable energy, energy efficiency has traditionally not been the focus. The same is true when we ask ourselves what to do about Russian gas. Some European Union (EU) countries were less affected in January 2009 because of their larger strategic gas storage. But storage is costly, and some couldn't afford it. With less energy use, they could also have afforded to store more.

So why does this not happen? One of the tragic truths is that we keep making the wrong decisions, based on wrong assumptions. Economists (most of them anyway) believe that we are rational, and policy is based on this. In reality, we are not. Instead, our society and regulators must act rationally for us, taking a broader national or regional perspective. This is sometimes hard to accept but in fact, this is just what minimum energy performance standards are all about. If we can not make good decisions, for whatever reason, someone else has to.

Let us take the car as an example: The US car industry would probably have been in much better shape if they had built fuel efficient cars. But consumers have not asked for this, and the industry builds what consumers want. In part this consumer preference was due to the low fuel price. However, by regulating the fuel efficiency (rather than just adding sufficient taxes to the fuel price), the society as a whole would have forced industry and consumer to adjust in time to a changing reality.

Standards are needed elsewhere, but it is not a fix for all things bad. There is no 'template' solution. Standards for 'stand by' should be the most sensible way to get forward – to believe that a label will change people's behaviour here is just silly when all we care for is what the products deliver. In other areas, such as refrigerators, a combination of standards and labels is the best way forward. For many years, the EU has been falling behind when it comes to energy efficiency! Luckily, for all of us, priorities are changing, and have changed already. European Commissioner for Energy, Mr. Andris Piebalgs, realised this when he took office. He dubbed energy efficiency the "fifth fuel". This very well reflects that energy efficiency indeed can and should be compared with various forms of supply.

The Energy End-Use Efficiency and Energy Services Directive

The purpose of this Directive 2006/32/EC is to encourage energy efficiency through the development of a market for energy services and the delivery of energy efficiency programmes and measures to end users. The Directive covers most forms of energy sold to end users, including transport fuels.

This Directive on energy end-use efficiency and energy services (ESD) is a welcome addition to the family of European Directives dealing with the use of energy, and it is often referred to as the Energy Services Directive and sometimes as the Energy Efficiency Directive.

Rather than focusing on specific technologies or measures, the new Directive addresses actors and institutions and the way markets for energy and services function. It will thus complement and improve the implementation of existing EU energy efficiency legislation, including the Directives on Energy Performance of Buildings, on Combined Heat & Power and on Energy labelling of appliances.

The End-use Efficiency and Energy Services Directive was adopted by the European Council on 14 March and formally entered into force on 17 May 2006. Member States have 2 years to transpose the Directive into national law.

The Directive defines and sets savings targets on a national level, and will require action by each Member State of the European Union. Member States must achieve a minimum annual energy savings target of 9% by the ninth year in the period from 2008 to 2016. In line with this, each national government will have to produce energy efficiency action plans (EEAPs) in 2007, 2011 and 2014.

Extracted from http://www.eceee.org/EEES/

A couple of years ago, the International Energy Agency (IEA) published a review of 30 years of energy policy.[1] The report shows that energy efficiency alone has contributed more to delivering energy services than any single source of energy supply. Similar newer studies show the same thing. In the McKinsey report[2] on mitigating climate change, a host of energy efficiency measures come out as the cheapest, most cost-effective measures to reduce carbon emissions (admittedly, a few are also expensive, this is clear, but on average, energy efficiency is cheapest).

However, one problem with many such studies is their strong focus on cost efficiency of each measure. Cost efficiency is important, but very often an analysis will miss the synergy effects by focusing on the cost efficiency of each single measure. One good example is energy efficient windows: the prime reason for installing them may not be energy efficiency at all, but the need for sound proofing. Sound proof windows can be installed that are not particularly energy efficient, but the energy efficiency features often come at a low additional cost if the first cost is

[1] http://www.iea.org/textbase/nppdf/free/2004/30years.pdf

[2] http://www.mckinsey.com/clientservice/ccsi/pathways_low_carbon_economy.asp

already borne. One typical example is a listed house in Stockholm that was renovated a few years ago. The city demanded that the original windows were kept. The windows were taken to a workshop and fixed. Had the building owners chosen to replace one glass pane with low emission glass at that time, the payback would have been fairly short: now, the next window of opportunity will not open for another 30 years or so.

2.4.2 Summer Studies

Luckily enough, energy efficiency is more and more becoming a mainstream activity. One sensor for this is the Summer Studies on energy efficiency, organised by eceee, the European Council for an Energy Efficiency Economy,[3] in the early summer of every odd year. Since 1993, the eceee Summer Studies have advanced the frontiers in energy efficiency policy, research and implementation. The Summer Study is Europe's premier, interdisciplinary event on energy efficiency. The event provides a full working week of formal, yet straightforward sessions and informal meetings. Here, more than 300 participants exchange ideas in a relaxed but intensely intellectual atmosphere, have lively discussions and come up with creative ideas.

The heart of the Summer Study is the presentation and discussion of peer-reviewed papers in parallel panel sessions. Posters are presented in a session attended by all participants. Keynote speakers address plenary sessions and participants can organise informal sessions in the afternoons. The 2007 Summer Study proved that energy efficiency really has become a mainstream activity. We, as an energy efficiency community, are now beyond the discussion whether there really is a savings potential and if it is cost-effective (Fig. 2.4.1).

Today, the discussion has come focus much more on how the possible energy savings should be realised:

– There is a shift in the focus from efficiency to total consumption (already in 2003, the theme of the Summer Study was "Time to turn down energy demand").
– There is a much stronger focus on government regulation today and the fact that both industry and government have separate, distinct but supporting roles in the implementation.
– There are three major Directives in place in Europe – the Buildings Directive, the Eco-design Directive on Energy-using Products, and the Energy Services and End-use Efficiency Directive – on which everybody needs to take action, which has further raised the interest for efficiency. In addition, the labelling Directive is being revitalised and the Energy Performance in Buildings is up for review.

[3] www.eceee.org

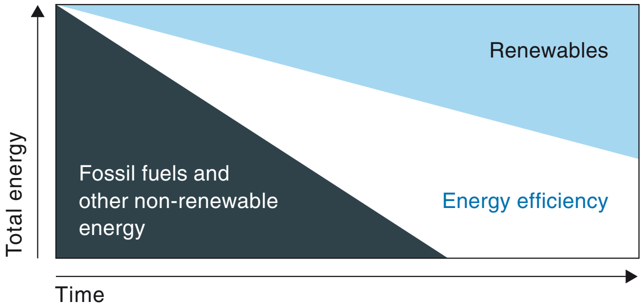

Fig. 2.4.1 Energy efficiency provides us with the time needed to replace fossil fuels and other non-sustainable energy sources with renewables in an ecological, economic and socially responsible manner (Image source: eceee) (see *Color Plates*)

There is, however, still a risk that this remains a political and rhetoric figure if the insights are not transformed into knowledge and actions (the theme of the 2005 Summer Study was "What works and who delivers?"). In other words, we have to go through the "tipping point" – the time when ideas, such as the need to pursue energy-saving measures more aggressively, become the accepted norm.

We, as the energy efficiency community, need to move our focus from justifying energy efficiency and examining the barriers to activities focussed on deployment of energy efficiency measures accompanied with a cultural change to attitudes on sustainable energy in all sectors. We also need to repeat, over and over again, our story that new supply, even if from renewable sources, does not serve any purpose if it is feeding wasteful use. Energy efficiency is the cornerstone of a sustainable society. The 2009 edition of the Summer Study will have the theme *Act! Innovate! Deliver!* This theme will be as valid in 2019 as it is in 2009.

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European Council for an Energy Efficient Economy (eceee) – eceee is a non-profit, membership-based European NGO. The goal of eceee is to stimulate energy efficiency through information exchange and co-operation, and to promote the understanding and application of energy efficiency in the energy research, policy and commercial organisations. eceee provides an information service through its *website and e-mail newsletter, arranges workshops and conferences, and takes active part in the European policy making process. One of eceee's principal events is the Summer Study, held for 5 days every odd year in the early summer. The Summer Study attracts more than 350 participants and offer governments, industry, research institutes and citizen organisations a unique resource of evidence-based knowledge and access to reliable information. For more information, please see* www.eceee.org

Chapter 2.5
Policy Design for Sustainable Integrated Planning: From Local Agenda 21 to Climate Protection

Francesco Musco

Abstract Recent history of town and city planning shows growing attention is given to environmental policies in this field, despite many apparent contradictions when comparing theory and actual practices. Sustainabilty issues and new systems of public governance, based on participatory and inclusive schemes, particularly characterise the last decade of urban planning culture. Many experts are indicating that local dimensions of sustainability have a prominent role to play in planning systems – a perspective supported by the United Nations (UN) since 1992 with the recognition of the Local Agenda 21 (LA21) concept. This article underlines that know-how introduced by LA21 at the local government level can be a useful start-up point for climate protection planning and, in particular in terms of changing peoples' attitude, can play a defining role in developing effective policies for climate change mitigation and adaptation in the urban context.

Keywords: Bottom-up approach • climate protection planning • Energy Descend Action Plan (EDAP) • governance • indicators • lifestyle • Local Agenda 21 (LA21) • planning instruments • policies • sustainable city • urban planning

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2.5.1 Designing Policies for a Sustainable City

What will our cities look like in 50 years' time? And in a century? Will urban planning have provided urban structures that are compatible with the new climate scenario? Which adaptation and mitigation strategies will characterise planning and management of urban areas? For about 2 decades the 'sustainable city' idea has played a relevant part in the scientific debate, but strategies developed for urban areas continue to ignore the growing scarcity of natural resources and the impact of human activities on eco-systems and the climate.

'Planet fever', as climate change is sometimes called, implies that cities have become the most relevant place where change and conflict is likely to occur, as most people now live in cities and the influx of new citizens continues. Competition for resources is unavoidable at this rate and systems will become overburdened. By 2025 there will be more than five billion people living in urban areas – in 135 metropolitan areas the number of residents is expected to exceed four million inhabitants per city. Cities are responsible for 75–80% of global greenhouse gas (GHG) emissions (Satterthwaite 2008). For this reason GHG inventories are required, to identify where emissions come from and to define proper policy for reduction and compensation (Willson and Brown 2008).

Even if the debate on the 'best' sustainable urban model remains controversial, it is possible to for an improved general public awareness to ensure change in the characteristics of urban life quickly. The comprehensive concept of sustainability has attracted policy makers and citizens alike, from a wide range of backgrounds and disciplines. The concept has evolved over time, and many of the meanings today are quite different from those of 2 decades ago. The possibility to achieve sustainability in the urban context is still controversial. Lee (2006) considers the transition to sustainable cities to be 'unimaginable'. Yet, Local Agenda 21 (LA21) and other instruments related with environmentally responsible actions are moving into the direction of sustainability: these aim to protect the ability of future generations to satisfy their needs, while permitting those who live now to also meet their needs. This seems to be an oxymoron.

Without offering a final definition of a 'sustainable city', it is important to state that it should include the approach in a city to work hard at promoting some operational version of sustainability. A sustainable city is holistic, outlined as a complex unity and not just the sum of separate parts (neighbourhoods, services, infrastructure, public spaces, etc.). Any urban activity can not be considered as sustainable if it satisfies only one area of sustainability (environment, economy, society). An environmentally friendly and technological advanced project is not sustainable if it needs high costs and access is limited to only a part of population that can afford to use the new facility. Many new neighbourhoods in European cities – built from a sustainable perspective – use the most advanced building techniques, but are often unaffordable for the 'normal' citizen. From this perspective an intersectoral approach to urban policy is a *sine qua no* condition to guarantee sustainability. The sustainable city is participatory based, defines new scenarios of development and shares them with its inhabitants. Implementing a sustainable urban policy requires permanent strategies to take decisions with the local community – a permanent shared decision process, not to be confused with any form of periodical information meetings, campaigns, and so on.

Public actors have to redefine their role, because anyone involved in the process of climate change mitigation, including inhabitans, is called on to take up responsibilities towards themselves, others and future generations. Different behaviour and lifestyles, leading to much reduced carbon dioxide (CO_2) emissions, must be developed in cities, and the urban context should be prepared to encourage this. Here planners and systems architects (should) play a fundamental role in defining and monitoring climate protection policies for the built environment. The idea of a sustainable community implies an understanding of the importance of individual human behaviour, and of the local context in which that behaviour takes place (Portney 2003).

But what does it take for a city to become sustainable? A few elements are mentioned: peoples' desire to make their city sustainable, and a strong commitment to reorient policies by the local government. Other elements that support this tendency, such as social, economic and physical resources, will follow. Even the 'political will' to support sustainability – which may be quite elusive and difficult to obtain – can be supported if a popular desire for sustainability is present and evident. Indeed, those who control 'political will' in a city are strategically placed in providing leadership necessary to maintain the broad-based desire necessary to achieve and retain a city's sustainability.

LA21 has played a prominent role in European cities outlining sustainable planning and environmental policies over the last 15 years. In fact, during the course of the 1990s many governments produced national reports on sustainable development, often supported by an Agenda 21 strategy at the national level – also indicating a new way of government for towns and cities. In this sense the bottom-up approach introduced by the LA21 processes encouraged local authorities to define more participatory and holistic policies, especially in the European context. According to one of the first definitions, Local Agenda 21 is a participatory, multi-sectoral process to achieve the goals of Agenda 21 at the local level through the preparation and implementation of a long-term, strategic action plan that addresses priority local sustainable development concerns (ICLEI 1996).

Evident connections appear between actions previously taken locally towards sustainability and forthcoming polices to be implemented towards a new climate scenario. Cities and towns play a key role in governance that can be much more effective when considered from a long term perspective and with a strategic approach. Innovation in policy design, introduced within local governments by the LA21 process, represents a valuable heritage for policy-makers. This is clear when one sees that the presence of previously established LA21 or similar strategic planning initiatives have had in general positive influences on the successful implementation of climate protection initiatives. At the same time, innovation has provided a growing autonomy of local governments in defining policies for urban sustainability, and has given a prominent role to policy design to city government. It has provided a perspective of greater authonomy from the upper levels of government.

During the mid-1990s the concept of sustainability indicators has been introduced as a measure to establish some kind of rigour within the evaluation process of sustainability achievements. The results have not been always positive. The outcome tended to fragment the overall focus through a technical exercise that attempted to assess the state of the environment without a clear reference to the practical steps taken.

The challenge of achieving sustainability is demanding new styles, even systems, of participatory governance and civic engagements accross all spatial scales. LA21, which had a great influence on education systems, also inside school systems (Musco et al. 2000), can contribute to this. It calls for action across all sectors of governance, including the international arena, but with a particular emphasis on the local or subnational level. A further element introduced by LA21 is the need for involvement and partnerships between a range of stakeholders and community groups in the development and implementation of any decision process. The experiences of these areas can add value to further developing styles and systems.

The 10 Aalborg Commitments, signed by a number of European local governments since 2004, support moving towards European community sustainability. It guides this self-activity of local governments, but also highlights a relevant gap between local action and the failure or absence of effective supporting national frameworks. At the beginning of 2009 approximately 6,000 local governments accross Europe had started some form of sustainable development process, more than 2,500 had signed the Aalborg Charter and around 600 included the Aalborg Committments in their policy-making processes.[1]

Since the start of LA21, the urban roll-out of ‘sustainability’ has created difficulties for policy makers. This can be explained as a twofold problem: on the one side there are protection and improvement needs required by the environment and human society; on the other hand there are limited public budgets in terms of expediture to support the costs of sustainable development, which requires a potential higher investment than ‘normal’ development, especially in early phases. This is related with the need to improve skills and know-how of public authorities, and to provide proper investments in terms of built environment (e.g. the beginning higher costs to realise fossil free buildings).

The differences between the number of theories on sustainable development and actual practices according to which cities are planning are relevant. The monitoring of the actual impact of sustainability declarations – e.g. in terms of saved resources or CO_2 emissions avoided – has been quite weak in many cases, especially in southern Europe. Many European cities can be regarded as essentially unsustainable at this stage. Yet one can determine that the introduction of the climate issue in sustainability policy development is supporting efforts of both local and other levels of government. In a certain sense the definition of the scope of initiatives for local sustainability – protecting the climate in this case – puts at the forefront the real

[1] A complete list of the Aalborg Commitments Signatores is available on www.aalborgplus10.dk

issue (sustainability). In other words, where the general aim to reach sustainable development remains vague and open to infinite interpretations, a sustainable policy for climate protection is clear to the policy maker as it has a (perceived) final scope. The general purpose to reach sustainability, is often a concept public decision-makers regard as equivalent to 'environmental protection' or simply'environmental attention' – and not in any positive sense.

2.5.2 Climate Protection and Cities: From Global Issue to Local Governments Commitment

The most recent report of the Intergovenmental Panel on Climate Change (IPCC) (2007) concluded that the warming of climate system is taking place, as is evident by empirical observation, such as increasing average temparatures of the air and oceans, as well as melting snow and glaciers, in turn with consequences on rising sea levels.

Climate protection is a controversal concept. The climate can not be protected, at least with direct actions. It is not possibile to activate any strategy to stop a sudden and violent atmospheric phenomenon; no technology is available to avoid glaciers melting or rstore them when they disappear. In fact the role of technology in this field is limited to specific sector of action (refer Table 2.5.1 below). Climate protection can be defined as the group of indirect policies of adaptation and mitigation finalised to reduce impacts of climate change on natural and anthropic systems on the one hand; and the reduction of all environmental externalities contributing to climate mutations in the medium to long term on the other. It can be referred to as a range of policies already used by public bodies at all levels, with the additionality needed for improving these, coordination and joint implementation of mitigation and adaptation policies, according to a strategic approach able to relate different levels of management, sectors as well as actions and actors.

The impacts will be seen in events, environmental conditions connected to climate change manifesting in damage of infrastructure and housing, stress on public facilities and emergency services, increasing incidence of diseases, and damage to agriculure (IPCC 1998). In some cases it will also be difficult to distinguish between the impacts of climate change and adaptation to climate change. For example, the abandonment of coastal areas because of a rising sea level, or the increase of health care expenses related to certain changes in weather and temperature could be considered both an impact of and adaptation to climate change – reactions of people and the environment to the new climate scenario (EEA 2008).

Climate mitigation policies (as presented in Fig. 2.5.1) may promote sustainable development when these are consistent with broader societal objectives. Some mitigation actions could also favour extensive benefits in areas outside of climate change, for example actions could reduce health problems; increase employment opportunities; reduce negative environmental impacts (e.g. air pollution); protect forests, soil and watershed; reduce subsidies and raise taxes on actions which cause

Table 2.5.1 Main technologies for climate change mitigation (Adapted from IPCC 2007)

Sector	Key mitigation technologies and practices currently commercially available	Key mitigation technologies and practices projected to be commercialised before 2030
Energy supply	Improved supply and distribution efficiency; fuel switching from coal to gas; nuclear power; renewable heat and power (hydropower, solar, wind, geothermal and bioenergy); combined heat and power; early applications of CCS (e.g. storage of removed CO_2 from natural gas).	Carbon capture and storage (CCS) for gas, biomass and coal-fired electricity generating facilities; advanced nuclear power; advanced renewable energy, including tidal and wave energy, concentrating solar and solar PV.
Transport	More fuel efficient vehicles; hybrid vehicles; cleaner diesel vehicles; biofuels; modal shifts from road transport to rail and public transport systems; non-motorised transport (cycling, walking); land-use and transport planning.	Second generation biofuels; higher efficiency aircraft; advanced electric and hybrid vehicles with more powerful and reliable batteries.
Buildings and built environment	Efficient lighting and daylighting; more efficient electrical appliances and heating and cooling devices; improved cook stoves, improved insulation; passive and active solar design for heating and cooling; alternative refrigeration fluids, recovery and recycle of fluorinated gases.	Integrated design of commercial buildings including technologies, such as intelligent meters that provide feedback and control; solar PV integrated in buildings.
Industry	More efficient end-use electrical equipment; heat and power recovery; material recycling and substitution; control of non-CO_2 gas emissions; and a wide array of process-specific technologies.	Advanced energy efficiency; CCS for cement, ammonia, and iron manufacture; inert electrodes for aluminium manufacture.
Agriculture	Improved crop and grazing land management to increase soil carbon storage; restoration of cultivated peaty soils and degraded lands; improved rice cultivation techniques and livestock and manure management to reduce CH_4 emissions; improved nitrogen fertilizer application techniques to reduce N_2O emissions; dedicated energy crops to replace fossil fuel use; improved energy efficiency.	Improvements of crop yields.

(continued)

Table 2.5.1 (continued)

Sector	Key mitigation technologies and practices currently commercially available	Key mitigation technologies and practices projected to be commercialised before 2030
Forestry/forests	Afforestation; reforestation; forest management; reduced deforestation; harvested wood product management; use of forestry products for bio-energy to replace fossil fuel use.	Tree species improvement to increase biomass productivity and carbon sequestration. Improved remote sensing technologies for analysis of vegetation/ soil carbon sequestration potential and mapping land use change.
Waste	Landfill methane recovery; waste incineration with energy recovery; composting of organic waste; controlled waste water treatment; recycling and waste minimisation.	Biocovers and biofilters to optimize CH_4 oxidation.

GHGs; and induce technological change and diffusion. These could also contribute to the wider goals of sustainable development. Similarly, development paths that meet sustainable development objectives may result in lower levels of GHGs, and the synergies are worthwhile exploring.

A small number of impact assessments have now been completed for scenarios in which future atmospheric concentrations of GHGs are stabilised. Although these studies do not take full account of uncertainties in projected climate under stabilisation, they nevertheless provide indications of damages avoided or vulnerabilities and risks reduced for different amounts of emissions reduction.

To introduce the concept of adaptation it can be useful to refer to the definition of ecosystem resilience. Ecosystem resilience is defined by the Resilience Alliance[2] as 'the capacity of an ecosystem to tolerate disturbance without collapsing into a qualitatively different state that is controlled by a different set of processes. A resilient ecosystem can withstand shocks and rebuild itself when necessary. Resilience in social systems has the added capacity of humans to anticipate and plan for the future'. According to Folke (2006), the concept of resilience in relation to social-ecological systems therefore incorporates the idea of adaptation, learning and self-organisation, in addition to the general ability to contrast disturbance.

In the climate change discourse, adaptation policies permit the management of inevitable (foreseen) impacts. Both in natural than in human systems, adaptation has the aim to increase the resilience of these systems in relation to future impacts of climate change. According to the IPCC (2007) adaptation consist of an 'adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory, autonomous and planned adaptation'. It is a range of trans-sectoral and cross-border policies requiring integrated

[2] www.resalliance.org

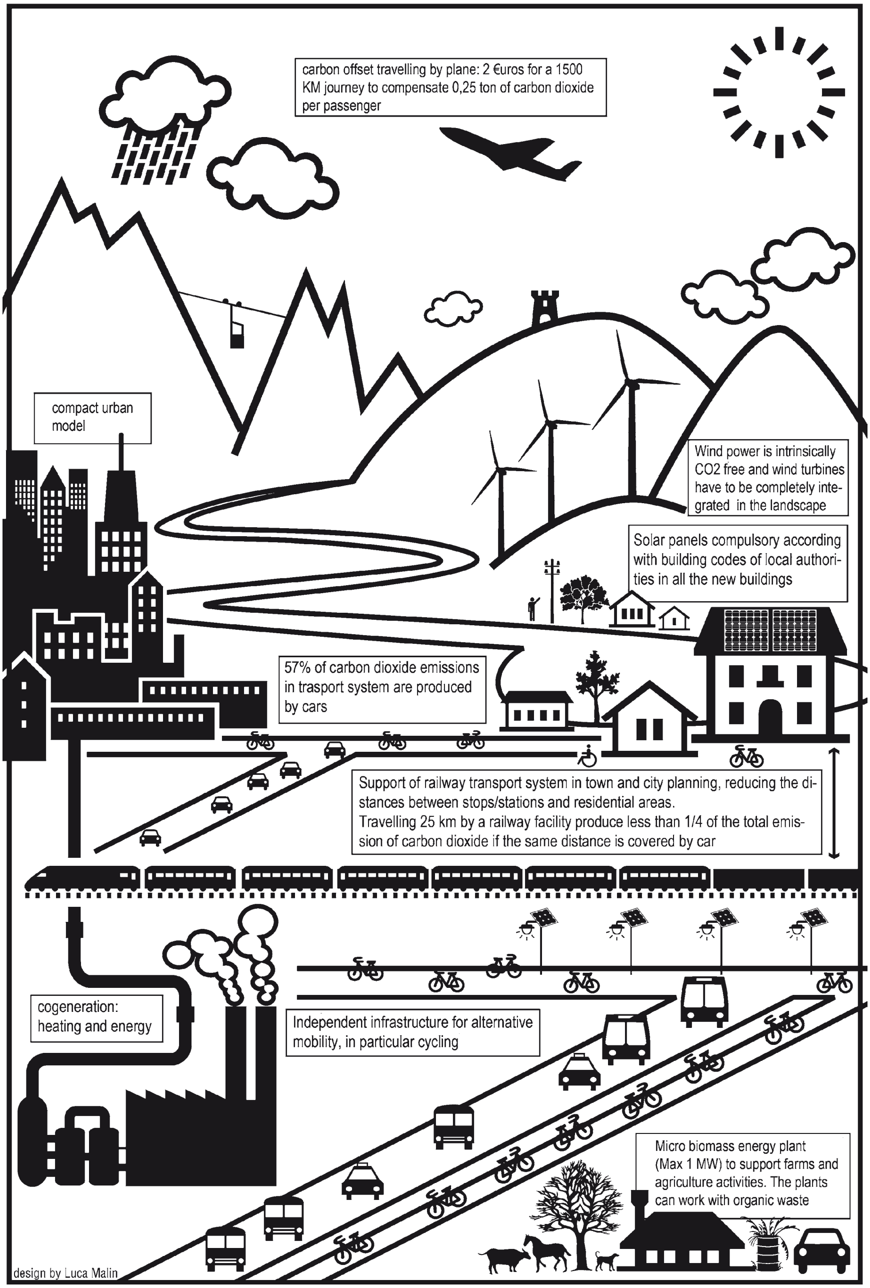

Fig. 2.5.1 Mitigation policies are oriented to reduce the future impact of climate change. These are mainly based on the limitation of CO_2 emissions from any possible source, or, alternatively, determine proper compensation procedures (elaboration of the author, design Luca Malin)

approaches. Integration of such policies represent a fundamental point to reduce vulnerability of ecosystems, economic sectors, landscapes and local communities.

The potential of adaptive responses available to human societies is quite large, ranging from purely technological (e.g. sea defences), through behavioural (e.g. altered food and recreational choices) to managerial (e.g. altered farm practices), to applied policy (e.g. planning regulation systems). While most technologies and strategies are known and developed in some countries, the assessed literature does not indicate how effective various options are to fully reduce risks, particularly at higher levels of warming and related impacts, and for vulnerable groups. In addition, there are formidable environmental, economic, informational, social, attitudinal and behavioural barriers to implementation of adaptation.

Impacts can be divided into two groups: the atmospheric events and related consequences. Atmospheric events can be differentiated according with the kind of effect on thermal condition (increase of average temperature) and changing frequency and/or intensity of extreme events (such as storms or hurricanes). Indirect impacts are directly connected to these two categories. Sea level rise or prolonged middle seasons result from changing average temperature. Increased flooding frequency is directly caused by more intensity rainfalls. Then, if both processes are put together, it might increase the impacts. Increased storm frequency on a certain coastline, together with a higher sea level increases the risk of coastal flooding, that in certain condition can become also permanent. Climate change has accelerated during the past decade and one can reasonably assume that it has already caused important damage in European regions and current evolutions are potentially threatening territorial and environmental balance. The most damaging impacts of climate change are flooding, drought and storms/hurricanes all events that can modify radically the live in urban areas (IPCC 2007).

The costs of the impact of climate change on the built environment are immense, but more relevant is the cost of delays to define proper adaptation policies, both globally and locally (EEA 2008). Usually the attention of scientists and academics in relation to climate change is focussed on global impacts and economic costs at the macro scale. Yet the effects of new climate tendencies are experienced 'locally', meaning often in a built environment setting, which is relevant role both for people in everyday life and for policy makers and public administrators.

Local governments often have relevant control and responsibilities on the main sources of pollution in their communities:

- Energy generation, distribution and use
- Buildings
- Transportation
- Waste management
- Water management

Often local governments directly produce or are (co-)owners of energy plants, and operators/shareholders of transport and waste service provider companies. They own a large number of buildings and offices, and can manage social housing and educational facilties – either directly or through a management agency. These areas can usually directly be influenced from a corporate (municipal) sector perspective. In the case of small municipalities there tends to be a more limited means, be it legal, financial or due to a lack of own infrastructure, but they can increase their options for action significantly through strategic climate cooperation. Local governments often control or influence many of the day-to-day activities in their communities that determine the amount of energy used and waste generated. This could include land use and zoning decisions, control over building codes and licenses, infrastructure investments, municipal service delivery and management of schools, parks and recreation areas. These decisions can help to drive and regulate change among citizens, businesses and industry.

Local governments are usually responsible for primary and, in some countries, secondary education, where influence on attitudes and behaviour of inhabitants is quite relevant. They can play an active role in raising awareness on the need to reduce GHG emissions, positively influence change and encourage citizen behaviour that directly affects climate change such as choosing less polluting transportation options, changing energy consumption patterns and general consumer decisions. Again in these cases, where many smaller municipalities cooperate, they can be as prepared and efficient as larger towns and cities, and can also motivate and guide the regional government level (province or state) to have a widespread impact. A large number of government reports have indicated the planning system as the crucial part of public policies to forestall consequences of climate change in the built environment. Including climate mitigation and adaptation aspects into planning procedures, permits early action which can be more cost-effective than any solution applied after changes have already happened (Wilson 2006).

There is a growing movement of local governments working to permanently include climate change in local agenda, facilitated by the creation of three transnational networks namely Climate Alliance and Energie-Citès with members concentrated in Europe, as well as the international organisation ICLEI – Local Governments for Sustainability with its Cities for Climate Protection™ (CCP) Campaign. In Italy a similar action is promoted by the Italian Coordination Local Agenda 21,[3] a non-profit association created by a voluntary network of local governments involved in LA21 processes, both municipalities and provinces. The Italian situation is still controversial because the efforts of public authorities to define policies for climate protection are not in proportion to the outcomes. At the national level there is no comprehensive national adaptation strategy as yet, and initiatives of local authorities remain separate from the national government – this lack of integration and coherency leads to inefficiency.

From the side of the European Union (EU), the commitment in terms of sustainability and quality of urban enviornment started in 1990 with the Green Paper on the Urban Environment, and continued during the 1990s with different documents produced. Among these also by the EU Expert Group on the Urban Environment, drawing attention of policy makers towards integrated visions for sustainability in the built environment. The main steps, adoped after 2000, provide operative indications to Member States to integrate different policies for the urban and natural environment (see Table 2.5.2 below).

[3] www.a21italy.it

Table 2.5.2 Main steps of EU policy for sustainable development and climate protection (http://eur-lex.europa.eu 2009)

Year	Document/strategy	Main contents
2001	A Sustainable Europe for a Better World: A European Union Strategy for Sustainable Development (Commission's proposal to the Gothenburg European Council) – COM(2001) 264	Cross-cutting proposals and recommendations to improve the effectiveness of policy and make sustainable development happen. This means making sure that different policies reinforce one another rather than pulling in opposite directions. Steps to implement the strategy and review its progress.
2002	Towards a global partnership for sustainable development – COM(2002) 82	Ensure that globalisation contributes to sustainable development, providing incentives for environmentally and socially sustainable production and trade. Renewable energy resources, as well as energy savings and improved energy efficiency play an important potential in terms of sustainable development.
2004	Towards a Thematic Strategy on the Urban Environment – COM(2004)60	
2005	Review of the Sustainable Development Strategy – A platform for action – COM (2005) 0658	The EU will seek commitments to cut greenhouse gas emissions further, beyond the end of existing commitments in 2012, by developing proposals and working towards broader international agreements that cover all greenhouse gases and sectors, encourage innovation and include measures for adaptation. The EU will develop future climate policy through the second phase of the European Climate Change Programme, working with stakeholders to develop new actions to systematically exploit cost-effective options, covering for example cars, aviation, technology development and adaptation
2006	Communication from the Commission to the Council and the European Parliament on Thematic Strategy on the Urban Environment – COM (2006) 16	Adopting an integrated approach to the management of the urban environment helps avoid conflicts between the range of policies and initiatives that apply in urban areas and helps achieve a long-term vision for the development of the city. In addition to the voluntary initiatives Local Agenda 21 and Aalborg Commitments several Member States have legislated or put mechanisms in place to require integrated management of the urban environment.
2007	Green Paper from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions – Adapting to climate change in Europe – options for EU action – COM (2007) 849	Green Paper examines climate change impacts in Europe, the case for action and policy responses in the EU. It focuses on the role of the EU, but takes account of the prominent role of Member State, regional and local authorities in any efficient adaptation strategy. As the adaptation challenge is global by its very nature, the Green Paper also raises the external dimension and looks at adaptation measures in Europe that could also apply to other parts of the world, and the opportunity for the EU to provide international leadership in this area

(continued)

Table 2.5.2 (continued)

Year	Document/strategy	Main contents
2009	White Paper_ Adapting to climate change: Towards framework for action – COM (2009) draft document	It represents the first operative policy document dedicated exclusively on climate protection initiatives. The document set out a framework to reduce EU's vulnerability to the impact of climate change on the base of the discussion and consultation launched with the Green Paper in 2007.

In 1997 sustainable development became a basic objective of the EU with its inclusion in the Treaty of Amsterdam as a general objective of all EU policies. After the Gothenburg Summit in June 2001, EU leaders proposed the first EU sustainable development strategy based on a proposal from the European Commission (EC). This first complete strategy was composed of two main parts. In the first it policy measures and instruments were proposed to tackle a number of key unsustainable trends; in the second part, definitely more ambitious, a new approach to policy-making was called for to ensure the EU's economic, social and environmental policies mutually reinforce each other. The central instrument developed for this purpose was the obligation for the Commission to submit each new major policy proposal to an Impact Assessment. The EU added a third, environmental dimension to the Lisbon Strategy of economic and social renewal. These two strategies are complementary.

The Gothenburg declaration formed the core of the EU's policies towards sustainable development. But these also encompassed other programmes and commitments, such as the Millennium Development Goals (MDGs) agreed on in 2000 and the commitments made at the 2002 World Summit on Sustainable Development (WSSD) in Johannesburg, as well as global pledges to increase official development aid and to take account of the needs of developing countries in international trade. The strategy sets overall objectives and concrete actions for seven key priority challenges for the coming period until 2010, many of which are predominantly environmental:

- Climate change and clean energy
- Sustainable transport
- Sustainable consumption and production
- Conservation and management of natural resources
- Public health
- Social inclusion, demography and migration
- Global poverty and sustainable development challenges

Recently the EU (2009) published the White Paper, Adapting to Climate Change: Towards an European Framework for Action. The document identifies the main aspects of vulnerability in European areas to the impact of climate change and indicates the reasons to define urgenly an adaptation strategy at EU level. The

White Paper outlines the main sectors suffering from forecast impacts of climate change in the continent, including:

– Human health and well-being because Europe is experiencing more extreme climate events, and weather related diseases could increase
– Water: the quality and amount of water resources is a basic issue in the context of a changing climate
– Agriculture: the impact on crop yields, livestock management and the location of production will be relevant
– Energy: supply and demand will be affected by the new climate scenario, especially because of the increase of energy need for cooling during warmer summer periods, and the possibility of damage to the electricity distribution network because of intensive storm and other atmospheric phenomena
– Infrastructure: possible damage to public infrastructures and facilities may affect economic and social development of EU countries.

The EU is working on an online knowledge management tool (EU Clearing House Mechanism) to share and manage information on climate change impacts, vulnerabilities and best practices on adaptation, introduced by the White Paper on adapting to climate change. This will be an important knowledge source for cities to tap into. Some countries have developed national adaptation plans, and all EU-27 Member States are now required to do so. These will also provide valuable guidance also for cities, although this level of government is in most cases excluded from deliberations in developing the actual plans. The advantage of being part of the EU is that cities not so experienced in terms of knowledge and resources for climate protection can gain support. At this stage, improvement in the exchange of experiences and best practices among cities would be very valuable to improve continuoius support and guidance.

At the urban scale, burdens and benefits of climate change are not equally distributed (EEA 2008). For example the type and location of threats will lead to significant economic loss, as some cities will suffer extensive negative impacts while others will benfit from more positive effects. In the built environment climate change will contribute to social differentiation, as in the most cases poor people live in less favourable areas with an accompanying higher threat potential (e.g. closer to rivers with a larger danger of flooding). They also do not have the resources to adapt their situation according to the (expected) effects of climate change, or to handle impacts.

Climate change is expected to increase the occurence of the urban heat island (UHI) effect – where air temperature in cities rises disproportionately to the surrounding areas and results in locally acute adverse impacts on human health, as well as economic and environmental impacts (Cobyrn 2009). The UHI can create differences of temperatures up to 7 degrees Celsius (°C) between centers of large urban areas and surrounging urban areas – a phenomenon that will surely increase with expected heatwaves during the summer. The consequences include more deaths during heat waves, as well as increased health problems as a result of additional particle emissions during droughts, increased ozone and decreased air quality.

An intensification of the distribution and spread of infectious diseases has also been demonstrated and will intensify. The other consequence is that to the economy. The Stern Review (2006) argues that if no action is taken, the general costs and risks of climate change will be equivalent to losing at least 5% of global gross domestic product (GDP) each year worldwide. In contrast, the costs of action – reducing GHGs to avoid the worst impacts of climate change – can be limited to around 1% of global GDP each year.

The current consumption framework and lifestyles contribute to climate change, threating the ecological, economic and social basis of our quality of life. Different European cities have started programmes to support the orientation of their citizens towards behaviour characterised by lower carbon dioxide emissions.[4] A similar bottom-up initiative has been promoted by the movement of *Transition towns*. Based in UK – now with many members around Europe, USA, Australia and New Zeland – the movement developed its approach from the fact that the world has been reached the peak oil point. This means that oil and oil derivates will be available in a reduced quantity and at a higher price per unit from now on. The only alternative is the progressive increase of independance from fossil fuels and the reduction of our ecological footprint (Chamberlin 2009). The working program of a transition community is based on an Energy Descend Action Plan (EDAP)[5] – often called a pathway or vision. This is a document starting from a complete analysis of resources in the area, including agriculture fields, transport systems, health, renewable energy sources, and building techniques. Transition is implemented through a new relationship between different levels of government and the definition of environmental policies to transit towards an 'oil independent' society.

Generally speaking climate change provides an opportunity to accellerate 'green economy' implementation and create new opportunities for stimulating the local and regional economy, wirh new jobs linked to the market development for energy efficiency and renewable energy technologies and measures. The vulnerability of cities and increasing awareness on this, are driving forces to find alternative solutions for adaptation to climate change, and at the same time ensure good quality of life. Financial benefits from a shift towards the development of new technologies could, at least in part, compensate for the costs of necessary changes in production and consumption (EEA 2009).

[4]For example, the City of Venice promoted an experiment in 2005 called 'Cambieresti? Consumption, environment and lifestyle' involving 1,000 families in a project that was part of the Local Agenda 21 process to analyse and modify their behaviour in term of consumption, mobility, food habits. The initiative has been implemented by a number of small and medium sized local authorities in Italy, and was promoted at the European level through the Intelligent Energy Europe project Echoaction. An article on Cambieresti? developed by the municipality of Casalecchio di Reno, in the Bologna area is part of this publication.

[5]Not only towns have developed an EDAP and instruments for a comprehensive policy for fossil fuel independence, for example, Portland in Oregon recently published an EDAP for all the sectors of the city administration.

2.5.3 From Government to Governance of Sustainable Cities: Towards Climate Protection Plans

The general challenge to governance in climate policies is the effective connection between general scientific knowledge on climate change and the implementation of succesful local policies. Especially urban planners are facing two opposite emerging behaviours: on the one hand there is the globalisation of environmental polices, and on the other the decentralisation of policy development responsibilities (Corburn 2009). In this sense climate protection policies are in the near future expected to be the results of a mutual support relationship between the global theories and definition of local urban policies.

The structure of governance is based on the interaction between different levels of governments and different sectors, with the main aim to contrast fragmented decisions (Le Galès 2003), but also to strenghten each other against different kinds of power and legitimisation. Governance is a complete alternative to hierarchical control of policy making (both in the public and private sectors), and in this sense it defines a new style of government characterised by a deeper condition for cooperation and interaction between the State and civil society actors, within the decision making network. The government of a territory requires a permanent process of comparision and exchange between public and private actors (as a governance procedure), rather than being a single actor operating with the support of a specialised bureaucracy according to an own vision of the common public good.

A similar distinction is outlined by the Organization for Economic Development (OECD 2001), suggesting the substitution of the word 'government' with 'governance' when referring to territories or populations. 'Government in no longer an appropriate definition of the way in which populations and territories are organised and administrated. In a world where the participation of business and civil society is increasingly the norm, the term "governance" better defines the process by which we collectively solve our problem and meet our society's needs, while government is rather the instrument we use'. Instead the United Nations Development Programme (UNDP) (1995) proposed a definition connected with democratisation, sustainability and participation – very suitable from the perspective of local govenments – with governance as '[…] a framework of public management based on the rule of law, a fair and efficient system of justice, and broad popular involvement in the process of governing and being governed. This requires establishing mechanism to sustain the system, to empower and give them real ownership of the process'. Key factors of governance applied in local government activities are trust in the public institution proposing a new approch to manage the city, followed by the local community's control. Processes based on a governance approach can work only if these are really inclusive, if interests and point of views of involved actors play an effective role and can influence the decison making process. According to this vision, governance can be considered as the capacity of a public governing actor to clarify the stakes taken into consideration within the decision process, avoiding previously decided-on agreements and opening up of public control, Climate protection implies a multi-scaled approach to analyse how policy is defined and applied, but also how the political arena and institutional networks are considered within such policies. The main issues of climate protection arise when planning urban areas, in mobility management, the design of buildings and planning the percentage of renewable energy resources used in processes (Bulkeley and Moser 2007). Here it is evident that local governments can and have to promote new instruments to assess all local policies for any kind of impact on climate (mainly in terms of CO_2 emissions equivalent). Coherent climate protection strategies and plans can be the proper solution in this sense.

The tradition of LA21 – in particular the part of the process dedicated to the Local Action Plan – is very relevant to determine an operative institutional and societal context that is ready for applying the new instrument. Since the start LA21 had a specific weak point namely that it is a voluntary agreement that is too dependent on local politics, often only implemented due to a specific individual such as a deputy mayor or technician working for a local authority in a particular period. Climate protection can not be a voluntary based policy – its impacts are too devastating for this. It is not necessary to define an instrument to be used in all local authorites, but it is important to outline a common framework in which all institutional and private actors must play a role to respond to a common challenge. Today in this sense the situation at the European level is very different from country to country. The presence of a National Mitigation Strategy and a National Adaptation Strategy – a first possible common framework – is not at at the same stage of preparation, development and implementation among the EU-27 countries (see Table 2.5.3 below).

However, the presence of a national institutional framework is not necessarily a guarantee for success. In the USA, for example, it was possibile to outline a first generation of climate plans promoted by local authorities belonging to the same network: it is the case of ICLEI's CCP campaign and the US Environmental Protection Agency (EPA) project for GHG inventories, as mentioned by Wheeler (2008).

2.5.4 Conclusions

LA21 permitted a large number of local authorities to start and implement policies for urban sustainability. Climate protection plans can provide the impetus for the local level to place a strong emphasis on CO_2 reduction but, at the same time, to also put into practice the adaptation policy and to prepare the urban environment for anticipated climate scenarios. To avoid large differences among countries and to address common challenges, a comparable policy method is urgently needed. The presence of a National Adaptation Strategy could be a proper framework to start plans at local level and provide a suitable indication to all public authority levels.

Ideally a strong coordination role and providing know-how has to be assumed by the intermediate level of government (province, county, region), to support small and medium sized local authorities to implement effective action for climate protection. The final responsability to protect their communities lies with local authorities.

Table 2.5.3 Implementation of National Adaptation Strategies in EU members (Adapted and completed from EEA 2008)

Countries	NAS adopted	Impacts, vulnerability or adaptation assessments to develop a NAS
Austria	–	'Anpassungsstudie'
Belgium	(Expected in 2012)	SSD project
Bulgaria	–	NAPCC
Czech Republic	–	–
Cyprus	–	–
Denmark	2008 Klimatilpasnings strategi	–
Estonia	(Expected in 2009)	ASTRA project
Finland	2004 Finadapt	FINADAPT project
France	2006	GICC project adaptation au changement
Germany	2008 Klimazwei	KomPass Competence Centre KLIMZUG projects
Greece	–	–
Hungary	2008	VAHAVA project
Iceland		VO project
Ireland	Provisional National Climate Strategy 2007–2012	ERTDI programme Climate Change Research Programme (CCRP)
Italy	–	In 2007 an important national conference but no official plan or strategy adopted. Some relevant initiatives by local governments or networks (Association Local A21 Charter, Rovigo Outreach)
Latvia	(Expected in 2009)	ASTRA project
Liechtenstein	–	–
Lithuania	–	ASTRA project
Luxembourg	–	–
Malta	–	Malta Climate Change project
The Netherlands	2008 National Program of Spatial Adaptation to Climate Change	Delta committee ARK Programme –CcSP Knowledge for Climate
Norway	2008 NORKLIMA project	NORADAPT project
Poland	–	–
Portugal	–	Climate Change in Portugal: Scenarios, Impacts, and Adaptation Measures – (SIAM)
Romania	(Expected in 2009)	–
Slovak Republic	–	–
Slovenia	–	–
Spain	2006 Plan National de Adaptació al Cambio Climático (PNACC)	ECCE project Impacts on coastlines
Sweden	2009 Sweclim	SWECIA project; CLIMATOOLS project
Switzerland	–	OcCC activities
Turkey	–	–
UK	2008 Climate Change Adaptation Strategy (2008–2011)	UK National Risk Assessment UKCIP studies

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Chapter 3
Strategic framework supporting local action

Chapter 3.1
The International Local Government Climate Roadmap

Monika Zimmermann, Gino Van Begin, and Irene Vergara Cristóbal

Abstract Cities and local authorities are involved in a process aimed at incorporation in the international climate change negotiations in the months leading up to the 15th Conference of the Parties (COP 15) in December 2009, Copenhagen, Denmark. They call for a strong and comprehensive post-2012 climate agreement, as well as for greater recognition of their crucial role in contributing to global climate protection in the anticipated agreement to be adopted in Copenhagen. Such recognition could be a starting point for a new dynamic wave of local activities and action. In this context the international Local Government Climate Roadmap was initiated in Bali in December 2007, working towards COP 15 and beyond, for an inclusive and effective global climate agreement.

Keywords Conference of the Parties (COP) • international climate negotiations • local climate action • Local Government Climate Roadmap • Local Government and Municipal Authorities (LGMA) Constituency Focal Point • municipal leaders • national climate strategies • post-2012 agreement • United Nations Framework Convention on Climate Change (UNFCCC)

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3.1.1 Introduction

The UN Climate Change Conference held in Bali, Indonesia in December 2007 ended with relatively vague results and overall mixed feelings from participants. Although by now the impacts of climate change are recognised and well-documented, national delegations were only partly able to conclude this conference without extensive disappointment. They at least found agreement to move together toward a defining a new international agreement, and the 'Roadmap' from Bali to Copenhagen was launched. The new agreement would ideally be decided on and concluded at the UN Climate Change Conference in December 2009 in Copenhagen (the 15th Conference of the Parties – COP 15), with the COP 14 in Poznan in December 2008 a step to be used to further discuss issues for inclusion in this post-2012 agreement (Fig. 3.1.1).

This process is not only important to activate a new wave of international action for further climate protection, but in particular because the Kyoto Protocol will expire in 2012. With several important countries (such as the USA, China and India) not adhering to the Kyoto Protocol, and with the low targets set therein, it is clear that a stronger successive agreement is urgently needed to set up new instruments and strengthen existing mechanisms to prepare the economical, political and social arena for radical change. An extensive, coherent, and ambitious implementation plan needs to be prepared with all key actors. At this stage in the international climate negotiations, local authorities are not formally included in the process of debate and decision-making (Fig. 3.1.2).

In 2007, in an unprecedented display of unity of purpose, leading local government associations worldwide, representing communities around the globe, have embarked on a 2-year strategy – the Local Government Climate Roadmapto work for a strong and comprehensive post-2012 climate regime and to draw attention to the crucial role and interest of local governments (LGs) in climate protection.

Fig. 3.1.1 The International Local Government Climate Roadmap as a process with key events and a vision for the final outcome (see *Color Plates*)

Fig. 3.1.2 Commissioner Jantre of Thane Municipal Corporation (India) and Environmental Mayor of Copenhagen (Denmark) Klaus Bondam during the Local Government Climate Change Sessions in Poznan, December 2008 (see *Color Plates*)

3.1.2 Goals

The Local Government Climate Roadmap was launched in Bali, Indonesia in December 2007 at the Local Government Climate Sessions held in parallel to the annual United Nations Climate Change Conference the Conference of the Parties (COP). It is designed to be an accompanying process to the international negotiations leading up to COP 15 in Copenhagen, Denmark in December 2009, where the post-2012 (post-Kyoto) climate agreement shall be negotiated and hopefully adopted.

The global partners of the LG Climate Roadmap are:

- ICLEI – Local Governments for Sustainability (ICLEI)[1]
- United Cities and Local Governments (UCLG)[2]
- Metropolis[3]
- C40 Climate Leadership Group (C40)[4]
- World Mayors Council on Climate Change (WMCCC)[5]

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[1]http://www.iclei.org

[2]http://www.cities-localgovernments.org

[3]http://www.metropolis.org

[4]http://www.c40cities.org

[5]http://iclei.org/wmccc

These organisations are involved in the process, and work in conjunction with their regional and national associations, networks and partners. ICLEI acts as international Roadmap facilitator and is the Local Government and Municipal Authorities (LGMA) Constituency Focal Point of the United Nations Framework Convention on Climate Change (UNFCCC), in addition to its own Observer status, whereby ICLEI acts on behalf of Local Government facilitating dialogue with national governments and the UNFCCC Secretariat.

The main messages of the local government Roadmap thus far (early 2009) have been the following:

- Local climate action must become part of national climate strategies, to achieve coherence and reach climate protection goals.
- Municipal leaders and local governments can implement effective action on climate change as the closest government level to citizens.
- Mayors worldwide are committing themselves to reducing municipal greenhouse gas (GHG) emissions by 2050 with 60% from 1990 levels for developing countries, and by 80% in industrialized countries. This is among others done by signing the World Mayors and Local Government Climate Protection Agreement.[6]

When equipped with supportive and enabling framework conditions and corresponding funding, cities and local governments would strive to be integral actors and therefore have a substantial role in the post-2012 climate actions.

The LG Climate Roadmap is the first of its kind global action, leading a movement to connect to the international negotiation process and aiming to gain a mandate, responsibility and resources, so that local climate mitigation and adaptation work can be strengthened.

3.1.3 Local Governments as Precursors to Global Climate Protection

3.1.3.1 Starting a Process of Global Recognition

Since the beginning of the 1990s, local governments have been working together in order to develop energy saving options, new mobility concepts, environmentally responsible procurement, and other actions that address local sustainability. Yet recognition of their role in the international arena remained limited.

One of the early developments that augured a change took place in 1992. While the primary objective of the 1992 Earth Summit was to generate new commitments from national governments on global environmental issues, one of the most tangible

[6]http://www.globalclimateagreement.org also for further commitments in addition to the GHG targets.

outcomes of the summit was to focus international attention on the role of cities as central actors in the Earth's ecosystem. From the global discussion on 'Agenda 21' regarding the ecological, social and economical development process, experts predominantly came to the same conclusion that many of the UN mandates from 1992 onwards will be realised at the local government level. Here 'Local Agenda 21'[7] was also coined as a term focusing on the community level.

More recently the recognition realised on the importance of local governments in biodiversity action was gained during the UN Biodiversity Conference in 2008.[8] As a result a dynamic process was started up. The aim and process of the Local Government Climate Roadmap is similar to what happened in these cases.

3.1.3.2 Local Initiative as a Driver

Local governments are likely to show more initiative, and achieve greater success than most nations, because they can easily recognise grassroots trends, respond in an innovative manner at a faster temp than other more wieldy administrations. This also holds true for climate protection.

With climate change identified as a global phenomena and its impact becoming increasingly visible at a community level, climate protection was explicitly added to this list of actions. In this sense local governments have been able to act considerably faster to such a new challenge than the national government level. Cities and local governments have monitored and attended the international climate conferences since their commencement. Already in 1995 ICLEI – Local Governments for Sustainability,[9] with support from the German government, organised the Municipal Leaders Summit on Climate Change in Berlin, taking place in parallel to the First Conference of the Parties (COP 1). The then German Environmental Minister, Dr. Angela Merkel (currently German Chancellor) conveyed the welcome on behalf of the federal government, and Professor Klaus Töpfer spoke as the General Secretary of the United Nations Environment Programme (UNEP).

With this event a new tradition was established – when the nations meet for the global climate change debate, key representatives of local governments also come together, traditionally on invitation from the city hosting the UN Conference. These meetings are timed to ensure that local government representatives can address national government ministers in the 'High-level Segment' that occurs toward the end of the UN Climate Change Conferences, sending a key message to the attendees.

[7]http://www.un.org/esa/sustdev/documents/agenda21/index.htm

[8]http://www.iclei.org/biodiv-bonn2008

[9]In 2003, ICLE'I's Members voted to revise the organisation's mission, charter and name to better reflect the current challenges local governments are facing. The International Council for Local Environmental Initiatives became ICLEI – Local Governments for Sustainability with a broader mandate to address sustainability issues.

In this way over the past decade and more, the nations of the world were explicitly addressed on the need to focus on the role and potential impact local governments have, and could have, to effectively address climate protection. Initially the focus was on mitigation and CO_2 strategies. More recently climate change adaptation has been added to the mix.

The main message of these events has always been: 'Local governments are active, and the same is requested from national governments', linked to a second important message, namely that 'local governments can do much more for climate protection, but require improved framework conditions to act even more effectively'. Such framework conditions mean, among others, supportive legislation, financial and tax mechanisms, direct financial support and formal responsibility (i.e. mandate). In most countries, to date local governments address climate protection voluntarily.

3.1.4 Roadmap

3.1.4.1 Starting the Process

Local governments were also present in December 2007 in Bali on the invitation of ICLEI, and with the support of the main international local government associations and networks. The Indonesian administration and several UN agencies, along with 200 mayors, department heads and other high-level city representatives attended the Local Government Climate Sessions in Bali.[10] New York mayor Michael Bloomberg and the mayor from Bonn, Bärbel Dieckmann, on behalf of local governments, made the following clear during the High-level Segment of COP 13: the potential and readiness of municipal action toward global climate protection is extensive and must be rolled out on all continents. Further to this, national administrations need to recognise that they will not be able to achieve their CO_2 reduction goals without the support of local communities.

The following local government climate conferences where organised in parallel to the UN Climate Change Conferences (more details under http://www.iclei.org/climate-roadmap):

- 1995: The Second Municipal Leaders Summit on Climate Change, held alongside the First Conference of the Parties (COP 1) in Berlin, Germany.
- 1995: The Third World Mayors' Summit, held in Saitama, Japan, in preparation to COP 3 in Kyoto (1997).
- 2002: Mayors' Meeting, organised alongside COP 8 in Delhi, India – the first time in a developing country.

[10] http://www.iclei.org/bali2007

- 2004: Mayors' Meeting, taking place in parallel to COP 10 in Buenos Aires, Argentina.
- 2005: The Fourth Municipal Leaders Summit on Climate Change alongside COP 11, at the same time the first MOP in Montréal, Canada.
- 2007: Local Government Climate Sessions at COP 13, Bali, Indonesia.
- 2008: Local Government Climate Sessions at COP 14, Poznan, Poland.
- Planned for 2009: Copenhagen Mayors' Summit in parallel to the COP 15, Copenhagen, Denmark.

The participants of the Local Government Climate Sessions in Bali were part of one of the largest represented 'delegations' of the UN Conference, and yielded two far-reaching results:

- The conceptualisation and launch of the World Mayors and Local Government Climate Protection Agreement, calling on mayors (and their equivalents) as local government representatives from around the globe, and as representatives of the entire world, to reaffirm their community commitment for CO_2 reduction.
- The start of a local government process toward Copenhagen 2009, called the 'Local Government Climate Roadmap'.[11]

The latter is a process actively supported by United Cities and Local Governments (UCLG), Metropolis, ICLEI – Local Governments for Sustainability (ICLEI), the C40 Climate Leadership Group, and the World Mayors Council on Climate Change (WMCCC), together with their regional and national organizations, networks and many partners. It is an ambitious process working towards COP 15 in Copenhagen in December 2009, and to have an impact beyond this eventan impact aimed to accelerate global climate protection through local action.

Such a global collaborative political process of local authorities has not occurred until now. With this new dynamic approach the networks have started a new dimension of intervention from cities and municipalities in international negotiations. Why? Because local authorities, in a very real, yet dramatic sense, will bear the brunt of a changing climate. Local authorities have a responsibility towards their citizens, to protect them in this changing climate. They furthermore have a wide range of possibilities, for example to save energy, change the production and use of energy, reduce CO_2, and develop innovative socio-economic and political environments that support and enhance the quality of life of inhabitants.

3.1.4.2 Networks Taking the Lead

Generally, impulses from networks extend outward with a ripple effect. They tend to pick up trends and act on these to ensure that there is more concerted action, based on discussion and inclusion into processes. The following illustrates this,

[11]http://www.iclei.org/climate-roadmap

focusing on networks that have been particularly active in climate protection, either globally and/or within Europe:

- C40 is a group of the world's largest cities committed to tackling climate change. Started in 2005 as the C20, representatives of some of the leading world cities met in London on invitation of former Mayor of London Ken Livingstone and with the support of ICLEI, to discuss joining forces to tackle global warming and climate change. The group has since expanded to include 40 of the largest cities in the world, and works in partnership between the Clinton Climate Initiative.
- Climate Alliance[12] was established in 1990 with the goal to highlight the need for cities in the northern hemisphere to take on responsibility for ecosystems in the southern hemisphere, especially the rainforests. Since then Climate Alliance, with its headquarters based in Germany and offices in other European countries, has achieved very relevant impact at the local level. It has supported cities and in particular smaller communities to recognise, use and strengthen their scope of action for increased climate protection.
- Energie-Cités,[13] created in 1990 in France, is an association of European local authorities promoting local sustainable energy policies.
- EUROCITIES[14] is the network of major European cities. Founded in 1986 with offices based in Brussels, Belgium, the network brings together the local governments of more than 130 large cities in over 30 European countries. It provides a platform for its members to discuss relevant issues, and recently established a Climate Change – Air Quality – Energy Efficiency Working Group.
- ICLEI was established as an international association in 1990 at the UN Headquarters in New York. Its mission is to build and serve a worldwide movement of local governments to achieve tangible improvements in global sustainability with special focus on environmental conditions through cumulative local actions. Its headquarters are based in Toronto, Canada, with 13 regional and country offices around the globe. Already in 1991 fourteen ICLEI members joined an international model city project on climate protection. Based on results from this project, ICLEI's international Cities for Climate Protection™ (CCP) Campaign was established in 1993, and has since grown into a large global network with more than 1,000 participants today.

In a very concrete sense local communities can help to achieve national and international GHG reduction targets. And they most certainly can, and should, address climate change adaptation to improve community resilience. However, such local efforts need national and international framework conditions that facilitate and support. To this end local authorities intend to influence the international climate negotiations. On the one hand they aim for inclusion in national delegations as representatives of cities and local governments, to also have a voice at the UN level. On the other hand they are setting a clear agenda that calls for support for implementation.

[12]http://www.klimabuendnis.org

[13]http://www.energie-cites.org

[14]http://www.eurocities.org

In parallel to the COP 14 in Poznań Poland in December 2008, the Local Government Climate Sessions were organised where the most relevant issues were discussed and the draft text for a COP Decision on "Cities, Local Authorities and Climate Change" was presented.[15] This text is in the process of being changed as inputs are received, with the aim to propose a final text in December 2009 requesting that local governments are recognised in the expected international post-2012 agreement.

3.1.5 Conclusion

This process is a challenge for municipalities and the representatives of city and municipal networks. Some questions that arise in this phase, and can have a dramatic impact, are:

– Can we be innovative enough to achieve success, and give the many initiatives an incentive to cooperate in this Roadmap and beyond?
– Will we find enough common ground, i.e. positions on the many relevant topics, also regarding issues such as biofuels and nuclear energy?
– Will we be successful in incorporating all the differing starting positions from cities around the world developed countries, emerging economies and the developing world?[16]
– Will we find enough partners in national governments that will address community concerns or is the fact that the local level aims to profile itself an issue that will generate resistance from national governments, as has happened in the past with some governments?
– Will there be enough national governments, businesses, foundations and cities to co-finance this extensive discussion process?

Yet regardless of achieving the aim of the Roadmap, it is clear that everyone at the local level engaging in climate protection, as well as sustainability, can make a contribution. Some ideas for such action are listed below, and all local actors are encouraged to make use of these:

– Connect the work being done at the community level with the international process, especially by sharing news with the media (local, regional, national and international).
– Compile and share excellent examples in such a way that these can be integrated into international debates and be used for motivation of other actors (e.g. using the City Climate Catalogue,[17] developing case studies, etc.).

[15] www.iclei.org/poznan2008

[16] While in Europe climate mitigation has a defined goal, cities in countries with emerging economies are concerned about securing more energy, and others cannot see climate politics as an issue other that poverty, and those who are at the limit of their capacity are primarily fighting with the necessary strategies of adaptation and have little capacity to serve the global climate.

[17] www.climate-catalogue.org

- Start projects and programmes, and search for funding that could supports this and link it to specific campaigns and global processes (e.g. CCP Campaign).
- Cities and communities can play host to or funder of activities that promote the world-wide cooperation process.
- City associations and networks can bring together facts and arguments at their conferences and outreach options, to motivate many others.
- Scientists, experts and funders can contribute their capacity and suggestions to further improve processes and actions.
- Administrations at supra-national (e.g. EU) or national level, and the levels below this, can show their recognition of and support for the enormous community potential by engaging with local administrations in dialogue, include them in processes and improving framework conditions.
- Politicians, regardless of the level they act in, can document developments and, through participation in national processes and international negotiations, can support climate protection as a priority agenda item.

The Local Government Climate Roadmap is an exciting worldwide process, facilitated and supported by ICLEI- Local Governments for Sustainability, a worldwide local government association with more than 1,000 cities in over 60 countries. Working together with several other global organisations, as well as their regional networks and partnersand in particular their members: local governments, cities and towns across the globeICLEI helps bring forward the international Local Government Climate Roadmap as a unique development, logically following in the footsteps of pioneers of local climate protection actions and cross-border cooperation.

Monika Zimmermann *has been leading ICLEI's International Training Centre since its establishment in 1992. She has been responsible for ICLEI's global conferences, among these are events organised in parallel to major United Nations (UN) events (e.g. UNFCCC COPs, Convention on Biological Diversity (CBD) COP 9, and the World Summit on Sustainable Development). As political scientist her aim is to establish and support local government advocacy processes to unfold the potential for action and change within committed cities and towns. As coordinator of several global projects, such as the Local Renewables Model Communities Project and the Local Government Climate Roadmap in emerging economies project, she helps to build capacity within local leadership.*

Gino Van Begin *is the European Director of ICLEI, leading the ICLEI European Secretariat from its headquarters in Freiburg, Germany. In this capacity he is also responsible for climate protection work of ICLEI in Europe and with ICLEI members in the region. Trained as a lawyer, Gino provides his knowledge on international law to help shape the local government positions within the current global climate debate. As Deputy Secretary General of ICLEI he is co-responsible for ICLEI's global development and campaigns. Together with Monika, he acts as Roadmap coordinator and also supports many other local government associations in their work.*

Irene Vergara Cristóbal *studied Environmental Science at the Universidad Autónoma of Madrid. She has recently taken on responsibility for the Local Government Climate Roadmap acting in a supportive capacity to the two Roadmap coordinators, within ICLEI Europe's Climate and Air Team. As Project Officer, Irene also works on a EuropeAid co-funded project Local Governments' mobilisation and backing for the development and implementation of a global and comprehensive post-2012 climate change agreement, which will last until mid-2010. Having worked for the Local Government Climate Roadmap process, Irene has strongly supported the design of this process as well as the programme of the Local Government Climate Sessions in Poznan in December 2008.*

Chapter 3.2
The Covenant of Mayors: Cities Leading the Fight Against the Climate Change

Pedro Ballesteros Torres and Roman Doubrava

Abstract The Covenant of Mayors addresses the European Union (EU) top priority for sustainable energy action at local and regional level. The Covenant of Mayors consists of the unilateral formal commitment of the signatory cities to go beyond the EU objective of 20% reduction of carbon dioxide (CO_2) through the implementation of sustainable energy action plans. The EU institutions support the approach through a number of measures.

Keywords Benchmarks of Excellence • Covenant of Mayors • long-term policy initiative • Directorate Transport and Energy (DG TREN) • Energy Efficiency Action Plan • European Investment Bank (EIB) • EU Joint Research Centre (JRC) • Supporting Structures • Sustainable Energy Action Plans (SEAPs)

3.2.1 Introduction

The Covenant of Mayors is the most recent and most ambitious European Union (EU) initiative to encourage European cities and regions to take the lead in the fight against global warming. It consists of a formal justified commitment by cities and regions, which is endorsed and supported by EU institutions. It entails the empowerment of citizens to act in order to mitigate climate change. This effective European action is developed from a bottom-up approach.

The Covenant of Mayors addresses the EU's top priority for sustainable energy action at the local and regional level and consists of the unilateral formal commitment of the signatory cities to go beyond the EU objective of 20% reduction of CO_2, through the implementation of sustainable energy action plans.

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3.2.2 Why Focus on Cities?

The fight against climate change is a top priority for the EU. It has made a commitment to curb its CO_2 emissions by at least 20% by 2020. Climate change, we all know, is a global problem, but the solutions for this problem are predominantly found at the local level. More than 75% of European greenhouse gas (GHG) emissions are created in and by cities.

Cities are becoming the places to deliver new ideas and innovative projects against global warming. Cities are the public spaces where strategies for the use of resources are publicly debated and agreed upon, whether in the field of development of alternative energy or pollution control, energy management, or change of behaviour. Cities are also the privileged places where it is possible to find multi-cultural, cross-sector solutions, and the necessary balance and reconciliation between private and public interests.

The approach to mitigate climate change should be holistic, integrated, long-term and most of all, based on citizen participation. This complex picture is best managed at local level. Therefore, cities must become leading actors for implementing sustainable energy policies, and should be supported by the European Commission (EC) in their effort.

3.2.3 Starting This New Initiative

The Covenant of Mayors was born with this context in mind: the crucial role to be played by cities to mitigate the causes of climate change. It was launched in January 2008 and is a priority within the EU Energy Efficiency Action Plan. Its aim is that signatory cities formally commit to go beyond the EU objective of 20% reduction of CO_2 emissions, with a focus on energy conservation, energy efficiency and the use of renewable energy sources. When signing up cities agree to submit a sustainable energy action plan – planning forward to 2020, outlining the concrete measures and strategies necessary to achieve such an objective. Those Covenant cities that do not comply with these requirements will be excluded from the Covenant.

The EC endorses the actors in the Covenant. It has also established and funds the Covenant of Mayors Office – COMO, operational since January 2009, which is in charge of daily management of the Covenant. The Commission also negotiates the involvement of other actors: financiers, industry and other public administrations.

3.2.4 Step-by-Step Developments

The Covenant of Mayors was first mentioned in the EU Energy Efficiency Action Plan, approved in October 2006. The initial approach, which mainly focused on larger cities and the exchange of experiences, was quickly surpassed by policy developments. The new approach adopted for the Covenant was a consequence of the successful strategy applied by the EU at a global level, when negotiating world emission reductions. Instead of sticking to the conventional approach, 'I, Europe, will reduce my emissions if you, any country, reduces yours', the EU decided to commit unilaterally to reduce its CO_2 emissions. Then, as a negotiating tool, the EU offered to reduce even further (from 20% to 30%) emissions should world partners accept the principle of reducing their emissions. This strategy paid off: It put the EU on a high moral ground, making Europeans the leaders in the negotiation; and eventually our partners accepted the principle of limiting their emissions.

The idea was then to extend the successful global approach also within the EU borders, by proposing a Covenant of Mayors based on those principles: unilateral formal commitment to achieve quantitative objectives through the implementation of clear measures. Should the response of the cities be positive, the Covenant of Mayors would be endorsed by the EU and considered as a mainstream policy issue, led by the local governments themselves.

During the first phase research was conducted to identify relevant developments. Many statements, agreements and declarations by cities and regions were found, expressing their legitimate concern on energy and climate change, their deep commitment to take action and their willingness to share efforts and merits with other parties. But no agreement was found that covered all of the following five elements:

– The unilateralism (to make the commitments independent of the actions and decisions by other parties, namely national governments)
– The specificity (to express the objectives quantitatively; to explain the measures justifying how those objectives should be achieved)
– The acceptance of scrutiny (accepting that action plans and reports are made public and evaluated by third parties; accepting termination of their involvement in the Covenant in case of non-compliance)
– The involvement of other levels of government (the European Union, national and regional governments as supporting structures)
– The contribution of other stakeholders (banks, suppliers of urban technologies, scientific actors, support programmes, NGOs)

All these elements are deemed necessary to build a consistent long-term approach: Unilateralism as the only way of getting things done; specificity as a necessary condition for all others to happen; scrutiny as a credibility requirement, and the involvement of other actors as the crucial support to the whole scheme.

Prior to the formal launch in January 2008, the draft Covenant of Mayors was the subject of intensive and extensive informal discussions with local and regional actors, from networks and associations of cities and regions to individual cities and tows, from energy agencies to NGOs.

The EC, considering the initiative as a long-term one, was more keen on ensuring the consistency of the approach than it was on addressing shorter-term considerations. Because of that, and being well aware of the high level of requirements on the cities, it was decided that the Covenant would be launched only if a minimum of 25 cities expressed their interest to join it.

By December 2007 96 cities had sent expressions of interest, and the formal procedure to launch the Covenant was announced by EU Commissioner for Energy, Andris Piebalgs, during the EU Sustainable Energy Week in January 2008. A formal open consultation procedure ensued, which resulted in the final version of the Covenant as presented below. Since mid-July 2008, the Covenant of Mayors has been made available in all EU official languages plus Catalonian and Norwegian (and translations into other languages are accepted). Those cities and regions willing to join, need a decision on this made by their City/Regional Council, and then inform the Commission. By September 2009, more than 640 cities have joined the Covenant. The European Investment Bank (EIB), several regions and Member States, as well as many companies and programmes are also negotiating their adhesion (Figs. 3.2.1 and 3.2.2).

3.2.5 Description

The Covenant of Mayors is a result-oriented initiative, focusing on concrete projects and measurable results. The cities and regions signing up will formally commit to reduce their CO_2 emissions more than 20% by 2020. In order to do this, they will develop Sustainable Energy Action Plans (SEAPs). Both the commitment and the action plan are formal documents, which need a formal decision by the City Council or respective decisional body. The reduction of emissions needs to be calculated against a baseline emissions inventory.

Fig. 3.2.1 Mayors and Deputy Mayors at the launch of the Covenant of Mayors, February 2008 (Image courtesy of DG TREN) (see *Color Plates*)

Fig. 3.2.2 Mayors and Deputy Mayors at the 2009 ceremony in the Hemicycle (Image courtesy of DG TREN) (see *Color Plates*)

Citizens will be informed of the achievements of their respective cities through regular biannual reports, which can be monitored by an impartial third party body. Citizens are called on to participate more proactively, since local governments commit to mobilise civil society to take part in developing the Action Plan, to outline policies and measures needed to be implemented, and to achieve the objectives of the Plan. The organisation of Energy Days in the Covenant cities is another commitment aimed to involve and empower citizens in the sustainable energy action. Covenant cities also commit to share their know-how, exchange experience, envisage joint actions, spread the message and help each other – they commit to network. Last but not least, cities and regions signing up to the Covenant accept the termination of their membership of the Covenant in case of non-compliance with conditions.

3.2.6 Actors, Services and Facilities

Local governments are by no means the only actors in the Covenant of Mayors, although they are the leading agents. The EC acts, not only as initiator of the procedure, but also as its political endorser and provider of moral, technical and visibility support. It also acts as lead negotiator to attract other actors to the

Covenant. The EU Committee of the Regions (CoR) plays a key role, ensuring full political support of the initiative and co-operating with the Commission in the definition of strategies.

It is understood that the Covenant embodies the right of citizens to live in a city committed to fight climate change. Consequently the Covenant is open to any city willing formally to adhere to its conditions. Smaller cities may face the problem of lack of human and financial resources to prepare or implement the action plans. Those cities need the support of other government bodies: counties, provinces, regions, metropolitan areas, national bodies, networks and federations of cities and regions, mentor cities and other institutional structures. Those entities act as *Supporting Structures* to the Covenant of Mayors. Twenty-six Supporting Structures are operational as of September 2009.

Financing is a crucial issue for the Covenant of Mayors. The implementation of the action plans would involve very relevant investments, which, pooled, will account for a substantial input of financial resources into the local scene. Regular grants are 'de facto' excluded, given the unilateral nature of the Covenant's commitment (to make the implementation of the action plans dependent on external grants would be inconsistent with the Covenant's basic principle: the independent commitment of the cities). The Commission endeavoured then to mobilise the funds on market conditions, but with a special emphasis on the needs of the cities engaged in sustainable energy action plans. The European Investment Bank (EIB) accepted the challenge. Dedicated Technical Assistance Facility 'ELENA – European Local Energy Assistance', operated by the EIB and financed from the Intelligent Energy-Europe Programme, is to be implemented in Autumn 2009. The facility will finance the technical assistance costs for development of sustainable energy investment programmes and projects in cities and regions. The effort will continue with other banks and financing institutions.

The Sustainable Energy Action Plans (SEAP) mainly consists of measures involving extensive replication of best products, processes and systems developed by urban technology suppliers and other industrial and scientific actors, private and public bodies. Facilitating the dissemination in Covenant cities (and cities interested in achieving the conditions to join) of successful projects, ideas and programmes is then a natural win-win situation for both the beneficiary cities and the system & technology developers. With this in mind, the concept of Benchmarks of Excellence was proposed. These are defined as initiatives and programmes which represent a worldwide model of successful implementation of sustainable energy development concepts in urban settings. Representatives of the Benchmarks of Excellence state through the Covenant their willingness to share their experience and to help cities to implement similar approaches when applicable and convenient. The intention is to commit to the facilitation of know-how transfer through the distribution of information, including guidelines. It also means participation in events of Covenant signatories and in general, day-to-day co-operation with the Covenant.

There is not a standard model for the preparation of action plans or inventories. The reason for that is that there are several models that have been prepared by both private and public bodies, and the Commission considered it inadequate to look for any standardisation at this early stage. If there is a demand for harmonisation in the future, it will be considered by the Commission services. However, cities have a free access to the Action plan and emissions inventory template and guidelines, published on the website www.eumayors.eu. The latter has been developed in cooperation between the EC, COMO and JRC and consulted with experienced cities and networks of local governments. The template as well as guidelines represent the current state of play and respect the different methodologies used by local authorities. SEAP template provides the local authorities with a recommended model of SEAP and emissions inventory.

3.2.7 Timing for Implementation, Expected Developments and Results

The Covenant of Mayors was devised as a long-term policy initiative. As such, there is no particular end date. Cities and regions can sign up to the Covenant at any time, depending on their political readiness to do so. The implications in terms of workload and policy development of the Covenant are not to be underestimated. However, more than 640 cities, as of September 2009, are the evidence of commitment of local authorities towards the Covenant objectives.

The Covenant is not related to particular national objectives concerning reduction of CO_2 emissions. No matter the socio-economic situation or the market and policy particularities of their respective countries, cities commit to reach their own objectives in their fields of competence. Upon this rationale, the Covenant is open to any city with a democratic government keen to join efforts with European cities and to benefit from the services and facilities around the Covenant. With a longer-term perspective, the idea of getting local governments from around the world together as the motors for action is quite enticing and feasible.

Most local governments all over Europe claim that there is a growing imbalance between the responsibilities, mandated or not, that they assume, and the resources allocated from national or regional administrations. The Covenant of Mayors was devised with this problem in mind, aiming to provide local governments with visibility and to help them get the critical mass necessary for having their requests addressed.

In conclusion, among the high number of solutions, measures, policies and strategies proposed to tackle the gravest global problem of our era, climate change, the Covenant of Mayors appears as the only proposal based on moral rather than competitive or economic values: citizen participation, citizen empowerment, solidarity and debate. The Covenant will be a success only if local governments share its aims and means with the people, if the actions implemented come as a result of a deeply democratic process. The Covenant of Mayors will not solve the global warming problem on its own, but, if successful, will greatly contribute to the solution, minimising the locals climate impact and maximising co-operation.

Pedro Ballesteros Torres *is principal administrator at DG Energy and Transport (DG TREN) of the European Commission (EC). Among his duties, he is in charge of the launch and management of the Covenant of Mayors; the Sustainable Energy Europe Campaign, which is the EC programme for communication on clean energy; the ManagEnergy initiative to foster local action on sustainable energy and transport;, the co-ordination at DG TREN of the Intelligent Energy Europe (IEE) programme and the initiative Islands for Sustainable Energy. He qualified in Engineering/Food Industry at the Universidad Politécnica of Madrid, Spain, and has a MBA in Energy Business. From 1984 to 1994 Pedro worked as consultant in energy and environment topics for European institutions and the United Nations. He has been working for the EC since 1995.*

Roman Doubrava *joined DG TREN in July 2008. He is in charge of implementation of the ManagEnergy initiative, Covenant of Mayors, and other initiatives targeting the local energy actors. He is qualified as an Engineer in Business Administration at University of Economics in Bratislava, Slovak Republic, and complemented his studies with Economics and Politics of Renewable Energy Sources at the University of Salzburg, Austria. From 1996 to 2008 he worked as a consultant and managing director in an energy consulting business.*

Chapter 3.3
ICLEI's Support for Local Climate Action: A Selection of Tools

Maryke van Staden and Christine Klas

Abstract What is being done for and by cities to tackle climate change? There are many actions, a vast array of information and, in recently, a particular upsurge of interest in the concept of local climate action – the focus is now on cities and towns. One of the oldest and most well-know campaigns running since 1993, is ICLEI's international Cities for Climate Protection™ (CCP) Campaign. Together with its members, the organisation decided to develop a support framework for local governments around the globe to look at community climate action. Since then the CCP support framework was expanded and tools were developed, also addressing other angles of community sustainability. More recent developments include the publication of the first international Local Government Greenhouse Gas Emissions Analysis Protocol, developed to create a standardised approach when addressing community emissions data collection. Another global activity is the City Climate Catalogue, specifically aimed at presenting a collection of community climate change mitigation targets to be presented to the national governments during the 15th Conference of the Parties (COP) to support the call that communities should be recognised as important actors in the international climate debate.

Keywords City Climate Catalogue • community resilience • ICLEI's Cities for Climate Protection™ (CCP) Campaign • International Local Government Greenhouse Gas Emissions Analysis Protocol

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3.3.1 Introduction

Since the early 1990s local climate protection has become a subject of a growing interest both in Europe and internationally, with an initial focus on climate change mitigation. In 1993 ICLEI's international Cities for Climate Protection™ (CCP) Campaign was launched. Since then it has grown, hand in hand with an emerging movement of local governments (LGs) implementing pioneering actions in various fields to reduce greenhouse gas (GHG) emissions. In Europe this has also been accompanied by a proliferation of other local government networks and organisation supporting cities and towns. More recently the need to adapt to a changing climate has been recognised as an additional essential element for local response to address the impact of climate change and improve community resilience to inevitable changes.

As stated at the Johannesburg World Summit on Sustainable Development (WSSD)[1] in 2002, it became evident that there was, and until today remains, a vast gap between the actual role played by local governments and the support provided to them by national government. Activities the local government level is engaged in tends to revolve around local issues, often with an explicit mandate. Considering the local impact of climate change is just that – local – it is rather unusual for local governments not to have a mandate to address this and in most cases no funds to do so. This situation needs to be urgently corrected to provide a secure environment for citizens who pay taxes and expect services in return, including information and guidance from their local leaders. A correction is also required with better supportive frameworks and mechanisms that will help to empower local governments – at various levels, not only financially, but through other resources as well to address both mitigation and adaptation. This includes regular updated information and scenarios on which decisions can be taken, and building of capacity on how to deal with climate change.

3.3.2 ICLEI's International Cities for Climate Protection™ (CCP) Campaign

3.3.2.1 The Start of the International CCP Campaign

In 1993, at the invitation of ICLEI – Local Governments for Sustainability,[2] municipal leaders met at an international summit of municipal leaders held at the United

[1] www.un.org/events/wssd

[2] ICLEI – Local Governments for Sustainability was formerly known as the International Council for Local Environmental Initiatives.

Nations (UN) headquarters in New York, and adopted a declaration that called for the establishment of a worldwide movement of local governments to reduce greenhouse gas (GHG) emissions, improve air quality, and enhance urban sustainability. This was the start of the Cities for Climate Protection™ (CCP) Campaign.[3] Its aim was to provide a framework for action to help communities that wanted to engage in climate protection. The Campaign grew out of ICLEI's Urban CO_2 Reduction Project (1991–1993), which brought together a group of American, Canadian, and European cities, to develop a municipal planning framework for greenhouse gas reduction and strategic energy management. The experience of the Urban CO_2 Reduction Project led to the development of the CCP five-milestones framework and a software product designed for municipal use.

Since then ICLEI has been assisting cities, towns and counties around the world to reduce GHG emissions and air pollutants that contribute to global warming and air pollution. The CCP was designed for a specific target group, namely the local level of government – municipalities and councils of cities, towns, villages, or counties, as well as clusters of communities (e.g. provinces). Local governments can shape, lead, motivate others and guide climate protection strategies and actions, and have a specific type of mandate for local action as well as an interest to serve the community.

The Campaign provides an international framework to assist local and regional governments in adopting policies and implementing quantifiable measures to reduce local GHGs, improve air quality, enhance urban liveability and sustainability. It advocates that cumulative local action is an effective approach to addressing climate change, and that local government, as the level of government closest to the community, is in a unique position to create and sustain local action.

3.3.2.2 A Proven Methodology: The Five Milestones Process

A strategic milestone framework was developed that empowers councils to make an inventory of their greenhouse gas emissions, set reduction goals, plan and implement actions, and monitor their progress. This innovative performance framework of the CCP Campaign is structured around five milestones that local governments commit to undertake (a voluntary decision taken by the Council). The milestones allow local governments to understand how municipal decisions affect energy use and how these decisions can be used to mitigate global climate change while improving community quality of life.

The milestones listed below on the mitigation side are general CCP milestones used globally. The adaptation milestones were added in 2006 by ICLEI Europe and are used in this region to address community based adaptation from a climate

[3] www.iclei.org/ccp

perspective. Both streams form part of a logical process that can be followed by any local government when addressing climate change in their community (Table 3.3.1).

These milestones, which do not necessarily have to take place in strict order (some can occur in parallel), can be visualised as a cycle. Achieving each step is a valuable highlight in a process, with a result that is the actual 'milestone' that contributes towards moving forward with local climate action. As a cycle the idea is to start the process, go through each of the steps, and determine what has been achieved. Then the process should start all over again with the aim to achieve the next level of improvements, and so on until the community is a climate neutral community and climate resilient, i.e. having implemented all relevant adaptation measures. The milestone process has at its core a long-term approach to climate protection (Fig. 3.3.1).

Table 3.3.1 The ICLEI five-milestone methodology as applied in Europe

Mitigation	Adaptation
Milestone 1 – *Conduct a baseline emissions inventory and forecast*	Milestone 1 – *Identify climate impacts (vulnerability, opportunity and resilience assessment)*
Milestone 2 – *Adopt an emissions reduction target for the forecast year*	Milestone 2 – *Identify relevant adaptation strategies*
Milestone 3 – *Develop a local action plan*	Milestone 3 – *Prioritise areas for action and develop a Local Action Plan*
Milestone 4 – *Implement policies and measures*	Milestone 4 – *Implement policies, systems improvements and adaptation measures*
Milestone 5 – *Monitor, verify results and report on results*	Milestone 5 – *Monitor, evaluate and report on results*

Fig. 3.3.1 The CCP five-milestone cycle (Courtesy of ICLEI European Secretariat) (see *Color Plates*)

3.3.2.3 The CCP Campaign Today

With experiences gathered over more than a decade, the CCP Campaign has developed into a well-known established and effective international campaign. It is one of the largest local government networks active in the area of climate protection. Today more than 1,000 local governments participate in the CCP Campaign, and have begun to integrate sustainability and climate change mitigation into their decision-making processes. Adaptation is still a relatively new field and is included in some regions, such as Europe. The Campaign includes many large cities around the globe, but also smaller cities, towns and even villages – size is irrelevant; a commitment to local climate action and action are key. Many of the communities that are renowned for the local climate action are CCP participants.

ICLEI runs this highly successful and widely recognised campaign either regionally or nationally in Australia, Canada, Europe, Japan, Latin America, Mexico, New Zealand, South Africa, South Asia, Southeast Asia, and the United States. The various ICLEI offices run campaigns and initiatives based on available interest and funding. As such not all offices necessarily manage a CCP Campaign.

An example on how different approaches are taken, the ICLEI European Secretariat coordinates the European CCP Campaign, with a very extensive geographical focus. This includes the EU27, the rest of Europe (e.g. Norway, Switzerland), the Middle East and the Newly Independent States (NIS). As this is such a broad area it works closely with organisations identified to act as national CCP Campaign coordinators, for example in Finland, Israel and Turkey, which ensure the participating communities can be supported in their national language and cultural context, with news feeding into the European and international CCP Campaign processes.

There are many different local mitigation and adaptation actions, and a wide range of currently available technologies and materials that could be considered for local relevance. The aim is to continuously improve and move towards climate neutral and climate resilient communities, ideally also towards 100% sustainable energy communities, which brings with it multiple other local benefits. Furthermore the focus is on maintaining or improving the quality of life (to keep citizens and businesses, and draw more people) and sustainable development. Examples are provided in Chapter 6, addressing the diversity of approaches and options for local climate action.

A basic requirement for joining the Cities for Climate Protection Campaign is political commitment to respond to climate change. The political commitment can take form of a resolution or proclamation, and is usually adopted by the Council. The commitment should then subsequently be translated into policy and action. This is where the CCP five milestones process starts. In order to know where the problem areas, or potential areas, are, an assessment needs to be conducted. This should aim to address all the greenhouse gas emissions (GHGs) as far as possible, also considering which energy sources the community depends on (e.g. imported oil or gas), and any vulnerabilities and/or opportunities the changing climate brings. Based on this assessment(s) the next step would be to identify targets for change with an accompanying timeframe (e.g. CO_2 or equivalent reduction, renewable energy and/or energy efficiency targets by 2015 and 2030). The targets and timeframe need to be considered when developing a programme for action (Local Action Plan). It is also useful to address how the progress of implementation would be monitored, thereby giving the Council concise information on which it can take the next round of decisions. The implementation of the Local Action Plan is of course key – and all local governments are encouraged to start activities, even if they have not yet conducted an assessment. All CCP participants are expected to use the CCP five-milestones process, and to report regularly to the relevant CCP coordinator, at least within 3 years of starting the process.

Each region and country has a different culture and political background, which also influences the role of the local governments. As such the CCP Campaign accommodates the requirements and realities of each area. Activities implemented in each region/country are also dependent on available funding and issues highlighted in that region, as such a variety of projects have been developed and the international CCP Campaign reflects a rich diversity that supports productive technical and political peer exchanges. The mutual exchange of experiences has benefited many cities and towns in the development and implementation of strategies and actions, inspiring leaders and staff with ideas, motivating action and last but not least providing encouragement in what used to be a very isolated world. Many CCP participants were pioneers in local climate action, and forged ahead despite a lack of support from other levels of government. These now lead the way in their countries, working closely with ICLEI on climate protection and community sustainability issues.

3.3.3 The City Climate Catalogue: A Global Collection of Community Mitigation Targets

The Copenhagen World Climate Catalogue of City Commitments to Combat Climate Change, in short known as 'The City Climate Catalogue'[4], is a new initiative to capture community climate commitments from around the world. Launched in February 2009 to start a collection process of climate protection targets and achievements of local governments, the focus of the targets collected is on energy savings, energy efficiency, and the local use of renewable energy sources to reduce CO_2 emissions.

The City of Copenhagen, as host of the 15th Conference of the Parties (COP 15) in December 2009, together with ICLEI, has developed this virtual tool as a supportive element of the Copenhagen Climate Summit for Mayors, which will take place in parallel to the COP15 in 2009 in Copenhagen. It will be used as part of the international Local Government Climate Roadmap to send a strong message to

[4]www.climate-catalogue.org

the United Nations, national governments and other important actors around the globe, showing the ambitious climate work of the world's communities. It will be used to call for greater recognition of the essential role local governments play in the global climate and energy debate, and emphasizes the need for including the world's cities in UN climate talks and outcomes.

Cities, towns and counties around the globe are contributing their greenhouse gas (GHG) reduction targets, as well as experiences and mitigation results in the online database. This collection of local climate commitments will help to build a strong case for local climate action. The aim is to capture and disseminate useful information on as many local targets as possible, and to share interesting local developments and effective climate protection implementation actions that lead to substantial GHG reductions.

The focus of the Catalogue is on capturing key information:

- Of greenhouse gas (GHG) reduction goals adopted by the world's cities and towns.
- Diverse climate strategies, policies, methods, and tools applied to reach substantial GHG reductions at a community level.
- Reductions achieved at a local level, which in turn contribute to national and international climate protection targets.

All cities and towns around the globe are invited to share their targets and eCO_2 reduction actions – www.climate-catalogue.org. The Catalogue is the first of its kind and will be a valuable resource for researchers and local governments alike.

3.3.4 The International Local Government Greenhouse Gas Emissions Analysis Protocol

Local governments have unique requirements of greenhouse gas management programmes to account for the broad range of operations that typically fall under their jurisdiction. Local government greenhouse gas inventories comprise two parts – the operations of local government itself and the community that they govern.

ICLEI released the International Local Government Greenhouse Gas Protocol[5] in 2008 to provide an easily implemented set of guidelines to assist local governments in quantifying the greenhouse gas emissions from both their internal operations and from the whole communities with their geopolitical boundaries. This international Protocol consists of the general principles and philosophy that any local government, regardless of location, should adhere to when inventorying GHGs from its internal operations and community as a whole. The emission sources that should be included in a GHG inventory and the methods used to quantify these sources are generally consistent between local governments, but are unique when compared with any other type of entity.

[5] www.iclei.org/ghgprotocol

By developing common conventions and a standardised approach, ICLEI seeks to make it easier for local governments to achieve tangible reductions in GHGs. The standardised approach described in this Protocol facilitates comparisons between local governments and the aggregation and reporting of results being achieved by the action of diverse communities. This Protocol will continue to evolve as new issues are raised and resolved. Country/Regional Supplements are being developed in order to address some protocol issues in an appropriate local context. The Supplements contain a description of how the principles outlined in this document are to be implemented in each country or region, including appropriate data sources for the specified country or region.

The International Protocol is informed by recent developments such as:

– IPCC 2006 methodological changes
– GHG Protocol Initiative Corporate Standard and Project Accounting Protocols
– ISO 14064 Greenhouse Gases series of standards
– GRI Public Sector Agency Supplement

Since November 2007 key peer organisations around the world – including United Nations Environment Program (UNEP), World Resources Institute (WRI), International Energy Agency (IEA), California Climate Action Registry (CCAR), and the Federation of Canadian Municipalities (FCM) and Center for Neighborhood Technologies (CNT) – have reviewed the International Protocol. It has also been reviewed by ICLEI member cities and stakeholders during a public comment period.

The Protocol has been designed to both provide guidance and establish a standard for local government greenhouse gas inventories. At this stage of the Protocol's development, it is intended that local governments will self-identify compliance with the Local Government GHG Protocol. An accreditation process and associated recognition may be established by ICLEI in the future, for those parties seeking more formal acknowledgment that their greenhouse management is compliant with the Local Government GHG Protocol. Version 1.0 of the Protocol is publically available and can be downloaded from the website listed below.

References

ICLEI – Local Governments for Sustainability (ICLEI) (2008) International Local Government GHG Emissions Analysis Protocol Release. Version 1.0. www.iclei.org/ghgprotocol

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Chapter 4
Local Action – Planning and Implementation

Chapter 4.1

Three Streams of Local Action: Strategy and Policy; Technology and Measures; People and Lifestyle

Maryke van Staden and Francesco Musco

Abstract Local climate action, sustainable energy and urban planning are closely interconnected, focusing on action in the (municipal) government and whole community area. Change is needed to improve existing policies or develop new policies, raise peoples' awareness on the need for change and how to do so, apply existing effective technologies and measures, and, last but not least, sustaining this over the longer term to achieve the required results. Three streams of local climate action are presented in this article, namely: strategy and policy; technology and measures; people and lifestyle – all closely inter-related, and linked to urban planning and sustainable energy. When addressing these issues, typical questions asked by local decision-makers and municipal staff revolve around aspects such as how to determine the right strategies and policies to guide the implementation of a Local Action Plan (LAP), where processes need to change, which key steps should form part of a LAP, how to select the right technologies, and how to engage people. The 'people stream' remains the largest challenge, in part also as it implies a redefinition of quality of life for all citizens – engaging them, retaining their interest, encouraging them to take responsibility for their choices, and radically changing the way they live.

Keywords Ambitious targets • citizens • cluster cooperation • community-based adaptation • courageous leadership • life cycle assessment (LCA) • lifestyle • Local Action Plan (LAP) • peak oil • policy and strategy • sustained action • technology and measures • urban planning

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4.1.1 Introduction

Tackling climate change is not a ‘one size fits all’ process. Just as the impacts of climate change will vary from place to place, the combination of institutions and legal and political tools available to public decision-makers are unique from region to region. Actions need to be tailored to the circumstances of different communities, also looking at their strengths and weaknesses. It is necessary that local, regional, and state government decision-makers take an active role in preparing for climate change, because it is in their jurisdictions that climate change impacts are felt and understood most clearly. This article addresses community climate change mitigation and adaptation through the implementation of sustainable energy solutions, highlighting three streams of action that are logical areas of action when addressing local climate action, namely: strategy and policy; technology and measures; people and lifestyle.

Tackling anthropogenic climate change means mitigating the human impact on the process by rigorously reducing greenhouse gases (GHGs). This can effectively be addressed in urban areas, where more than half the global population lives today and where their energy generation, distribution and use can be transformed into more sustainable solutions. Local adaptation to climate change is also necessary, as change has already occurred and inevitable changes are expected. Considering that climate change is non-linear in character and that there is a continuous release of emissions globally, the growing ‘concentrated’ threat will impact on people and the world they live in, also in decades to come. The need for climate change adaptation is often questioned, as it is perceived to take away attention form mitigation. Yet when considering the above, it is clear that planning and action for community-based adaptation is needed, in parallel to, and where possible in combination with mitigation action.

Sustainable energy, as well as sustainability in general, needs to form a foundation when addressing these challenges. Sustainable energy means energy savings – as an immediate priority – improving energy efficiency and switching to renewable energy. Energy savings and improved energy efficiency are usually priorities of local governments, based on their assessment of needs, which tends to ignore the realities of external political and economic developments relevant to energy. From this perspective switching to renewable energy is an important factor, bolstered by other benefits such as local job creation, stable energy prices, ensuring sufficient energy for the community. There is a real need for presenting facts and examples that can help to inform and motivate decision-makers to act. This is also relevant to the concept of sustainability in general – using an approach that does not harm future generations and resources should form the basis of such decision-making.

Adaptation, as it relates to energy, should address the need for safe, affordable and secure energy for everyone in the community – electricity, heating/cooling and fuel for transport. People also require housing, roads and other infrastructure (e.g. waste, sewage, water), which need to be resilient to climate change: temperature/moisture changes, increasing number and intensity of storms. Here the impact on energy is not always clear, but should definitely be considered from a stability, availability and efficiency perspective. Infrastructure should be stable and not collapse when there is a systems change. Local governments should address this in urban planning (for the next 2–20 years) and improving infrastructure and systems, preferably combining community-based adaptation and changing the energy that goes into the improvements and future operations (local mitigation action).

When talking about change needed from an energy perspective, this is often referred to as the 'transition to a sustainable energy future' – a gradual transition. With the delay experienced in addressing this transition, as national governments are slow in responding to a global challenge, partly also due to self-serving interests of lobby groups, the need for a gradual transition is changing into a rapid transition likely to cause more upheavals and requiring better planning than has been seen thus far. As explained by Don Aitken in the International Solar Energy Society (ISES) White Paper – A Transition to a Renewable Energy Future, in 2003 the renewable energy transition was expected to move to the top of the national and international political agendas as a logical development (Aitken 2003). This need remains valid, yet the urgency thereof has quadrupled. New scientific evidence of the (faster than anticipated) tempo of climate change and the lack of a level playing field for renewables versus other energy options, are two aspects where an improved and enabling framework is needed to support local climate action. Such frameworks need to be improved by national governments, and are also linked to the international climate negotiations.

The aspects addressed above can best be illustrated by an example. From a mitigation perspective the need for urgent reduction of greenhouse gases (GHGs) means moving away from the use of fossil fuels. Logic dictates that one should not switch to other finite energy resources expected to peak in the next few years, e.g. oil and uranium, but rather look towards long-term solutions. The sustainability angle requires that energy solutions need to be found that are clean, have a minimal GHG impact, and also a minimal environmental impact over the short to long term. From this perspective the life cycle assessment (LCA) of materials and products is required, considering GHGs released over the lifetime of producing, using and disposing of the material/product. If a community is 100% dependent on importing electricity generated from a combination of nuclear energy and fossil fuels, but also has renewable energy sources (RES) (e.g. wood waste and solar radiation), it can switch to RES for co-generation (heat and power) and use high efficiency technologies to reduce energy use. This mitigates the community's impact on climate change. From the LCA angle one should consider GHGs released during the extraction of raw material (e.g. uranium vs RES) needed to run the power plant, the construction of a actual power station and all materials needed for this, and the handling of waste (hazardous nuclear waste vs wood waste). By addressing such relevant issues, relevant facts can be identified on which appropriate decisions can be taken. This example also addresses adaptation – it reduces dependency on imported energy (energy security, financial security), while energy infrastructure is made more robust (new, efficient technologies, local distribution), using local energy for local use. This reduces dependency on externally managed electricity grids that could collapse (e.g. in times of high peak demand such as extremely cold winters or warm summers) or in extreme weather conditions (e.g. very warm summers leading to dropping water levels in river, requiring the shutdown of nuclear power stations as cooling systems is no longer possible). This illustrates that there are many different aspects that need to be considered when addressing mitigation, adaptation and sustainability.

4.1.2 Local Governments Need to Engage

When focusing the EU's sustainable energy and climate protection targets, it is clear that these are the most advanced targets of any region in the world. Achieving these targets will require a combined effort by many different actors, including local government as the closest level of government to citizens, but also as owner and/or manager of assets and infrastructure, and as community leader and administrator. Local climate action covers a wide range of issues and can encompass many different approaches. It must include a diverse range of stakeholders in order to be effective, from planning to implementation and monitoring. Considering the need for fast and wide-spread roll-out of sustainable energy at community level, three streams are highlighted below that cluster relevant topics. This is done to simplify the approach for planning and decision-making. The three streams for local climate action are:

– Strategy and policy
– Technology and measures
– People and lifestyle

In Chapter 6 these three streams and their interconnections are illustrated by practical examples – many cases presented at the European Rovigo Climate Conference 2008 and mainly examples of small and medium-sized local governments in Europe that are active in climate protection and the roll-out of renewables in their communities. The three streams are useful in bringing together different groups of actors needed in the planning, implementation and monitoring of local climate action at community level – from political leaders and strategic planners to architects, engineers, urban planners and sociologists that address the technology, integration and 'people' perspectives.

4.1.2.1 Spheres of Influence

Increasingly local governments (LGs) around the globe are recognising that they need to address mitigation and adaptation to climate change at both the corporate (municipal or government) and community level. However, this remains a voluntary area of action. The degree of influence – based on mandates and responsibilities – they have differ from country to country. In general local governments tend to have a wide range of competencies and influence that can be used to guide change in the community. Decisions can be made to help drive and regulate change within the municipality, for example Council decisions and regulations. These can also be relevant to the community as a whole or particular sectors or specific target groups: citizens, businesses and industry. There is extensive potential to lead, guide and motivate action to reduce the main sources of pollution in the community energy, building, transportation, water and waste sectors.

For example, many local governments are energy producers or (co-)owners of energy plants, or operators of transport/waste companies, and normally own buildings and even manage social housing companies or other services. These areas can usually be directly influenced from a corporate (government/municipal) sector perspective, but local governments can also control or influence many of the day-to-day activities that determine the amount of energy used and waste generated by their community – from land use and zoning decisions to control over building codes and licenses, infrastructure investments, municipal service delivery and management of schools, parks and recreation areas. It is interesting to explore the opportunities local governments can consider to influence citizen behaviour that directly affects climate change such as transportation options, energy consumption patterns, and general consumer decisions. An important step is to determine where GHGs are released and options for changing approaches or systems to reduce these.

4.1.2.2 Courageous Local Leadership

Elected leaders have the mandate to act as community leaders, and are expected to lead and guide the community as a whole – establishing local policy and regulations, shaping local developments. This can very effectively also be used to address climate protection in all sectors. However it requires a well-considered approach and sustained action – thus thinking beyond years and even decades, and certainly beyond the political lifetime of an elected representative. This type of thinking also requires a vision, as well as committed and more courageous leadership. In communities where local climate action is effective, this often is due to a political leader acting as champion for the cause, supported by informed technical staff, and – in the most successful cases – backed by the whole city council which is in agreement that climate protection is a priority for all political parties. Such cross-party political consensus is invaluable for stability and continuity.

When considering climate change adaptation as a topic, this may present a particular challenge to local decision-makers. Normally decisions taken tend to be based on facts, which, are practically impossible to provide when considering the future impact of climate change and how to adapt to this. Nonetheless, anticipated impacts based on scientific research and forecasts need to be taken seriously and should be used as the basis for community adaptation, as there is no alternative. The risk and costs of non-action are estimated to be much higher than any potential margin of error made in predictions and scenarios. These at least provide information on a basic anticipated direction that can be followed.

4.1.2.3 Awareness and Information

One of the advantages local governments have is that they are in an ideal position to inform, mobilise and involve the local population and a wide range of stakeholders in different activities. This involvement is necessary to achieve success in the field of local climate action. Without engaging people, there will be no change. The aim should be to engage, as far as is possible, every resident, the whole business sector and local industry, but also all political parties, municipal staff and local stakeholder groups. This is an ambitious aim, yet also one needed to optimise the impact of local climate action.

Key messages should include taking on responsibility for their actions and related GHGs, and to drastically reduce emissions in all walks of life. As climate change is a rather complicated and abstract topic, the problem and inter-relationships should be presented in easily understandable language for young and old, for literate and illiterate. It should highlight how climate change is accelerated by the way we used energy in the past and are still in most cases using today, which in turn directly links to peoples' lifestyle and the choices they make. Awareness about the direct correlation will help to highlight the need for behaviour change.

The Local Agenda 21 approach can be valuable to include citizens in planning and decisions, also to provide information and feedback on developments. Local government plays an important role – to lead, motivate, inform, monitor and report. However, in order to positively influence behaviour change, solutions should also be provided, such as a public transport system that encourages a change in mobility behaviour.

4.1.2.4 Small Yet Powerful?

Small municipalities tend to have more limited resources – whether staff capacity or financial means – than large cities do to provide for local climate action. This is in particular also the case as climate protection (mitigation) falls beyond the formal responsibilities of local government. However, the examples shared in Chapter 6 show that this is not always a barrier and that innovative solutions can be found. There are many options that can be considered, in particular through strategic climate cooperation with other small and medium-sized communities, or other levels of government, and certainly starting in a limited manner and moving forward step-by-step is also an option. The concept of 'cluster cooperation' is highlighted, as it can be very effective. This means working either with other communities in the same vicinity or with those that have similar circumstances, alternatively building on existing relationships such as twinning agreements, or working with another level of government or a business/industrial sector, and sharing tasks and/or pooling resources. An example of this – the Covenant of Mayors provides an interesting role for Supporting Structures in this context.

4.1.2.5 Starting Point

Obviously local governments (LGs) can, and do, implement ad hoc climate protection activities. Sometimes people involved do not even realise that these could be seen as such, in particular where the motivation for action is different e.g. to save money for electricity bills. However, a more strategic and coherent plan is needed, and can be valuable in providing clear direction and addressing climate protection in a more comprehensive manner.

To get a clear picture on the actual problems and challenges as well as implementing and monitoring relevant options, it is recommended to use a formalised process that establishes a framework for action. This will help to bring together all the key elements required – from planning to implementing, monitoring, evaluating and reporting. As a wide variety of actions should be considered by the LG, the potential complexity can further be supported by developing a well-structured plan and having an integrated approach. In ICLEI's Cities for Climate Protection™ (CCP) Campaign a logical 5 milestone process is used as a methodology using a cyclical approach, going through steps (some could take place in parallel depending on internal processes in the municipality), ideally until a community is climate neutral and climate resilient. This is seen as a long term process, and to achieve this continued political commitment is needed (refer to Chapter 3 for more details).

The starting point is to consider the situation in the community, conducting an assessment of local resources, problems/challenges, and needs. The results can be used to develop a strategy, identify where policy has to be changed or newly developed, and outline a clear plan of action (Local Action Plan) that can ensure an effective systematic process of change – with the right people involved at each step. The original assessment should include a GHGs inventory to determine where these are being generated in the community, considering typical boundaries used (defined in the International Local Government Greenhouse Gas Emissions Analysis Protocol – www.iclei.org/ghgprotocol). It could also include an Energy Status Report, identifying which energy sources are used in the community and related emissions. What is further of interest is to identify whom the energy sources belong to in order to determine potential threats (e.g. dependency on import of fuel) and where potential changes are possible. From the adaptation perspective it is necessary to assess the local impacts (or expected impacts as far as can be ascertained) of climate change, and to evaluate what this means for the community in terms of both vulnerabilities and opportunities. Climate change does not only have negative impacts, so there are likely to be new opportunities that could be explored.

A Local Action Plan should explicitly (ideally also extensively enough so that laypeople will understand the action) list which activities should be undertaken. This can then be used as a checklist to determine developments, on which decision-makers in turn can base their next decisions on.

4.1.3 Three Streams of Action Explained

4.1.3.1 Strategy and Policy

In this stream two elements that work in tandem are presented – typically a *strategy* is seen as a long-term plan to achieve a goal, so a direction is provided aiming to achieve success in a specific area. A *policy* is a deliberate plan of action to guide decisions and achieve rational outcome(s). This addresses planning and supports moving towards the goal. Both strategy and policies are needed when addressing local climate and energy action, and are critical elements needed to guide and facilitate the process. One strategy that is underscored by multiple policies, addressing the diverse thematic fields where action is needed, should be developed or improved in a Local Action Plan.

An aspect in particular underscored when addressing strategy, is the need for political commitment from the start-up phase of the process throughout its implementation. To 'achieve' success in the Local Action Plan means reaching targets that were set (in principle this is only completed once the community is 'climate neutral' and 'climate resilient'). The examples presented in this book illustrate that courageous (individual or council) leadership, in combination with an ambitious vision and a coherent long-term path for action – both clearly outlined – are key factors in achieving success. In best practice cases[1] there is also unanimous agreement that climate protection is a Council priority, which has shown to lead to continuity of climate protection strategy (even if actions may change as political leadership changes). Effective local policies can mean many different things, as it is partly dependent on the local situation. Yet some generic elements can be observed. In general it is useful to study how these have emerged and were further developed in communities that are seen as good or best practice cases.

How to start with strategy and policy? As local climate action implies action in many different sectors (urban planning, energy, buildings, transport, waste, water, business, industry, etc.), and requires an overall coherent approach, a few pointers are listed below (ICLEI 2008):

– Use any driver that can help to kick-start developments, e.g. improving air quality, reducing energy costs, focusing on local job creation and development (i.e. aspects that can engage local leaders and the community, as climate protection often seems to be a rather abstract concept).
– Do not play the blame game. Rather focus on 'taking responsibility', provide direction and motivating information to raise awareness and activate people.

[1]The difference between a 'good' practice and a 'best' practice is essentially that the former is an example that is recommended for consideration but also depends on a particular context, while a best practice is highly recommended for replication in most cases (truly exemplary and highly recommended for replication). The term 'best' practice tends to be over-used, and should probably rather be referred to as 'good' in the majority of cases.

By sending a clear message on the challenges, the need for action, what can be done and how to share the local climate action burden across the whole community spectrum, once can gain the interest of people.

– National and regional strategies can give framework for, and stimulate, local action, but are not necessary to start. Some national governments are slow in taking up their responsibilities. Local action does not have to wait for others. Where a national framework is in place or under development, be aware of top-down regulation. Rather discuss, engage, explore and find solutions together – as the only solution is a win-win solution.
– Local politicians have a local mandate, yet need to be aware of developments outside their turf. It is necessary to also have an international focus when considering climate change – it is after all a global challenge. One very relevant issue is the need to consider burden sharing and equity (those who are responsible for causing GHGs need to engage and pay to 'clean up the mess'). Politicians need to link from local to (sub)regional to national to supra-regional and finally the international arena and developments. Pooling knowledge and results, inspiring one another, and motivating for the next steps, can be valuable – as the international Local Government Climate Roadmap is showing.

4.1.3.2 Technology and Measures

Modern man is used to having energy available at the flick of a switch, and has not yet fully realised the value and the real (direct and indirect) cost of using energy. Having energy was a luxury 100 years ago, today having energy at hand is an expected standard for many people. We need to 'relearn' the value of energy, regard it as a valuable necessity generated from valuable resources. Sustainable energy – energy savings, energy efficient and renewable energy – focuses on a broad range of measures and technologies.

The combination of identifying and using appropriate (and efficient) technologies and measures to achieve both fast, yet sustainable long-term change in reducing GHG emissions is essential – but can also be challenging. In general the guidance provided through labelling of technologies and their energy efficiency standards and performance is a useful guideline. From the measures perspective one can only repeat – action, action, action. The more extensive, the better. Combining proven approaches with innovative ideas is useful, also as it helps to draw the attention of the media.

A recommended starting point under this heading of technology and measures is to build on aspects that are non-technological in nature, namely changing people's behaviour, but closely linked to technologies being used. Energy savings is a key crucial step. By reducing the need for energy one can reduce production, directly leading to GHG reduction – both from the distribution and transmission side as well as from the demand side. The positive side effect is cost savings – lower energy bills are normally welcome to those who need to pay them. From here it is a logical step (which can also take place in parallel to savings actions) to move forward to improve energy efficiency and switching to renewables, preferably using local renewables to minimise dependency on external sources. Buying green electricity is an example of a good practice, buying locally generated green electricity can be regarded as a best practice, as it further reduces losses during transmission and most probably has additional benefits such as local job creation in the small and medium-sized enterprise (SME) sector.

Finding ways to finance the technologies and measures can be a particular challenge for LGs and the communities. The banking sector has not yet realised that energy efficiency has a huge potential for them, as well as for the environment. Ethical banking is slowly emerging as an interesting area – also for investors that want to address sustainability. The development of the Covenant of Mayors and exploring low cost loans with banks in Europe is something to watch closely. From this the message to the banking sector is increasingly clear – without acceptable financing solutions there can be no fast and widespread roll-out of local climate and energy action.

4.1.3.3 People and Lifestyle

People remain vital in this area as well. Without the interest and active engagement of people, success cannot be achieved in local climate and energy action. The focus here should be on how best to motivate people – young and old, rich and poor, employees and employers – to achieve and sustain change. Community awareness and engagement are critical elements to achieve success in local climate protection action. It is means addressing a broad target audience, and is relevant to a broad range of topics – from waste (reduce, recycle, reuse) to energy consumption at the home and office/school to personal choices made regarding transportation. In the context of local governments the Local Agenda 21 process is also important. The example of Malmö presented in Chapter 6, shows how many different activities are used to reach different target groups in different ways, to great effect.

The following issues are highlighted here, as an outcome of the discussions during the Rovigo conference – and certainly still valid today:

– Municipalities can and must lead the way, they also have to involve the private sector and citizens.
– It is important to identify and propose energy efficiency measures that are financially attractive to private investors.
– By focusing on local benefits such as the use local resources, local job creation, saving money, support local, and economic development, one can draw the interest and motivate a wider audience to engage.

4.1.4 Conclusion

In conclusion a few key messages are highlighted. It is necessary to become much more serious about climate change and pick up the pace in terms of responding – both from a mitigation and adaptation perspective. When doing so it is useful to have a vision of where to go, and to look beyond the perceived short term financial benefits towards sustainable solutions that have a long term benefit for both the environment and people. As time is running out quick fixes are needed, but having sustainability as the core is critical, and there are logical solutions such as saving energy (with an immediate benefit), buying more efficient technologies (also with an immediate benefit) and switching to renewable energy – once again with an immediate benefit. These are thus the logical quick fixes, and not building huge powerplants that take years to construct and that run on finite fuels.

When considering the expected increasing scarcities of fossil and other finite fuels, increased competition and the impact thereof on costs, becoming more independent of imported energy is another logical step. The many different technologies and measures that can be applied can be selected by a local government, considering the local context and resources. To help shape the direction a strategy and policy is invaluable – know where you want to go and how to get there. Only by involving citizens and other local stakeholders from conceptualisation to implementation, can wide-scale results be achieved, requiring soft measures with impacts that are more difficult to monitor. The monitoring is an aspect requiring more deliberation – in particular by national governments and the international organisations – but the most important part is action. Action means results, and reducing GHGs as well as adaptation to climate change must become community priorities around the globe. The initial focus on mitigation should be broadened to include community-based adaptation – looking at expected impact, risks, opportunities and resilience of people, infrastructure, fauna and flora. The challenge is identifying appropriate responses based on predictions and scenarios, and planning accordingly. Partnerships are needed to make this a success, but it definitely can be a win-win scenario for all.

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Chapter 4.2
Urban Renewal: A Particular Challenge for Many European Cities

Sander Scheurwater, Ursula Hartenberger, and Laura Lindberg

Abstract In Europe a large percentage of land in urban areas has been developed, with much of the building stock old and in need of renovation. This development goes hand-in-hand with the need for urban renewal and using a sustainable approach to address a wide range of issues that are important to urban dwellers – issues that impact on quality of life. The Royal Institution of Chartered Surveyors (RICS) is studying these issues in the built environment, and in this article a few key issues that need to be addressed in cities and towns across Europe are highlighted – both in Old or New Member States.

Keywords Energy efficient renovation • living standards • passive housing • population growth • sustainable urban (re)development • urban sprawl

4.2.1 The World Is Increasingly Urban

Population growth, higher living standards (e.g. more living space per person) and demographic change (e.g. more single-person households) are some of the developments which have changed our environment into an increasingly urban one. In Europe, around four out of every five citizens are currently living in what can be described as an urban environment.

It is also becoming increasingly unsustainable. The high intensity of human activities in cities has led to a number of challenges, including climate change, rising

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energy consumption and fossil fuel prices, contaminated land, uncontrollable urban sprawl, social instability, urban poverty, increasing disparities, crime and alienation. In such an urban unsustainable environment, 'business as usual' models focusing on economic aspects alone are no longer sufficient to address these problems effectively.

… and there is a need to act! This increased awareness needs to be transformed into concrete action. In the built environment, case studies already exist that demonstrate the vast potential of the sustainable urban regeneration approach. The challenge rests in building upon these examples and fine-tuning them to suit local requirements.

Commonly, sustainable development has three pillars: economic, social and environmental. Sustainability, therefore, is more than being 'green' in terms of the environmental aspects. Sustainable urban (re)development needs to take into account all three aspects simultaneously.

In 2008, Royal Institution of Chartered Surveyors (RICS) organised a series of evening lectures on the topic of 'Sustainable Urban Regeneration' in Brussels,[1] which resulted in a research paper titled 'Sustainable Urban Regeneration is in Your Hands!' (Scheurwater and Iagher 2008). Amongst the conclusions in the paper are:

– Communication is key, and all stakeholders, including citizens, should be involved.
– Markets alone cannot provide for sustainable regeneration. Governments at all levels have a significant role to play, and they should take the lead.
– We need to look at things differently to address them differently. The current economic crisis shows exactly this.

4.2.2 No Sustainability Without Addressing Energy Issues

One of the key issues of urban design and running across all three pillars of sustainability and urban design is energy. Eighty percent of our energy consumption takes place in cities, largely for buildings and transport. Both reducing and 'greening' this consumption are minimum requirements to ensure our future.

Energy goes to the heart of all three sustainability 'pillars', as:

– It has **economical** implications. We remain largely dependent on increasingly scarce fossil fuels, most of which are imported from outside Europe. Security of supply and affordability are essential for economic growth.
– Fuel poverty is a serious issue. With rising fossil fuel prices more people have difficulties in making ends meet. These are often people leaving in the least energy-efficient dwellings. The **social** aspect of energy policy needs to ensure everybody is able to pay their energy bill, live comfortably and warm.

[1] http://www.rics.org/Practiceareas/Property/Regeneration/EU_lecture_series_e_210208.htm

– The link between energy usage and the **environment** is very clear. Forecasts show that global dependency on fossil fuels will remain the norm for many decades to come. Therefore energy efficiency and a switch to clean and renewable energy technologies are vital to mitigate climate change effects.

4.2.2.1 Be Efficient, Reduce Energy Consumption

To state the obvious, 'not using energy' is the best way to address the challenges mentioned above. Reducing energy consumption of buildings is vital for occupiers as well as for society as a whole, as "The buildings we live and work in have an impact not only on our lives, and our sense of well-being, but also on the world we live in" (Hartenberger 2008).

The European Union (EU) Energy Performance of Buildings Directive (EPBD),[2] which was adopted in December 2002 with overwhelming support from Member States and the European Parliament, came into force on 4 January 2003, and aims to improve the overall energy performance of buildings. It covers a wide range of requirements which can be split according to five main themes: certification procedures; inspection of boilers and air conditioning system, requirements for experts and inspectors; calculation procedures; and minimum energy performance requirements. To centralise relevant information the EPBD Buildings Platform[3] was established – as a European Commission initiative in the framework of the Intelligent Energy – Europe (2003–2006) programme, which provides information services for practitioners and consultants, experts in energy agencies, interest groups and national policy makers in the European Member States for helping the implementation of the EPBD.

In 2007 and 2008, RICS conducted intensive research into the implementation status of the EPBD in the 27 European Member States. Although implementation is not fully achieved in all Member States, comparing data from both years shows an upward trend. As the EPBD allows for a 3-year derogation period from the implementation date of 2006, Member States have until 1 January 2009 to fully implement this directive.

In the meantime, the EU is discussing a revision to the EPBD. The outcome of this discussion is presently unclear, but it is positive to see that the obligation to consider alternative systems for new buildings is extended to all buildings. This significantly enlarges the scope of the Directive and supports the EU targets on renewables.

[2] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2003:001:0065:0071:EN:PDF
[3] http://www.buildingsplatform.org

4.2.2.2 The Road to Renewable Energy

No matter how efficient we will become, we will still need energy, and a lot of it. Renewable energy sources are an essential alternative to fossil fuels. To reach the ambitious EU target of a 20% share of energy from renewable sources in the overall energy mix by 2020, we need an innovative society with strong (political) leadership.

Many local initiatives around Europe illustrate what cooperation and determination can lead to. These also highlight that a different way of thinking and seeing things long-term can make significant changes and have cost-saving implications for local governments. A few examples are listed below.

Exeter City Council has recently installed the first of a series of wood pellet burning boilers – a self contained unit which also has a solar panel array that is used to power the boiler controls. Over the coming 2 years the City Council will replace all of its oil-fuelled boilers with boilers that run on wood pellets. Using wood pellet boilers will reduce the Council's energy bill, whilst at the same time reduce the environmental impact – not only during usage, but also in case of an oil spill (where wood pellets can be simply swept up, an oil spill could have much greater implications).[4]

Wind energy is largely produced outside urban areas, as cities lack often lack space for large wind turbines. However, local governments have plenty of opportunities to promote this renewable energy resource, for example through their procurement procedures, but also by taking stakes in organisations that buy or run wind energy plants. The Municipality of Ringkøbing in Denmark, for example, has made a large effort to include its citizens in the decision-making process regarding wind turbine planning schemes.[5]

Spain is one of the most attractive countries for the development of solar energy, as it has more available sunshine (solar radiation) than any other European country. The Spanish government is committed to achieving a target of 12% of primary energy from renewable energy by 2010, with an installed solar generating capacity of 3,000 MW.[6]

What these examples show above all is that the use of renewable energy is partly geographically bound, and regions and cities should identify their strengths in this field.

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[4] http://www.exeter.gov.uk/index.aspx?articleid=7842

[5] http://www.agores.org/Publications/CityRES/English/Ringkobing-DK-english.pdf

[6] http://www.codigotecnico.org/index.php?id=33

[7] http://www.managenergy.net/

4.2.3 Get Active in Passive Housing

Though today there is not yet a common definition of 'passive houses' at the European level, this concept is broadly recognised and stands for 'highly energy efficient houses' rather than for 'business as usual'. Furthermore, these standards are not only designed to suit mid and northern European cold to temperate climates but also for Mediterranean warm and humid climates as well. From an energy point of view, climate change is as much (or perhaps even more so) about the cooling of houses as it is about the heating of houses.

With the aim to raise awareness on their huge potential, RICS, together with a group of regional energy agencies involved in the EU ManagEnergy[7] initiative, is helping the European Commission to identify and disseminate some of the best examples of high performance affordable homes in Europe through a practical guide on passive social homes[8] designed to inform the general public.

According to this practical guide, a passive house's design enables thermal comfort without traditional active heating and cooling systems. The building air-tightness is excellent, whilst a good indoor air quality is guaranteed by a mechanical ventilation system with highly efficient heat recovery.

Among the various successful examples of today's passive house standard social dwellings presented in the ManagEnergy guide, is a project implemented in Biskopshagen, in the region of Växjö (Sweden). This project helped to save a lot of money and provide a high quality of life for the occupants since 2007, but it also created a new market in the region. The project reduced the annual energy demand in 24 dwellings to 15 kWh/m^2, including the use of hot water and electricity. Landlords and site managers of this project were planning to replicate this successful experience in other locations, applying the same strict energy performance thresholds to new buildings and to existing building stock.[9]

In Eastern Europe, the Solanova project in Hungary – with an investment cost of €240/m^2 – provided dwellers with an increased level comfort in the 42 flats that were retrofitted in 2006. Two major improvements were providing living comfort in summer without using active cooling systems, and reducing energy consumption from 220 to 32 kWh/m^2.[10]

These and other examples in Europe show that passive, affordable houses certainly improve the quality of life of their occupants, help to maintain a good quality indoor climate, and at the same time avoid the risk of excessive internal temperatures in warm climates, bad odours, excessive noise, poor ventilation, draught, and dust or excessive humidity. However, these existing examples also indicate that obstacles still remain, and that policy-makers, builders, tenants and

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[8] The first part of the ManagEnergy practical guide on passive houses is available at: http://managenergy.net/themes/downloads/TG_Buildings_final_20_10.pdfMore information on passive houses can be found in the RICS website: http://www.rics.org/Newsroom/Keyissues/Energy/chng_behv_pasv_houses_f_171008.htm

[9] The Swedish data comes from Energikontor Sydost/Energy Agency for Southeast Sweden.

[10] Info from: http://managenergy.net/themes/downloads/TG_Buildings_final_20_10.pdf

investors need to remove these obstacles in order to support spreading this sustainable success formula across European cities. The technology used to build passive houses already exists – including insulation, super efficient windows, air handling units with high heat recovery ability, solar systems, etc. Yet what is missing is a much larger number of people ready to change their approach to energy use, that are also determined to invest in these high energy performance standards.

As part of the energy policy in the EU, the European Action Plan on Energy Efficiency (2007) is a good starting point to encourage behaviour change. It encourages the European Commission (EC) to develop a strategy for very low energy or passive houses in dialogue with Member States and key stakeholders, to move towards more wide-spread deployment of these buildings by 2015. Another development impacting on the local level is the Covenant of Mayors, bringing together the mayors of Europe's forward-thinking cities to build a permanent network to exchange and apply energy efficiency good practices. But will all these declarations of good will bring about an energy efficient, affordable house for everybody?

The implementation of financial incentives, further professional training to increase the number of competent design, construction, real state and energy experts on the labour market, are but a few of the actions that still need to be taken to make this change of behaviour happen.

4.2.4 Conclusion

Cities have a vital role to play in our future. Whilst local circumstances differ, a common European approach is needed to ensure best practises are shared and implemented. With cities addressing these key issues, it is expected that many more excellent initiatives happening all over Europe will find their way into mainstream policies. RICS will continue to provide expert advice in this joint effort towards a sustainable future.

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Chapter 4.3
Renewable Energy Technology Roadmap: 20% RES by 2020

Christine Lins

Abstract The European Renewable Energy Council (EREC) has for the first time in January 2004 called for a binding target of 20% renewable energy (RE) by 2020. In March 2007, the Heads of States and Governments of the 27 European Union (EU) Member States adopted a binding target of 20% RE from final energy consumption by 2020. Combined with the commitment to increase energy efficiency by 20% until 2020, Europe's political leaders paved the way for a more sustainable energy future for the EU and for future generations. In January 2008, the European Commission (EC) presented a draft Directive on the promotion of the use of energy from Renewable Energy Sources (RES) which was adopted in spring 2009 and which contains a series of elements to create the necessary legislative framework for making 20% RE a reality. The Directive sets the legislative framework that should ensure the increase of the 8.5% RE share of final energy consumption in 2005 to 20% in 2020.

EREC and its members have an EU Technology Roadmap outlining how the EU Renewable Energy Industry foresees to reach the 20% RE consumption target. The estimates given by the Renewable Energy Industry are based on a feasible annual growth scenario for the different technologies. Some RE sectors have developed much more ambitious projections showing that the European RE industry could deliver much more than 20%. This article gives an overview of a possible contribution of the different RE sectors towards the 20% target, the state of the respective industry sectors as well as sectoral technology roadmaps up to 2020.

Keywords Electricity generation from Renewable Energy Sources (RES-E) • employment projections • mandatory national targets • technological developments • Renewables Directive • technological developments • investor security • mandatory national targets • Renewable Heating and Cooling (RES-H)

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4.3.1 Policy Background

In March 2007, the Heads of States and Governments of the 27 EU Member States adopted a binding target of 20% RE from final energy consumption by 2020. Combined with the commitment to increase energy efficiency by 20% until 2020, Europe's political leaders paved the way for a more sustainable energy future for the EU and for future generations. In January 2008, the EC presented a draft Directive on the promotion of the use of energy from RES which contains a series of elements to create the necessary legislative framework for making 20% RE become a reality. The RES Directive was adopted in spring 2009. It sets the legislative framework that should ensure the increase of the 8.5% RE share of final energy consumption in 2005 to 20% in 2020. If timely adopted and adequately transposed in national law, the Directive would become the most ambitious piece of legislation for renewable energy in the world. In order to reach the binding overall 20% target outlined in the RES Directive, the development of all existing RES and a balanced mix of the deployment in the sectors of heating and cooling, electricity and biofuels are needed.

4.3.1.1 Electricity from Renewable Energy Sources

The EU aims to have 21% of its electricity coming from RES by 2010.[1] This target has been formulated in the Directive 2001/77/EC on the promotion of renewable electricity. While some Member States such as Germany, Spain and Denmark are well on track in reaching their targets, others are far behind. The Renewable Energy Framework Directive needs to maintain and strengthen the existing legislative frameworks for renewable electricity. It needs to establish minimum requirements for the removal of administrative barriers, including streamlined procedures such as one-step authorisation. Issues such as priority grid access and a more balanced sharing of the costs related to grid connection need to be addressed.

4.3.1.2 Heating and Cooling from Renewable Energy Sources

As far as the heating and cooling sector is concerned, the Directive finally closes the legislative gap which existed so far for this sector. Until recently, Renewable Heating and Cooling (RES-H) has received little political attention and in most EU Member States there is not yet a comprehensive approach to support RES-H. This is particularly striking in view of the fact that nearly half of the EU's final energy consumption is used for the generation of heat, making the RES-heating sector a sleeping giant.

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[1] http://europa.eu/legislation_summaries/energy/renewable_energy/l27035_en.htm

4.3.1.3 Biofuels for Transport

The EU's biofuels policy kicked off in 2003 with the first Biofuel Directive, which set indicative targets to promote the use of renewable fuels in the transport sector. For 2010 the target was set at 5.75% by energy content (this is a reference value for these targets calculated on the basis of energy content, of all petrol and diesel for transport purposes placed on their markets by 31 December 2010). As the experience with the existing Biofuels Directive shows, fuel distributors only use biofuels if there is a financial incentive or because they are forced to use them. Therefore the Renewable Energy Directive introduces a binding target of 10% RE in transport by 2020. However, only sustainably produced biofuels are allowed to count towards the target and the Directive proposes a comprehensive sustainability scheme (Fig. 4.3.1). The RES Directive:

- **Sets mandatory national targets for RE shares of final energy consumption in 2020, including a 10% renewables in transport target** – The Renewables Directive sets mandatory national targets for RE shares of final energy consumption in 2020. These are calculated on the basis of the 2005 share of each country plus both a flat-rate increase of 5.5% per Member State as well as a Gross Domestic Product (GDP) weighted additional increase to come up with the numbers as outlined in the table below.
- **Sets interim targets** – The Directive sets interim targets per country for 2011/12, 2013/14, 2015/16 and 2017/18 as a percentage share of their 2020 target. These interim targets are crucial for monitoring the progress of RE development in a Member State. The Commission proposal contained an indicative trajectory. However, EREC is concerned that these interim targets need to be of mandatory nature in order to avoid delay in renewables deployment. EREC believes that the Commission should as a consequence impose direct penalties on Member States which fail to comply with the binding interim targets. These penalties should be set at an appropriate level to provide strong incentives for Member States to invest in RE.
- **Requires national action plans from Member States stating how they intend to reach their targets** – Member States shall adopt national action plans which set out their targets for the shares of energy from renewable sources in transport, electricity and heating and cooling in 2020 and adequate measures to achieve these targets. Member States shall submit their national action plans to the Commission for examination at the latest by the end of June 2010. These plans should provide for two things: they give Member States the flexibility to decide for themselves how they want to meet their national targets, but at the same time they create investor security and help to mobilise private capital by setting clear goals and mechanisms on the national level. National action plans should include detailed mandatory outlines and targets for the different RE sectors (heating/cooling, electricity and transport fuels), which show the way ahead on the national level. In addition, support measures to meet the national targets must be outlined.

	Share of energy from renewable sources in final consumption of energy, 2005	Target for share of energy from renew-able sources in final consump-tion of energy, 2020
Belgium	2.2%	13%
Bulgaria	9.4%	16%
The Czech Republic	6.1%	13%
Denmark	17.0%	30%
Germany	5.8%	18%
Estonia	18.0%	25%
Ireland	3.1%	16%
Greece	6.9%	18%
Spain	8.7%	20%
France	10.3%	23%
Italy	5.2%	17%
Cyprus	2.9%	13%
Latvia	34.9%	42%
Lithuania	15.0%	23%
Luxembourg	0.9%	11%
Hungary	4.3%	13%
Malta	0.0%	10%
The Netherlands	2.4%	14%
Austria	23.3%	34%
Poland	7.2%	15%
Portugal	20.5%	31%
Romania	17.8%	24%
Slovenia	16.0%	25%
The Slovak Republic	6.7%	14%
Finland	28.5%	38%
Sweden	39.8%	49%
United Kingdom	1.3%	15%

Fig. 4.3.1 Mandatory national targets set out in the Directive (2005 and 2020) (see *Color Plates*)

– **Requires reduction of administrative and regulatory barriers to the growth of RE, improvements in information and training and in renewables' access to the grid** – Administrative barriers are still a major problem for RE development and need to be removed. There are a number of non-cost related options to be integrated for any Member State in its regulatory framework in order to really promote renewable energies. This is reflected in planning regulation

and administrative procedures. The Directive provides important provisions to further remove administrative and regulatory barriers, which must be put in practice to pave the way for a quick and large-scale RES deployment. Infrastructure development and priority access for renewables to the grid are key for a large-scale penetration of renewables. This should not only apply to electricity networks but should also apply to district heating networks sourced by renewable and gas pipelines for the increased use of biogas. On information and training, the Directive requests Member States to introduce a certification of installers by accredited training programmes. EREC welcomes this provision as it should positively contribute to the widening of knowledge of RE technologies (RETs). EREC believes it is essential that the quality of the installations is ensured via certified installers in the framework of the obligation to introduce minimum levels of RES in new or refurbished buildings. However, s sufficient adaptation period should be granted for the development of certification schemes as the latter are still in an embryonic stage in a number of Member States.
– **Creates a sustainability regime for biofuels** – The binding nature of the 10% target has triggered the very important debate on sustainability criteria and a certification scheme. Notwithstanding the fact that EU biofuel producers comply already today with the highest possible global farming standards, the EU biofuel objective justifies the building of a sustainability and certification scheme. This scheme will serve as an example for biofuel production standards globally. The industry is committed to strict but practical sustainability standards that apply for domestic production as well as imports and that will eventually be applied to all energy sources be it biomass, food or fossil fuels.

EREC has for the first time in January 2004 called for a binding 20% renewable energy target by 2020. Within the RESTMAC project co-funded by the 6th EU Framework Programme for Research & Technological Development (FP6), EREC together with its members and ADEME have drawn an EU Technology Roadmap outlining how the EU Renewable Energy Industry foresees to reach the 20% renewable energy consumption target. The estimates given by the Renewable Energy Industry are based on a feasible annual growth scenario for the different technologies. Some renewable energy sectors have developed much more ambitious projections showing that the European renewable energy industry could deliver much more than 20%.

4.3.2 RES Industry Roadmap up to 2020

4.3.2.1 Contribution of Renewables to Electricity Consumption for the EU-27 by 2020

Under the present state of market progress and the political support given to electricity generation from RES, the current target for RES-Electricity for 2010 can

	2005 Eurostat TWh	2006 Eurostat TWh	2010 Projections TWh	2020 Targets TWh
Wind	70.5	82.0	176	477
Hydro [1]	346.9	357.2	360	384
Photovoltaic	1.5	2.5	20	180
Biomass	80.0	89.9	135	250
Geothermal	5.4	5.6	10	31
Solar thermal elect.	-	-	2	43
Ocean	-	-	1	5
TOTAL RES	504.3	537.2	704	1370
Total Gross Electricity Generation EU27	3320.4	3361.5		
(Trends to 2030-Baseline) *			3568	4078
(Combined RES and EE) **				3391
Share of RES	15.2%	16.0%	19.7%	33.6-40.4%

1 - Normalised according to the formula proposed in the RES Directive

* - European Energy and Transport: trends to 2030 – update 2007, 2008, European Commission Directorate General for Energy and Transport
** - European energy and transport: Scenarios on energy efficiency and renewables, 2006, European Commission Directorate General for Energy and Transport

Fig. 4.3.2 Contribution of RE to electricity consumption (see *Color Plates*)

be met. The overall target can be reached through a higher contribution by some of the more successful technologies. The figures of Table 2 outline the new targets for 2020 with the expected annual growth rates and the necessary growth rate to increase the share of RES-electricity significantly.

If the projected growth rates were achieved, RE would significantly increase its share in electricity production. The estimations below are based on the rather moderate growth rate projections.

Depending on the development of the total electricity generation, renewable energies will be able to contribute between 33% and 40% to total electricity production. Assuming that the EU will fulfill its ambitious energy efficiency roadmap, a share of over 40% of renewables in electricity production by 2020 is realistic (Fig. 4.3.2).

4.3.2.2 Contribution of Renewables to Heat Consumption for the EU-27 by 2020

The lack of a favourable political framework in Europe for the renewable heating and cooling sector until now has prevented higher market penetration. With the creation of such a political framework expectations could be raised. The contribution of RES heating is especially significant in the biomass sector, but geothermal and solar thermal energy will also be able to increase shares significantly.

If the projected growth rates were achieved, renewable energies would significantly increase their share in heating production. The estimations below are based

	2005 Eurostat Mtoe	2006 Eurostat Mtoe	2010 Projections Mtoe	2020 Projections Mtoe
Biomass [1]	57.5	60.0	75	120 [2]
Solar thermal	0.68	0.77	1.5	12 [3]
Geothermal	0.63	0.68	3	7
TOTAL RES HEAT	58.8	61.45	79.5	139
Total Heat Generation EU27 (Trends to 2030) * (Combined RES and EE) **	579.2	570.1	 583.5	 606 541
Share of RES	10.2%	10.8%	13.6%	22.9-25.7%

1 - Biomass for heat and heat derived from co-generation and district heating
2 - AEBIOM (European Biomass Association) believes that a target of 147 Mtoe is achievable by 2020 for biomass for heat and derived heat
3 - Based on the assumption that 1m² of solar thermal collector area per EU inhabitant is achievable by 2020,
ESTIF's target is 21 Mtoe of solar thermal energy in 2020.

*- Includes only district heating
**- Includes all applications incl. shallow geothermal heat pumps

Fig. 4.3.3 Contribution of RE to heat consumption (2006–2020) (see *Color Plates*)

on the rather moderate growth rate projections and a share of 25% in 2020 seems to be possible (Fig. 4.3.3).

4.3.2.3 Contribution of Biofuels to Transport Fuel Consumption for the EU-27 by 2020

The EU depends heavily on imported energy for running its economy. For the transport sector there is hardly any diversification of energy sources: crude oil fuels more than 98% of the EU's transport sector. Biofuels have a major role to play both in improving energy security and tackling climate change, which are the core objectives of the EU's biofuels policy.

The current Biofuels Directive sets an indicative target of 5.75% in 2010. In 2007, the EU consumed between 2.5% and 3% of biofuels for road transport. Given the fact that the European biofuels industry experienced strong double-digit annual growth rates during the past several years Europe is well on track to reach the 5.75%. With the 10% binding target for the transport sector the Renewable Energy Directive sends a clear signal to investors and confirms the EU's strong commitment to renewable transport fuels. The 10% target is ambitious but feasible without any adverse effects on the environment or food availability.

The RES Directive sets an important framework for the future growth of the industry and will pave the way for a stable investment climate. New technologies and applications of biofuels will be developed and marketed up to 2020. With this stimulation of the industry and a further coordinated development of biofuels throughout the EU and the possibilities of significantly reducing the oil dependence in the transport sector over the next years, the European biofuels industry is committed to reach the share of 10% biofuels by 2020 (Fig. 4.3.4).

	2005 Eurostat Mtoe	2006 Eurostat Mtoe	2010 Projection Mtoe	2020 Projection Mtoe
Transportation Biofuels	3.13	5.38	16	34.0
Gasoline and oil consumption (Trends to 2030-Baseline) * (Combined RES and EE) **	297.2	300.4	317.3	349.5 323.9
Biofuels' Share %	1.05	1.79	5.0	9.7-10.5

* - European Energy and Transport: trends to 2030 – update 2007, 2008, European Commission Directorate General for Energy and Transport
** - European energy and transport: Scenarios on energy efficiency and renewables, 2006, European Commission Directorate General for Energy and Transport

Fig. 4.3.4 Contribution of RE to transport consumption (see *Color Plates*)

4.3.2.4 Contribution of RES to Final Energy Consumption

Given the present state of market progress and strong political support, the European RE Industry is convinced it can reach and exceed the 20% renewable energy share in final energy consumption by 2020. The estimates by the Renewable Energy Industry are based on a moderate annual growth scenario for the different technologies. Strong energy efficiency measures have to be taken to stabilise the energy consumption between 2010 and 2020.

EREC and its members assume that a 20% share of RE of final energy consumption by 2020 is a realistic target for the EU under the condition that certain policy developments will occur and a continuation of the existing policy instruments are ensured. The individual sector projections are based on moderate estimates, some of the sectors forecast much higher numbers for their sectors by 2020.

A development of all existing RES and a balanced mix of the deployment in the sectors of heating and cooling, electricity and biofuels guarantees the start of a real sustainable energy mix for Europe. The table below gives an overview of the resulting contribution of renewable energy in the electricity, heating and cooling and biofuels sectors towards attaining the overall 20% target.

4.3.4 RES Technology Roadmaps up to 2020

The following section contains an overview of the state-of-the art of the EU RE industry as well as the sector view on technological innovations expected to happen in the market from now up to 2020.

4.3.4.1 Geothermal Technology Roadmap up to 2020

In some regions of Europe geothermal power plants already substantially contribute to an environmentally friendly and sustainable energy supply, using existing technologies exploiting steam and hot water reservoirs. This is done mainly in Italy, the Azores and other islands of volcanic origin in Europe, including Iceland. In South-East Europe, Greece, Turkey and the Caucasian region huge, yet unexploited reservoirs, may contribute to a sustainable energy supply.

Meanwhile, innovative power plants permit the production of electricity using low thermal water temperatures around 100°C. A major advantage of geothermal energy is the availability of the resource all day and night throughout the year – a load to the grid, operating up to 100% of the time. Recently Austria and Germany have also produced electricity from low temperature geothermal sources.

The technological developments of recent years have opened new ways to use the heat from the interior of our planet. The excellent results achieved on the Enhanced Geothermal System projects in Soutlz-sous-forêt show that electric power can be produced from geothermal energy throughout Europe, at economically and ecologically acceptable conditions, and not only in regions known for high ground temperatures.

Heat supply from geothermal energy in Europe is achieved by using hot water from deep aquifers for district heating or other direct uses, or via a large number of small to medium shallow geothermal plants. Shallow geothermal allow the delivery of heating and cooling anytime and everywhere, and can be used for thermal energy storage.

To achieve the targets, besides economic incentives, research and technical development are required in the geothermal sector. Technology evolution can be expected in both the power and heat sectors, and towards increasing the usable geothermal potential, improving plant efficiency, and decreasing installation and operational cost – decrease to 2–5 €ct/kWh in 2020, for electricity generation.

In the geothermal power sector, the main new developments can be expected concerning:

- Develop enabling technologies for the exploitation of geothermal resources: innovative drilling technologies, resource assessment, utilisation of lower temperature resources, exploring supercritical zones, etc.
- Proliferation of the EGS (Enhanced Geothermal Systems) to other sites and regions.
- Increased overall efficiency in geothermal Combined Heat and Power (CHP), improvement of exploration methods, installation technologies, and system components (pumps, pipes, turbines, etc.).

The future development of the geothermal heating and cooling sector is bound to achieve:

- Improved site assessment (incl. geographic information systems – GIS), exploration and installation, also for shallow systems, and dissemination of successful approaches from some countries to the whole EU.
- Further increase of efficiency of ground source heat pumps, optimised system concepts, application of advanced control systems, improved components and materials (compressors, refrigerants, pipes, etc.).

– Construction of new district heating networks, and optimisation of existing networks and plants, in particular in East/South Eastern Europe and Turkey. Increased application and innovative concepts for geothermal energy in agriculture, aquaculture, industrial drying processes, etc.
– Demonstration of new applications such as de-icing and snow melting on roads, airport runways, etc., sea-water desalination, and geothermal absorption cooling.

In addition, non-technical development is paramount, comprising administrative and legal clarity, suitable infrastructure in the shape of machines and skilled labour, information to the public, etc.

4.3.4.2 Bioenergy Technology Roadmap up to 2020

4.3.4.2.1 Biomass

Biomass is a non-intermittent RES that can provide energy to be used for heating and cooling, electricity and transport. Biomass fuels can easily be stored meeting both peak and baseline energy demands. Biomass can take different forms (solid, liquid or gaseous), and can directly replace coal, oil or natural gas, either fully or in blends of various percentages. Bioenergy is CO_2 neutral, as all carbon emitted by combustion has been taken up from atmosphere by plants beforehand.

Bioenergy contributes to all-important elements of national/regional development, namely: economic growth through business earnings and employment; import substitution with direct and indirect effects on GDP and trade balance; as well as security of energy supply and diversification. Other benefits include support of traditional industries, rural diversification and the economic development of rural societies. Bioenergy can also contribute to local and national energy security that may be required to establish new industries. Additionally, biomass fuels can be traded at local, national and international levels, providing flexibility to countries that have less biomass resources.

Technological Development up to 2020

Significant progress has been achieved with biomass production and conversion technologies over the last decade resulting in the increase of competitive, reliable and efficient technologies. They are represented by dedicated large and small scale combustion, co-firing with coal, incineration of municipal solid waste, biogas generation via anaerobic digestion, district and individual household heating, and in certain geographical areas, liquid biofuels such as ethanol and biodiesel. Nevertheless, new fuel chains addressing more complex resources, new conversion routes such as gasification and pyrolysis, and new applications, are under development.

Biomass Heating

Biomass is the Renewable Heat source for small, medium and large scale solutions. Pellets, chips and various by-products from agriculture and forestry deliver the feedstock for bioheat. Pellets in particular offer possibilities for high energy density and standard fuels to be used in automatic systems, offering convenience for the final users. The construction of new plants to produce pellets, the installation of millions of burners/boilers/stoves and appropriate logistical solutions to serve the consumers should result in a significant growth of the pellet markets. Stoves and boilers operated with chips, wood pellets and wood logs have been optimised in recent years with respect to efficiency and emissions, however, more can be achieved in this area. In particular, further improvements regarding fuel handling, automatic control and maintenance requirements are necessary. Rural areas present a significant market development potential for the application of those systems. There is a growing interest in the district heating plants which currently are run mainly by energy companies and sometimes by farmers' cooperatives for small scale systems. The systems applied so far generally use forestry and wood processing by-products, but the application of the agro-waste will be an important issue in the coming years.

Combined Heat and Power (CHP)

Significant improvement in efficiencies can be achieved by installing systems that generate both useful power and heat (co-generation plants have a typical overall annual efficiency of 80–90%). CHP is generally the most profitable choice for power production with biomass if heat, as hot water or as process steam, is needed. The increased efficiencies reduce both fuel input and overall greenhouse gas emissions compared to separate systems for power and heat, and also realise improved economics for power generation where expensive natural gas and other fuels are displaced. The technology for medium scale CHP – from 400 kW to 4 MW – is now commercially available in the form of the Organic Ranking Cycle (ORC) systems or steam turbine systems. The first commercially available units for small scale CHP (1–10 kW) have just arriving on the market. A breakthrough for the gasification of biomass in the size between 100 and 500 kW might occur in a few years.

Biogas

Biogas technology is becoming an important part of the biomass-to-energy chains. Biogas is produced from organic matter under anaerobic conditions in nature (swamps), in landfills or in anaerobic digestion facilities (fermenters). Various types of anaerobic micro-organisms produce biogas from liquid manure, silage, left over food, waste or other organic materials. Biogas can either be used to fuel a gas engine, which is coupled with a generator to produce electricity and heat or – after upgrading to pure methane – in natural gas grids or in filling stations as transportation fuel for gas vehicles. Typically biogas is used in a CHP unit to produce electricity and heat, but its role as transport fuel will also become more important in the near future. Biogas produced from energy crops such as corn, sweet sorghum or others yields high energy outputs per hectare, because the total plant can be used as raw material and 65–80% of the carbon contained in the raw material can be converted to biogas.

Electricity Production

The use of biomass for power generation has increased over recent years mainly due to the implementation of a favourable European and national political framework. In the EU-25 electricity generation from biomass (solid biomass, biogas and biodegradable fraction of municipal solid waste) grew by 19% in 2004 and 23% in 2005. However, most biomass power plants operating today are characterised by low boiler and thermal-plant efficiencies, and such plants are still costly to build. The main challenge therefore is to develop more efficient lower-cost systems. Advanced biomass-based systems for power generation require fuel upgrading, combustion and cycle improvement, as well as better flue-gas treatment. Future technologies have to provide superior environmental protection at lower cost, by combining sophisticated biomass preparation, combustion, and conversion processes with post-combustion clean-up. Such systems include fluidised bed combustion, biomass-integrated gasification, and biomass externally fired gas turbines.

Feedstock

Biomass resources cover various forms, such as products from forestry and agriculture, by-products from downstream agro and wood based industries, as well as municipal and industrial waste streams (the biodegradable fraction). Dedicated woody or herbaceous energy crops can be grown, and transformed into various forms of energy. Improved agricultural and forestry practices can result in higher yields per hectare and per unit of input. New methods in erosion control, fertilization, and pre-processing can result in improved life cycle performance, sustainable practices, and enhanced feedstock production.

4.3.4.2.2 Biofuels

The two most commonly used biofuels are bioethanol and biodiesel. At a global scale bioethanol is the preferred biofuel (90%). However, in Europe 75% of the market is biodiesel. Bioethanol is the principle fuel used as a petrol substitute for road transport vehicles whereas biodiesel substitutes fossil-derived diesel. These first generation biofuels have the big advantage that during their production not only liquid fuels are produced but also protein feed, which is in terms of quantity are as important as the fuels.

- **Bioethanol.** Bioethanol, also known as alcohol, is a renewable fuel made by fermenting sugars mainly from cereals such as wheat, maize, triticale, rye, barley and from sugar cane or sugar beet. Since 1986, EU law has permitted up to 5% bioethanol in petrol, and today most of the European petrol fleet can accept a 10% blend. Bioethanol can also be used in much higher concentrations in adapted cars such as E85 cars that run on a blend of up to 85% bioethanol and 15% petrol. Pure ethanol also fuels buses and trucks in Europe.
- **Biodiesel.** Biodiesel is the renewable transport fuel produced from plants such as sunflower or rapeseed as well as from used cooking oils, tallow or algae. It is a convenient transport fuel solution in Europe, being allowed in 5–7% blends in diesel for normal cars. In vehicle fleets for public transportation it can be blended from 30% to 100% with some engine and filter modifications.

The Biofuels Industry

- **Bioethanol.** Europe's fuel ethanol sector was a slow starter. It took almost 10 years to grow production from 60 million litres (47 kt) in 1993 to 525 million litres (414 kt) in 2004. In 2005 and 2006 there were double-digit growth levels of over 70%. In 2007 production increased by 'only' 11% to 1.7 billion litres (1.34 million tonnes). The top 4 EU producers of ethanol are France, Germany, Spain and Poland. Production capacity for bioethanol fuel in the EU is rapidly increasing. At present there is an installed capacity of 4 billion litres (3.16 million tonnes) and another 3.5 billion litres (2.76 million tonnes) under construction. Most of this capacity is located in France, followed by Germany and then Spain.
- **Biodiesel.** In 2008 a total of 214 biodiesel production facilities stand ready to produce up to 16 million tonnes of biodiesel per year. Production in 2007 was 5.74 million tonnes, reflecting a difficult year due to the presence of unfair US B99 subsidised imports. While at European and international level biodiesel production increased rapidly in absolute terms, more recently biodiesel production growth has decreased by a factor of 3 due to unfair competition from the US. This case is now being handled by competition authorities in EU and US. In addition there is an increasing diesel deficit at EU level, which makes European consumers economically vulnerable in front of unstable suppliers like Russia or Middle East countries. To this problem, biodiesel brings a practical and green solution having capacity already in place for substituting part of the fossil fuel demand.

[2]These numbers were based on an oil price of $48/barrel and therefore considerably underestimate job creation in Europe.

Employment and Economic Impact

Rural areas of Europe suffer higher than average rates of unemployment and underemployment. Those with jobs receive incomes significantly below the EU average. European biofuel farming and processing means more jobs, and increased wealth for rural communities. The European Commission estimates that a 10% market share of home-grown biofuels would lead to a net increase in EU employment of approximately 150,000 jobs.[2] This would lead to an increase in the European Union gross domestic product by at least some €25 billion and an increase in GDP of 0.17%.[3] Moreover, the sustainability path in which the biofuels industry is engaged, ensures a balanced development for rural areas and a decrease in disparities among European regions. For European production, CAP cross-compliance rules ensure already that a high sustainability standard is met.

Technological Development up to 2020

Despite the fact that biofuels production is a well-known and proven technology, many crucial research tasks remain to be accomplished, aiming at maximising the benefits of biofuels in Europe. The most important R&D objectives are further GHG emission reduction whilst enhancing economic viability. The main developments expected for 2020 are the following:

Feedstock

- **Bioethanol** – Advanced generations of bioethanol fuel offer the prospect of sourcing energy from an even wider range of feedstock. These include non-food crops such as grasses; agricultural wastes such as cereal straws and corn stover; industrial, municipal and commercial wastes and processing residues such as brewer's grain; and forest products and waste such as wood and logging residues. Those new pathways will provide even higher GHG savings.
- **Biodiesel** – Biodiesel production is expanding its feedstock and technological processes due to constant investment in Research and Development (R&D). New crops are being added to the traditional ones: algae or mono-crops from deserted land (i.e. jatropha curcas), used cooking oils or animal fats. These new pathways have an overwhelming positive impact on GHG savings, productivity increase, soil fixation, water purification, and can also be valuable from the perspective of third world country development.

[3] Renewable Energy Roadmap impact assessment.

Conversion Technology

Biomass Enzymatic Hydrolysis – Compared with a conventional dry-mill process, production of ethanol from new feedstock requires extensive processing to release the sugars in cellulose and hemicellulose that account for 30–50% and 20–35% of plant material, respectively. However, the composition of biomass is variable and more complex than starch-based grain feedstock. The right combination of the 'enzymatic cocktail' will be able to attack the cellulose and hemicellulose fractions, releasing sugars for fermentation. Research is being carried out to bring down the substantial costs of enzymes and thus the overall production costs of advanced bioethanol.

A further challenge is efficient co-fermentation of both hexose (six carbon, *C6*) and pentose (five carbon, *C5*) sugars to ethanol. None of the yeasts or other micro-organisms currently in commercial use can ferment *C5* sugars. Research is proceeding to develop organisms that can effectively use both types of sugars in order to maximise ethanol yields per ton of biomass feedstock. Efficient conversion of both types of sugars to ethanol is needed to make the whole process economical.

Thermo-chemical conversion – The biomass first undergoes a severe heat treatment. In the presence of a controlled amount of oxygen, a process called gasification takes place. The product gas from gasification is called synthesis gas or syngas. If the process is conducted in the absence of oxygen, the process is called pyrolysis; under certain conditions, this process might yield predominantly a liquid product named bio-oil.

The syngas can be used in a catalytic process for the synthesis of a variety of products. In a Fischer-Tropsch (FT) process, the syngas will be used for the production of transportation fuels like diesel and gasoline, along with other chemicals. The syngas can be used as well for the synthesis of methanol, ethanol and other alcohols. These in turn can be used as transportation fuels or as chemical building blocks. The bio-oil can be burned for direct energy production in a combustion process or can be gasified to syngas. Another potential use is the extraction of chemicals.

This 'biorefinery' concept, where biomass is processed into a wide spectrum of marketable products, resembles a petroleum refinery: the feedstock (conventional or advanced) enters the refinery and is, through several processes, converted into a variety of products such as transportation fuels, chemicals, plastics, energy, food and feed. The feedstock is used in the most efficient way thus enhancing economic, social and environmental sustainability.

New Utilisations

– **Bioethanol in fuel cells** – One of the newest markets being looked at for bioethanol uses is fuel cells. Electrochemical fuel cells convert the chemical energy of bioethanol directly into electrical energy to provide a clean and highly efficient energy source. Bioethanol is one of the most ideal fuels for a fuel cell. Besides the fact that it comes from renewable resources, highly purified bioethanol can solve the major problem of membrane contamination and catalyst deactivation within the fuel cell, which limits its life expectancy. Extensive research activities ensure that bioethanol remains among the most desirable fuels for fuel cells, delivering all the benefits that the bioethanol fuel cell technologies promise.

- **E-diesel** – The bioethanol-diesel blend, better known as E-diesel, contains up to 15% bioethanol, diesel fuels, and additives. Compared with regular petrol-diesel fuel, E-diesel can significantly reduce particulate matter and toxic emissions, and improve cold flow properties. Research is underway to make E-diesel commercially available.
- **Algae biodiesel and jet fuel applications** – While algae biodiesel has the same characteristics as normal fuel, the production process can be also used to capture CO_2 from power stations and other industrial plants (synergy of coal and algae). Algae oil production per acre is extremely high and does not even require agricultural land as it can be grown in the open sea, open ponds or even on industrial land in photobioreactors. Moreover algae biodiesel production can be combined with wastewater treatment and nutrient recycling, where polluted water (cleaned by algae) acts as a nutrient in their growth. But most importantly is that algae biodiesel jet fuel represents the best potential answer for the sustainability of the aviation industry.

4.3.4.2.3 Solar Thermal Roadmap up to 2020

Solar thermal systems are based on a simple principle known for centuries: the sun heats up water contained in a dark vessel. Solar thermal technologies on the market are now efficient and highly reliable, providing solar energy solutions for a wide range of areas of use and potential users. Most of the systems sold today are intended to supply domestic hot water, and an increasing number of Combi Systems additionally provide thermal energy for space heating, thus lowering the conventional energy demand for space heating.

The Solar Thermal Industry

What started in the 1970s as garage businesses is now an established international industry. Some of the pioneers are still amongst the market leaders. A number of major players from ‘neighbouring’ sectors entered the market. At the same time, several solar thermal companies are diversifying into other Renewable Energies such as biomass heating or solar PV.

The large majority of the systems sold in Europe are manufactured within the EU or its Mediterranean neighbours. Imports from Asia are limited mainly to components such as evacuated glass tubes. For European manufacturers, exports outside the EU are becoming a growing market. The main selling point is their high quality and reliability.

The industry is in a phase of dynamic growth. Production lines are constantly being expanded. Employment in the European solar thermal sector already exceeds 20,000 full time jobs. With the expected growth of solar thermal, more than half a million people will be employed in the solar thermal sector in just a few decades.

As in all industrial sectors, manufacturing will be more exposed to global competition as the market develops. However, for solar thermal, nearly half of the jobs are in retail, installation and maintenance. These works are necessarily local, and create jobs mainly in small and medium sized enterprises, directly in the areas where the solar thermal market develops.

Technological Innovations Expected in the Sector Until 2020

Energy demand of buildings makes up approximately 40% of the total energy demand in Europe – most of which is due to low-temperature heat demand for domestic hot water and for space heating. Today, solar domestic hot water systems are mature technologies and combi systems, which additionally cover parts of the space heating demand, have become commonplace in several Central and Northern European countries.

Other applications, which are expected to play an important role in tomorrow's energy supply have been successfully demonstrated and are slowly finding their way into the markets, for example, solar assisted cooling, solar industrial process heat, and solar desalination.

Increased funding for R&D – both from the private and the public budget – will enable solar thermal to cover an ever-larger share of the low- to medium temperature heat demand. Refined integration with other heating and building technologies, as well as falling costs will guarantee a broad adoption of solar thermal solutions for heating and cooling.

Solar Assisted Cooling

The global market for cooling and air-conditioning technologies is growing rapidly. Most of the demand is met by conventional, electricity-driven machines and their energy demand is putting an ever-increasing burden on power grids. Blackouts in summer are becoming a more usual occurrence. Thermally driven cooling machines have existed for decades. They typically used waste heat from industrial processes or co-generation plants and came in sizes above 100 kW cooling capacity. In recent years, machines with smaller capacities (20–50 kW) have entered the market, which can be driven by solar thermal energy. And the next generation of 2–5 kW machines is being tested. Because of the typically high coincidence of cooling demand and the availability of solar irradiation, solar cooling offers a convenient way to reduce unnecessary electricity demand in summer.

Research focuses on new materials, lowering costs and the development of practical guidelines and planning tools for solar cooling installations. It is expected that Solar Combi+ systems, which provide domestic hot water, space heating in winter and cooling in summer, will gain a major share of the solar thermal market by 2020–2030.

Solar Industrial Process Heat

Much industrial and commercial heat demand is in the temperature range up to 250°C, which could be supplied by solar thermal. For this, new types of collectors – specially designed for medium-temperatures – are being developed. So far, solar thermal has been used mainly for less critical processes, such as washing processes. With growing experience, solar thermal will spread to all kinds of industrial heat demands.

Solar Desalination

The availability of drinking water is a growing concern for many countries all over the world. The energy demand for desalination of seawater is on the rise, and especially in areas without connection to central electricity grids – solar thermal desalination can be advantageous already today. With more R&D efforts into this promising approach, new and more cost effective solar desalination will be made available.

Advanced Heat Storages

Most of the solar thermal systems used today use water to store heat for a few hours or days. Larger storage capacities are typically realised through increased tank sizes. Large underground water storages – natural aquifers or man-made concrete tanks – are already used for seasonal storage. But only advanced heat storage, which allows the efficient storage of larger amounts of thermal energy in smaller volumes will allow, e.g. existing buildings to be heated 100% by solar thermal energy. Phase change materials or thermo-chemical processes are being explored for these purposes. An increase of the energy density of heat storages by a factor of 8 would make it possible to convert the whole building sector into 100% solar heated buildings. While a breakthrough cannot be expected in the short run, increased R&D efforts in this field could already provide these new storage technologies by 2030.

4.3.4.2.4 Photovoltaic Technology Roadmap up to 2020

Photovoltaic (PV) solar electricity has a very high potential, since solar energy is a practically unlimited resource available everywhere. Therefore, it is ideally suited for distributed generation of electricity near the user, everywhere around the globe.

The PV Industry

During recent years the European PV industry has developed very successfully. All branches of PV (manufacturing, distribution, and system installation) are represented by strong companies, and their global market share is rising steadily. Technology development and research are on a high level, and the industry is in an excellent position regarding the challenges of the future. This Roadmap is designed to be an effective tool for maintaining, exploiting and strengthening European leadership in the PV sector.

Yearly growth rates for the PV industry were on average more than 40% between 2000 and 2007, which makes photovoltaics one of the fastest growing industries. In 2007, a world-wide production volume of 3 GW_p of PV modules was reached, and with a turnover of more than €14 billion, the PV industry employs over 119,000 people.

New Photovoltaic Industry Target: 12% of Final EU Electricity Demand by 2020

EPIA (European Photovoltaic Industry Association) redefined in September 2008 its industry objectives in the light of recent technology progress and the context of rising energy prices. The industry unanimously agreed that photovoltaic energy could provide 12% of European electricity demand by 2020.

The evolution of solar photovoltaic technology will be quicker than previously announced. Based on the concept of Grid Parity (when photovoltaic electricity is equal or lower than the retail electricity price), EPIA has shown that the addressable market for PV within the EU-27 will represent about 60% of the final EU electricity demand in 2020. This is mainly due the rising electricity prices in the different European countries and the decreasing cost of PV according to its 20% experience curve factor – the price of photovoltaic is reduced by 20% each time there is doubling of the cumulative installed capacity. Countries like Italy with high irradiation and high electricity prices are expected to reach Grid Parity in 2010. This Grid parity will be reached in Germany in 2015 and will cover progressively most other EU countries until 2020.

In order to reach this target, the PV industry does not expect any major technological change but rather continuous technological improvement. The acceleration of cost reduction will be achieved by economy of scale due to an accelerated PV deployment. The PV industry committed itself to make the necessary investments (annual growth rate 40%) in order to achieve the necessary price reduction.

It is absolutely vital and necessary to point out that this ambitious goal can only be achieved if in most of the 27 EU member states appropriate support programs – ideally in form of a well structured feed-in law with appropriate degression – will be in place for the next few years until the market drives the sector.

Achieving a 12% of European electricity demand in 2020 will place photovoltaic as a major source of electricity supply within the EU, which means that the photovoltaic installed capacity will reach 350 GW_p generating 420 TWh annually. Under such a scenario, the target of 20% renewables in the European end energy mix by 2020 may be exceeded, especially when taking into account the contribution from other RES.

Technological Innovations

The production of PV cells is constantly improving as a result of both technology advances and changing industrial processes. Production costs need to be reduced considerably to penetrate the major electricity markets. Consequently, the main effort of research and industrial technology development is directed towards reducing the production cost. About 75% of the PV system price is represented by the module, 10% by the balance of system components, and 15% by installation costs. The European Photovoltaic Industry Association (EPIA) expects that prices of systems will come down from about current €4 to €2/Wp by 2020.

The electricity generating cost has already declined from 55–110 €ct/kWh in 1990 to 22–44 €ct/kWh today, and will further decrease via 11–22 €ct/kWh in 2020 towards 7–13 €ct/kWh in 2030 – lowest value accounts for countries with high sun irradiation (1,800 full sun-hours/year) while highest value is for countries with low irradiation (900 full sun-hours/year).

The silicon (*Si*) wafer based solar cells in their different forms – mono-crystalline (*Cz-Si*), multi-crystalline (*mc-Si*), ribbon – represented in 2007, 90% of the photovoltaic market. The remaining 10% is covered by thin film technologies, mainly amorphous silicon (*a-Si*), cadmium telluride (*CdTe)* and Copper indium (*Gallium*).

Selenide *CI(G)S*. The share of Thin Film PV technologies is rapidly increasing due to both its low production cost and the recent poly-silicon shortage, which has affected the crystalline silicon producers. This shortage is expected to be overcome during 2009. EPIA expects thin film technologies to increase their market share to 20% and 35% in 2010 and 2020, respectively.

Concerning Si based technologies, the cost of raw material and consequently the cost of the wafer is a substantial part of the total cost of solar cells. As such, cost reduction of wafer production is a real challenge for the industry. EPIA has adopted the following technological goals in this field for 2010:

- Average material (*Si*) consumption for crystalline silicon from 9 gram per Watt peak (g/W_p) to 7.5 g/W_p
- Ribbons from 8 to 4 g/W_p
- Wafer thickness from 240 to 150 μm
- Kerf loss in the sawing process from 250 to 150 μm

Since the first solar cell was developed 50 years ago, major improvements in efficiency have been achieved. With much potential still to be exploited, EPIA has defined the following targets for the European PV industry up to 2020:

- Average efficiency increase for mono-crystalline silicon from 16.5% to 22% (although some commercial cells are already on the range of 19–22% efficiency)
- Efficiency increase for multi-crystalline silicon from 14.5% to 20%
- Ribbon efficiency from 14% to 19%

PV thin film technology, constructed by depositing extremely thin layers of semiconductor materials on a low-cost backing (glass, steel, flexible steel and plastic foils), offer the potential for significant cost reductions and flexible integration in buildings. Firstly, material and energy costs should decrease because much less semiconductor material is required and much lower temperatures are needed during manufacturing. Secondly, labour costs are reduced and mass production prospects improved because, unlike crystalline technologies where individual cells have to be mounted and wired together, thin films are produced as large and integrated series-connected modules.
EPIA has defined two targets for thin film technologies up to 2020:

- Module thin film aiming at efficiencies between 10% and 17% (*a-Si/mc-Si, CI(G)S and CdTe*)
- Building integrated PV (BIPV) with low cost per m^2, price reduction of 75%

Future material developments include further optimisation of the previously identified cell concepts but also the development and commercialisation of new concepts such as polymer solar cells and other types of organic solar cells (dye sensitive solar cells). Thin film solar cells on the basis of gallium arsenide (*GaAs*) and other III-V-compounds show the highest conversion efficiencies measured so far. Although they have a higher cost than Si-based cells, they are ideally suited for concentrating systems where the area price of solar cells is of minor importance. Solar cell efficiencies of 40.7% under concentrated light have been demonstrated in the laboratory, and concentrating systems have shown efficiencies over 25%. Concentrating systems using highest efficiency solar cells are becoming an interesting opportunity for installations in southern countries with high levels of direct irradiation.

Improvement in the lifetime of solar modules is another step to further reducing solar electricity prices. EPIA aims to expand their lifetime from 25 to 35 years, for example by longer lifetime encapsulation material or new module architectures. For the BOS (Balance of System) components, substantial cost reductions will result from larger production quantities. The operation time of these devices should be extended to the lifetime of modules. Standardisation of components and systems is important for mass production.

4.3.4.2.5 Solar Thermal Electricity Roadmap up to 2020

Solar Thermal Electricity is produced using concentrating solar radiation technologies. It is also known as Concentrating Solar Power (CSP) technologies. Solar thermoelectric power plants are fully dispatchable, match perfectly with the demand curve and can additionally provide the necessary back up to other fluent

renewable conversion technologies. Solar thermo-electric generation is highly predictable, and it can be coupled with thermal storage or hybridisation, with gas or biomass, providing stability factors for the national or European electricity networks. Solar thermo-electric plants have favourable inertial responses, as well as the capacity for primary, secondary and tertiary electrical regulation in both ways, up and down. Solar thermo-electric power plants can meet the demand needs at any time, day and night, and can supply electricity at peak hours if previously planned. Furthermore these plants can also easily respond to the demand curve and contribute to the electrical system's stability, allowing huge amounts of other less 'dispatchable' RES in the electrical systems.
The Solar Thermo-Electric technologies can be classified as follows:

– Parabolic-Trough Collector Plants
– Linear Fresnel Systems
– Central Receiver Plants
– Dish-Stirling Systems

The Industry

The great dynamism, the high potential, the operational reliability, the current production capacity of the European industry and the good dispatchability characteristics of this sector, makes solar thermo-electric generation a strategic resource for planning the 2020 European electricity scenario.

Europe, particularly Germany and Spain, is the world leader in this technology as demonstrated not only by the number of plants under construction in Spain but also by the ownership and construction of new plants in the USA and the international tendering of plants in northern Africa or the middle East which are being awarded to European companies, as well as by the number of R&D activities promoted and developed by research centres and by the industry.

Regarding components manufacturing, there are factories in many EU countries, for parabolic mirrors, absorber tubes, collector structures, heliostats, steam turbines, alternators, transformers etc. European solar plant construction and engineering are world references for these projects. The plants require skilled labour for construction, maintenance and operation. The types of jobs initially created would most likely be technical or in construction, but opportunities for manufacturing and service jobs may also develop as facilities evolve. For Solar Thermo-Electric Power Plants, every 100 MW installed will provide 400 full-time equivalent manufacturing jobs, 600 contracting and installation jobs, and 30 annual jobs in O&M (Operations and Maintenance).

In summary, the European industry is perfectly prepared to lead the development of these technologies worldwide.

Technological Innovations

– Parabolic-Trough Collector Plants

These plants use line-concentrating parabolic trough collectors which reflect the solar radiation into an absorber tube. Synthetic oil circulates through the tubes and is heated to about 400°C. Parabolic trough collectors are the most mature solar thermo-electric technology in the market. It can present a track record since the 1980s in the USA with a total power installed of about 350 MW, and a number of new plants have been constructed in the last years. Today 18 plants are under construction in Spain, which amounts to 700 MW. This technology is commercially and technically viable and the plants are being financed by banks on a regular basis. Nevertheless, public promotion and support schemes by means of direct investment, tariff increase (feed in) or by means of compulsory power objectives, are still necessary.

Some of the Spanish 50 MW power plants under construction have been designed to provide not only the nominal power in sunny hours but also to store energy, allowing the plant to produce an additional 7.5 h of nominal power after sunset, which dramatically improves the integration of solar thermal power plants into the grid. Molten salts are normally used as storage fluid in a hot and cold 'two tanks' concept.

The expectations on the reduction of the kWh generating costs are based upon the efficiency increase based on higher working fluid temperature. Further to this a more efficient use of the generation group by means of the storage is needed, with new concepts for the collector design and/or the contribution of the other primary sources (gas or biomass), by the size optimisation, and also by market evolution, without artificial administrative barriers are required.

R&D programmes are being carried out in several countries (Germany, Spain, Italy, USA, etc.) in order to improve the performance and reduce the cost of these plants. The maximum nominal efficiency of these plants is currently about 16% and it is limited by the working fluid temperature. R&D activities are being carried out in order to find more efficient fluids such as direct steam generation or molten salts. These technologies are not commercially available today, but there are many ongoing development initiatives, which are expected to be commercially available shortly.

Up to now more than 10,000 MW of projects under development were registered in Spain in October 2008.

– Linear Fresnel Systems

Linear Fresnel collectors are line focusing systems like parabolic troughs, with a similar power generation technology and thus with the same limitations. These systems are in a developing stage with first prototypes recently built and operated. The difference to parabolic troughs is the fixed absorber position above a field of horizontally mounted flat mirror stripes collectively or individually tracked to the sun. Demonstration plants in the several MW-scale have to be built to evaluate and prove electricity generation costs and to gain operation experience, thus eventually also commercial confidence.

– Central Receiver Plants

This conversion technology uses big mirrors (larger than 100 m^2) which are almost flat, called heliostats, which track the sun in two axes. The concentrated radiation beam hits a receiver atop a tower. The working fluid temperature depends on the type of fluid which is used to collect the energy and is in the range of 500 up to 600°C.

The PS 10 of Abengoa in Seville is the only power plant of this kind in operation today. The nominal power output is 10 MW and it is designed with a northern heliostat field and saturated steam as working fluid in the receiver. The storage system is only designed to cope with the transient situations. A second plant of 20 MW nominal power, in the same site and with a similar design will commence operation in the forthcoming months. Another 17 MW plant owned by Torresol is in a fairly advanced development phase. It will be placed as well in the province of Seville and it will be of a circular field type with a molten salt receiver and with a storage capacity of 15 h.

The commercial confidence in this technology will grow as more operational plants are being built and it will certainly improve in the near future.

– Dish-Stirling Systems

In this case the system consists of a parabolic dish, which tracks the sun and concentrates the radiation onto one spot where the heat absorber of a Stirling motor is placed. Helium is mainly used as a working fluid. This alternative is particularly well suited for decentralised power generation in the range of some 10 kW, although a larger power output could be achieved with the corresponding number of units arranged in a farm concept. The efficiency of the dish-stirling systems is higher then the two previously mentioned technologies and is potentially around 25%.

Until now there are only a few systems in operation, mostly as demonstration units, and the number of stirling motor manufacturers is also very small. Therefore there is not yet any sufficient experience and cost/power ratio data. Improved efficiency and the ability to supply electricity in isolated areas makes this technology very attractive for these types of applications.

4.3.3.2.6 Small Hydropower Roadmap up to 2020

Small Hydropower (SHP) – up to 10 MW of installed capacity – can be one of the most cost effective methods of generating electricity. Small hydro plants have a long life span and relatively low operation and maintenance costs. Once the high up-front costs are written off, the plant can provide power at low costs, as the life time of a SHP plant is potentially 100 years. Small Hydropower can provide baseload capacity and its potential in Europe is not yet fully exploited.

Hydro (large and small) is still the largest RES in the electricity sector. It contributed to 10% of total electricity consumption in 2006, and produced about 79% of total Renewable Electricity production in the same year (10% SHP and 69% Large Hydro).

Small Hydropower is not growing as expected mainly due to administrative and environmental barriers. Nevertheless the sector has real potential, especially in the New Member States (it has been estimated an additional 7.7 TWh in the New Member States for 2020).

The Hydro Industry

The European Small Hydropower sector has a turnover of about €120–180 million. The sector currently employs around 20,000 people in Europe and could easily reach in 2020 some 28,000 jobs. The European Hydro turbine manufacturers (large and small) have a turnover of about €3.5 billion. For 2020 it is expected to increase the turnover to €5.5 billion.

Technological Innovations Expected in the Sector Until 2020

Nowadays engineers working in the Small Hydropower field continue to develop techniques specific to Small Hydropower, in order to face the following challenges:

- Foster environmental integration
- Decrease cost
- Maximise electricity production
- Hybrid systems
- Standardisation
- Energy storage for the other RES

Small hydropower ought to be systematised as far as possible, so as to achieve an optimal design from a technical, environmental and economic point of view. This systematisation process has the advantage of guaranteeing the performance of the equipment, regarding the exact characteristics of the site to be equipped, thanks to the fact that it is based on laboratory developments. Therefore, the turbine R&D on SHP has focused on very-low-head and low-head turbines, as these sites make up the important remaining potential in Europe.
The results of turbine R&D by 2020 will:

- Allow manufacturers to propose simple, reliable and efficient turbines with guaranteed performances
- Exploit the important remaining potential composed mainly of low-head and very-low-head sites
- Cover the high cost of laboratory development, especially for SMEs
- Improved integration of SHP plants into the environment, by using water resources rationally, and by building submersible turbo-generators

– Increase the cost-effectiveness of the power plant, by simplifying turbine design, while optimising the annual electricity production and by using new materials

Such R&D allows SMEs to develop within the SHP market, and to increase their turbines' delivery per year. Such development also results in employment creation locally. At present, most R&D efforts concerning civil engineering aim at standardising design and technology, so as to reach an optimal integration of the SHP plant within the local environment while minimising costs and impacts into the ecosystems. Such objectives are reached by setting guidelines based on the latest design technology, new materials and best practice examples.

The development in civil engineering is continuously expanding and it is essential to integrate this development into the basic design technology through the whole chain of power plant design and construction. Indeed the global objective is to reach an optimal solution and a good environmental integration for every specific hydropower plants, both for new projects and restoration of old plants. The multipurpose schemes envisaging different uses and applications of the SHP is gaining importance as well in order to increase the social acceptance of the projects.

R&D results on electrical engineering are providing the SHP sector with available solutions ranging from generators, to grid connection, electric drives, and the control and management of the whole power plant.

New generator designs such as high pole synchronous generators with permanent magnet excitation have been introduced to the SHP market. Designed for direct grid connection or in combination with a frequency converter for variable speed operation, such generators allow avoiding speed increases and making very compact submersible turbine designs possible.

Current digital control systems offer site-specific optimisation methods in order to adapt the overall control to any hydrological or other condition. New concepts such as scheduled production, prediction of the energy output and condition monitoring are currently under development also for SHP, in order to improve grid integration, increase reliability and reduce the operation and maintenance costs.

The significant increase in research concerning the biological mechanism in rivers has consequently initiated the development of environmental engineering, focusing on minimising the local negative environmental impact on the river ecosystem and on the mitigation of it. Well-known examples are fish bypass systems, environmental flow or river restructuring. The close cooperation with ecologists has led to excellent compromises between environmental targets and economic and technical restrictions.

Such engineering is in continuous evolution especially in the design of fish bypass systems and fish friendly turbines in order to minimise fish damage; future R&D will deliver appropriate fish screening systems for downstream and upstream migration and new technically optimised fish bypass systems that guarantee the highest fish acceptance while reducing the amount of bypass operation flow.

4.3.3.2.7 Ocean Technology Roadmap up to 2020

Ocean Energy (OE), particularly offshore wave energy, is a significant source of energy, and has the potential to satisfy an important percentage of electricity supply worldwide. Globally, the exploitable potential of OE has been estimated around 30,000 TWh. The most significant advantages of OE are the vast availability, high predictability and stability of the resource, as well as the very low visual impact.

Currently many different concepts and devices have been developed (tapping on tides, waves, current, thermal gradient, and saline gradient), many of them are in an advanced phase of R&D, large scale prototypes have been deployed in real sea conditions, and some have reached pre-market deployment. There are a few grid connected, fully operational commercial wave and tidal farms.

Electricity Production

By 2020, the global installed capacity is estimated to be in the order of 21 GW, delivering an estimated power of 50 TWh, corresponding to 0.6% of the estimated world electricity consumption. By 2050, ocean energy is expected to deliver 660 TWh.

Socio-economic and Environmental Impact

The creation of an ocean energy industry could lead to a significant increase in jobs that is estimated to be in the range of 10–20 jobs/MW in coastal as well as in other regions as many equipment suppliers are not in coastal areas. Like any electrical generating facility, an OE power plant will affect the environment in which it is installed and operates. A number of the Environmental Assessment documents have been assessing the potential impacts of wave and tidal energy. These assessments, and the follow-on consents for installation of wave and tidal ocean energy conversation devices have provided findings of no significant environmental impacts. These findings support the general opinion that ocean energy represents a benign means of renewable energy generation with potential positive impacts in developing associated marine protected areas.

Technological Development and Research Priorities

Ocean energy has a tremendous potential to make a significant contribution to the renewable energy mix. While developers work diligently on technology development, their ability to expand commercially may be significantly hindered unless non-technological barriers are addressed in earnest:

– Electrical grid access: ocean energy is a coastal resource. Except for coastal countries, like Portugal and the SW region of UK where this problem is less critical as they that have high voltage transmission lines available close to shore, coastal communities lack sufficient transmission lines capacity to provide grid access for any significant amount of electricity that can be generated from ocean energy.
– Regulatory framework: initial efforts in securing installation permits in a number of countries demonstrated that permitting is expensive, long, and intensive. Governments can significantly impact licensing of ocean energy systems by creating one-stop permitting structures.
– Availability of resource and other physical data: top-level analyses of the available ocean energy resources have been done and are widely available. Now, these top level analyses need to be overlaid with constraints that would prevent harvesting of ocean energy in specific areas, i.e. other uses of the sea, access to transmission lines, populations centres, ocean geology etc.
– Economic incentives: it is a known fact that artificial market conditions need to be created at the early stage of industry development to create a market pull and to incentivise early adapters. Such market pull can have three elements – incentives for investors (investment tax credits), incentives for end-users (investment and production tax credits) and feed-in tariffs that would make high-cost pre-commercial ocean energy converters competitive.
– Public awareness: ocean energy is lacking public awareness, as it is a developing industry. A public awareness campaign may provide similar benefits as was enjoyed by the wind industry in its early days.

Recommendations

OE can become a major player in the world-wide renewable energy mix in a fairly short time, provided that industry players have access to the same level of financial support and incentives as other emerging industries. In particular, governments and private investors have the necessary resources to propel OE from a demonstration stage to the commercial stage in less time that it took the wind industry to mature. The following are some of the recommendations that can stimulate the growth of this emerging industry:

- Permitting, licensing, consenting requirements needs to be simplified and coordinated.
- Market driven incentives drive innovation.
- As demonstrated from other industries, long-term, fixed feed-in tariffs become a major factor in attracting project financing.
- Infrastructure, such as grid access, requires a long-term outlook and planning.
- Support baseline studies and follow up programmes related to the environmental impact.
- Establish a better balance between funding of research and demonstration projects.
- Ocean energy should be assessed in conjunction with other developing technologies to develop hybrid systems.

Considering the harsh marine environment, design of OE systems has to address significant technical challenges, those to achieve high reliability, low cost and safety.

At present there is no commercially leading technology among ocean energy conversion systems, which will be attained only after significant deployment and operational experience. However, it is expected that a different principle of energy conversion will be used at various locations to take advantage of the variability of ocean energy resource.

4.3.3.2.8 Wind Technology Roadmap for 2020

In 2007, wind power grew more in Europe than any other power generation technology making it the largest contributor to economic activity and employment in that sector. Over the last 10 years, only gas has exceeded wind power in the EU in new installed capacity. Cumulative installed wind capacity is perhaps the most relevant proof of this amazing success story. By the end of 2003, the EU-15 had installed more than 28,000 MW of wind turbine capacity. By the end of 2007, the enlarged EU-27 had in excess of 56,000 MW of capacity.

These 56,000 MW met 3.7% of total EU electricity demand, provided power equivalent to the needs of 30 million average European households and avoided 91 Mt of carbon dioxide emissions. In addition, there were billions of euros saved on imported fuel costs in 2007, while more than €11 billion were invested in installing wind turbines in Europe.

As a result of the climate and energy crisis, the EU has set a binding target of 20% of its energy supply to come from wind and other renewable resources by 2020. To meet this target, more than one-third of European electrical demand will need to come from renewables, and wind power is expected to deliver 12–14% (180 GW) of the total demand. Thus wind energy will play a leading role in providing a steady supply of indigenous, green power.

Europe is the undisputed global leader in wind energy technology. Sixty per cent of the world's capacity was installed in Europe by the end of 2007, and European companies had a global market share of 66% that year. Penetration levels in the electricity sector have reached 21% in Denmark and about 7% and 10% in Germany and Spain respectively.

Within a few years, large wind turbine manufacturing companies and project developers/operators will construct wind power plants the size of conventional power plants, up to 1,000 MW, which will lead to even greater penetration levels. The average wind turbine is in the 2–3 MW range. The largest individual wind turbine prototypes have already reached installed generator capacities of 7 MW and diameters of 125 m. In the beginning of the 1980s, wind turbines typically had a capacity of 0.022 MW.

But further penetration of wind in Europe's power supply depends on continued research and development efforts – leading to cost reductions – and efficient measures to integrate wind energy production into the electricity supply system.

Industry Development

For the 2007 to 2010 timeframe, Europe's top 15 utilities and independent power producers (IPPs) in terms of MW owned declared construction pipelines totalling over 18 GW, which translates into well over €25 billion in wind plant investment, based on current cost estimates per MW installed. Overall, the European wind market is expected to grow at a rate of over 9 GW installed annually through to 2010, which translates into annual investments of over €12 billion.

The European wind power market is coming of age with the technology's steady emergence into the overall power market. Wind has become an integral part of the generation mix, alongside conventional power sources, in markets such as Germany, Spain and Denmark. However, it continues to face the double challenge of competing against other renewable technologies while proving to be a strong energy choice for large power producers seeking to grow and diversify their portfolios.

Employment

By mid 2008, wind energy companies in the EU directly employed over 100,000 people; when indirect jobs are taken into account, this figure rises to 180,000. A significant share of direct wind energy employment (approximately 74%) is located in three countries, Denmark, Germany and Spain, whose combined installed capacity represents 70% of the EU total. However, the sector is less concentrated now than it was in 2003, due to the opening of manufacturing and operation centres in emerging markets and to the fact that many wind-related activities, such as promotion, O&M, engineering and legal services, are now carried out at a local level. Wind turbine and component manufacturers account for most of the jobs (59%).

Employment projections in the EU-27 wind power sector for the year 2020 indicate that up to half a million jobs will have been created in the wind sector. The actual numbers will depend on production volume, European production share, export outside the EU, regional market growth, productivity and cost reductions.

Technological Development

In its recently published Strategic Research Agenda the European wind energy platform, TPWind, proposes an ambitious vision for Europe. In this vision, 300 GW of wind energy capacity will be implemented by 2030, representing some 25% of EU electricity consumption. Moreover, the TPWind vision includes a sub-objective on offshore wind energy, which should represent some 10% of EU electricity consumption by 2030. An intermediate step is the implementation of 40 GW offshore by 2020, compared to the 1 GW installed today.

But R&D is urgently needed to ensure the efficient implementation of the TPWind vision for wind energy. TPWind has established R&D priorities in order to implement its 2030 vision for the wind energy sector. In addition to market and policy recommendations, four thematic areas have been identified in order to improve current techniques and develop as much as possible the wind potential.

The main envisaged technology development achievements in 2020 are as follows:

– Wind Conditions

TPWind proposes an ambitious long-term ‘3% vision’. Current techniques must be improved so that, given the geographic coordinates of any wind farm (flat terrain, complex terrain or offshore, in a region covered by extensive data sets or largely unknown) predictions with an uncertainty of less than 3% can be made concerning:

- The annual energy production (‘resource’)
- The wind conditions that will affect the design of the turbine (‘design conditions’) and
- short-term forecasting scheme for power production and wind conditions

– Wind energy integration

To ensure the future technological developments of the network, TPWind focuses on how to integrate wind power on a large scale into the electricity system. The goal is to enable high penetration levels with low integration costs, while maintaining system reliability (security of electricity supply).

- The first R&D objective is to make the most of the existing grids: Advanced grid integration characteristics such as active power and voltage control, fault ride through capability and advanced power forecasting will be gradually implemented. Planning and operation of the remaining power system, including system balancing and maintaining system adequacy, will be based on a profound understanding of the interaction of wind power plants and the grid.
- The next R&D objective will be the network reinforcement: The necessary planning and design process for development of a trans-European grid will be undertaken in connection with the wider energy sector. Advanced dedicated grid systems will be developed for the exploitation of the European offshore wind resource.

– Offshore deployment and operations

The objective is for offshore wind energy to represent more than 10% of Europe’s electricity demand in 2030. Sub-objectives are to achieve generating costs that are competitive with other sources of electricity generation, using commercially mature technology for sites with a water depth of up to 50 m, at any distance from shore, and developing in parallel technologies for sites in deeper water, proven through full-scale demonstration. To achieve these ambitious objectives, the TPWind recommendations encompass:

- Enabling the safe operation of offshore facilities
- Educating people with the necessary skills to develop the industry

- Improving and sharing knowledge on environmental aspects
- Manufacturing, delivering and implementing the necessary amount of substructures
- Assembling, installing and decommissioning the large-scale offshore wind farms
- Implementing the necessary offshore electrical infrastructure
- Developing specific designs for offshore wind turbines and
- Implementing adapted operation and maintenance strategies

– Wind Turbines

The future technological developments will focus on cost reductions with the main objectives of increasing the reliability, the efficiency and the accessibility of the machines. The present advanced wind turbine concept (horizontal axis, three-blade, variable pitch, variable speed, full size electronic converter for maximum control) is most likely to be pursued. Gearbox-based drive trains as well as direct drive systems will co-exist in the years to come. The up-scaling of wind turbines – beyond the present dimensions – as seen during the last decade will continue. Materials with higher strength to mass ratios and compliant components will increasingly be used in the design of elements bearing heavy dynamic loadings such as rotor blades, yaw systems, drive train parts and towers. New design tools will be used to efficiently design and manufacture very large wind turbines based on significant enhancements in the field of aerodynamics, aero-elasticity, control, drive train dynamics, etc. Dedicated O&M methods and transport and installation systems will be used in extreme locations such as offshore, extreme cold climates and mountainous terrain. Integrated condition monitoring systems for early diagnosis and assessment of damage will be widely used to increase wind turbine availability and reduce the need for design conservatism. In the market segment of small wind turbines (size from about 1 kW to a few 100 kW), a substantial improvement in technical quality will be made, leading to expansion of the market, especially in remote areas, small isolated communities and sites connected to weak grids.

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Created in 2000, the European Renewable Energy Council (EREC) is the umbrella organisation of the European renewable energy industry, trade and research associations active in the sectors of bioenergy, geothermal, ocean, small hydropower, solar electricity, solar thermal and wind energy. EREC represents the entire renewable energy industry with an annual turnover of more than €45 billion and more than 450,000 employees.

Chapter 4.4
Financing of Sustainable Energy Operations

Marco Bianchi

Abstract Ethical banking is a relatively new field, with extensive potential to support the roll-out of sustainable energy and environmental projects. Banca Etica has been active in this field since 1999, with an interesting track record. This article outlines the approach taken by the bank, with some examples of sustainable energy projects that were supported. Considering the current financial crisis, a switch to ethical banking and achieving impacts beyond purely gaining interest, are of growing appeal and could help to draw the attention of potential investors.

Keywords Ethical banking • ethical investments • financing • entrepreneur • Energy Service Company (ESCO) • micro-finance • sustainability projects and financing products • Third Party Financing (TPF) • values.

4.4.1 Towards Ethical Banking

The increasing depletion of fossil fuel sources and climate change, which is accelerated by the incorrect use of energy sources, has placed energy at the top of the world agenda. From national governments to ordinary citizens, from businesses and public administrations, we all need to assume a 'necessary responsibility' regarding the amount and quality of our energy needs and supplies.

In this sector, banks are becoming a strategic tool for the development of single and collective initiatives of energy responsibility, through financial (and non-financial) schemes that can be made available. A bank can commit itself in two areas, namely sustainability projects, and financial products addressing sustainability.

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Sustainability projects refer to activities which financial institutions can add to extend the range of competences and experiences for the development of local initiatives of environmental responsibility. There are many possibilities with varied aims – from communicative to entrepreneurial and social objectives. Some examples are the creation of synergies among networks considering environmentally responsible subjects, the creation of partnerships and new entrepreneurship in the sector of energy, starting local supply chains, etc.

Financial products addressing sustainability tend to address 'normal financing' for individuals, companies and public administrations, for example, for energy efficiency operations and implementing renewable energy solutions, or financing an Energy Service Company (ESCO[1]).

In the sector of energy business, the challenge for financial institutions, in particular ethical financial institutions, is not to present themselves to customers with the goal of 'selling' a financial product or project. The real challenge is the development of products and projects aiming at local community development, meaning that these lead not only to direct energy benefits, but rather to several financial, social and organisational aspects that affect the development of a person or a community.

4.4.2 The Concept of Ethical Financing

In Europe and in the economic world in general, there are people who have decided to address the ethical use of money and how to manage, invest and spend it. Their choice means evaluating the consequences of economic actions according to a social, human and/or environmental point of view: they developed the concept of 'ethical financing', i.e. the management of money according to ethical principles.

Ethical finance represents a real alternative to the traditional idea of finance, without ignoring its essential mechanisms. This means its reference point is the person and not the capital; the idea and not the wealth; a fair return of investments and not speculation and exorbitant gains. It is an ambitious idea with an ambitious objective – moving from a central approach in the financial system, giving credit to people and subjects with an economically and socially sustainable project, that are usually considered as not having financing potential by traditional financing institutions because of a lack of personal guarantee to warrant the investment (thus seen as high risk from a traditional perspective).

[1]The 2006/32/EC Directive defines the Energy Service Company (ESCO) as a natural or legal person that delivers energy services and/or other energy efficiency improvement measures in a user's facility or premises, and accepts some degree of financial risk in so doing. The payment for the services delivered is based (either wholly or in part) on the achievement of energy efficiency improvements and on the meeting of the other agreed performance criteria.

A general definition of ethical finance does not yet exist. In general it refers to two different applications of financial tools:

- Micro-finance (usually micro-credits) to the poorest population group, as done by the 'banks of the poor' [2] in developing countries and, in recent years, also in richer countries.
- Ethical investments (also called 'social investments') that are the management of financial sources in order to sustain organisations working in the fields of environment, sustainable development, social assistance and services, culture and international co-operation.
- In Europe, since the 1970s, many banks have been working on these issues, developing low import loan operations (so-called micro-credits) in developing countries. Another field has been the support of food and handicraft fair trade toward more developed countries, through channels that are parallel to normal distribution.

Ethical funds are typical of developed markets such as in Great Britain, where the offer is extensive and can support various projects with ethical values. Other funds that are defined as 'ethical' also exist, which do not choose between investments option but rather devolve a part of the earnings towards charity.

Giving attention to ethics in the financial business implies that one of the best practices is maximum transparency on investments and use of savings. This is usually done in two ways:

- Giving the customer the choice to invest his/her savings in specific areas (e.g. environment, social co-operation, quality of life).
- Excluding investments that are not coherent with an ethical use of money despite being highly remunerative (e.g. mutual funds on stocks by companies involved in the weapons business, or responsible of pollution).

4.4.3 Ethical Banks

An ethical bank is a normal financial institution working on financial markets according to values and criteria following the principles of ethical finance. It offers common banking services but adopts an accurate selection of investments where the savings are addressed. Like the 'banks of the poor', ethical banks usually work with micro-credit, giving low import and low interest rate loans to customers that typically encounter difficulty in using traditional financial channels.

The idea behind an ethical bank consists of creating a place where people or businesses wishing to save, and driven by the common desire for a more transparent and responsible management of financial resources, can identify social-economic initiatives inspired by the values of a sustainable social and human

[2] In the 2006, Muhammad Yunus, the founder of Grameen Bank, the first 'bank of the poor' received the Peace Noble Prize for the accomplishments in the development of a culture of peace through innovative financial mechanisms.

development. The bank manages savings from private citizens or businesses and institutions, and invests these savings in initiatives pursuing both social and economic objectives, operating from the perspective of respect of human dignity and the environment. In such a context the bank sets out to educate both savers and borrowers, by enhancing the awareness of the former about their savings destination, and encouraging the latter to develop their management and entrepreneurial abilities towards more ethically-driven activities. The ethical bank does not set out to reject the basic rules of finance, but it rather seeks to reshape its main values.

4.4.3.1 Banca Popolare Etica

In 1999 in Italy, a very specific bank was established, namely Banca Popolare Etica (Ethical Popular Bank). One of the distinctive elements of Banca Etica has been the path outlined in its constitutional charter. Indeed, Banca Etica is the only financial institution that was established outside a traditional economic setting. The bank project was developed in the third sector (civil society and social movements), with the objective of developing activities inspired by the principles of ethical finance and as a transparent tool to manage money for the development of civil economy. Banca Etica is the first Italian financial institution that is willing to support and develop all organisations taking care of social and environmental impacts of their activities.

Banca Etica grants financing to organisations operating within the third sector which carry out civil-oriented economic projects, have the legal form of cooperative societies, associations or social institutions, and are operating in one of the following areas:

– **Social cooperation:** social, sanitary and educational services; fight against social exclusion and integration of disadvantaged people in the community.
– **International cooperation:** social and economic development of the poorest areas of our planet, supporting fair trade, training and educating, promoting micro-enterprises, assisting and supporting immigrants, and aiding partnerships between solidarity organisations from the South and the North.
– **Environment:** promoting research, experiments and use of renewable energy sources; non-polluting production techniques; waste disposal services; ecological public transport; production and distribution processes with a positive impact on mankind and the environment; management of natural heritage sites; development of biological and bio-dynamic agriculture; promotion of ecological awareness and culture.
– **Culture and civil society:** management and protection of artistic and cultural heritage, promoting social-cultural animation, in areas most affected by social decline, and helping develop non-profit associations, artistic and cultural initiatives, aiding access to sport activities for the most disadvantaged groups.

Over and above the traditional economic evaluation procedures, projects considered for financing undergo an evaluation aimed at analysing the consequences/impacts of the projects regarding common welfare and the natural environment. In this respect, what is carried out is an analysis of the social and environmental responsibility.
To grant financing, primary importance is given to the following aspects:

– The reliability of the project, which undergoes a thorough economic feasibility analysis in order to assess the project's capacity to return the loan.
– The social responsibility of the project, in order to assess whether the project presents a positive social impact, whether it respects the environment and improves the quality of life.

Only in the presence of a positive result from both of these assessments is an ethical bank willing to give the financing. This means that only activities focusing on the development of improved life conditions for everyone, rather than the enrichment of just one person will be financed. The relation of personal trust between the bank's personnel and those representing the organisation that is requesting the financing is also a key factor during project evaluation.

Another important aspect of ethical finance is the absence of any distinction on the basis of gender, ethnical background, religion or wealth. The basic element is the project that is being developed. Therefore the evaluation is not based exclusively on the wealth asset and thus on the securities the client is able to ensure. In the evaluation of an investment project in the energy sector, it is necessary for a bank to make an analysis on three aspects:

– Technical and economic sustainability of the initiative
– Minimal environmental impact
– Maximisation of social benefits to the community

Below are examples of investments in the energy sector, looking at direct investment and third-party investment (Fig. 4.4.1).

Fig. 4.4.1 Banca Etica headquarters in Padova, designed and constructed according to bio-ecological architecture principles (Courtesy: Banca Etica) (see *Color Plates*)

4.4.4 Examples of Financing

4.4.4.1 Direct Investment

Direct Investment Example 1: Investment in Renewable Energy

A family decides to install a photovoltaic (PV) system on the roof of their house. According to the electricity bill there is an annual consumption total of 4,000 kilowatt hour (kWh), costing €600 each year. The family contracts a PV company to install a 2 kW system. Considering the hours of sunshine (solar radiation) in a year, it is evaluated that the 2 kW system will produce about 2,000 kWh of energy every year, covering half of the total need of 4,000 kWh. The family also applies for a state benefit that corresponds to €0.50/kWh produced by PV. This means that the family will earn €1,000 every year.

The PV company evaluates the total installation cost at €13,000, all included (maintenance is an annual cost not included it in the example).

The family decides to contact a bank offering low interest rate loans for PV installations. The loan will run over 12 years at an interest rate of 5.5%. This means that the bank lends €13,000 to the family and the family will repay this to the bank, paying €1,500 every year for 12 years (Table 4.4.1).

Example conclusion:

– If the family decides not to install the PV plant, it will continue buying 4,000 kWh from the energy utility and pay at least €600 for energy in the coming years (probably more in a country where the energy balance is dependent on oil imports, considering rising prices due to the depletion of resources).

Table 4.4.1 Example 1: investment in renewable energy

	Without a PV plant			With a PV plant		
	Details	Cost	Pay-off	Details	Cost	Pay-off
Energy consumption	4,000 kWh			4,000 kWh		
– Energy bought	4,000 kWh			2,000 kWh		
– Energy from PV	0 kWh			2,000 kWh		
Energy bill	0.15 €/kWh	−600€		0.15 €/kWh	−300€	
State benefit				0.50 €/kWh		1,000€
Loan payment					−1,500€	
Total		−600€			−800€ (first 12 years) +700€ (from the 12th to 20th year) −300€ (from the 20th year)	

– If the family decides to install the PV plant, it will first pay €800 for 12 years, in order to repay the loan. Then it will benefit of €700 until the 20th year (estimate lifetime of the PV system) as from now. From the 20th year the family will buy energy from the grid about €300 every year.

Direct Investment Example 2: Investment in Energy Efficiency

A family decides to change its diesel oil heater because of its high pollution and high energy costs. Every year, the family spends about €1,000 to heat their small apartment. The family contacts a plumber and asks for a high efficiency heater. The plumber suggests the installation of a condensation heater switching to gas supply. The cost of the installation and distribution system is €4,000 (more than a 'normal' heater which costs €2,500), but the savings are evaluated in about €400 each year.

An important factor in the investment is the national deduction of 55% of the total expenses in 3 years. This means that the family can regain about €2,200 over three (3) years (€2,200 equals 55% of €4,000), which means €733 for the first three (3) years (Table 4.4.2).

Using its own money, the family must wait for five (5) years for a complete payback of the investment, using the savings and the national deductions (Table 4.4.3).

Table 4.4.2 Example 2: investment without a bank

Year	0	1	2	3	4	5 Onwards
	–4,000€					
Savings		+400€	+400€	+400€	+400€	+400€
Deductions		+733€	+733€	+733€		
Total		+1,133€	+1,133€	+1,133€	+400€	+400€
Cumulated total		+1,133€	+2,266€	+3,399€	+3,799€	+4,199€

Table 4.4.3 Example 2: investment with a bank (Loan of €4,000 for five 5 years at an interest rate of 6%, approximately €950 each year)

Year	0	1	2	3	4	5	6	7 Onwards
	0€							
Savings		+400€	+400€	+400€	+400€	+400€	+400€	+400€
Deductions		+733€	+733€	+733€				
Loan payment		–950€	–950€	–950€	–950€	–950€		
Total		+183€	+183€	+183€	–550€	–550€	+400€	+400€
Cumulated total		+ 183€	+366€	+ 549€	–1€	–551€	–101€	+301€

Using a bank loan, the family must wait for seven (7) years for a complete pay-back of the investment, benefiting of the savings and the national deductions, and paying €950 for the loan.

4.4.4.2 Third Party Financing: An Opportunity for Medium-Sized Operations

In many cases we face some energy efficiency operations that deal with a high amount of energy and high costs needed to implement them: for example, a thermal insulation intervention in a condominium or operations in schools, swimming pools and buildings of the Public Administration. The production of energy efficiency operations requires particular competence and experience in these cases. It’s necessary to develop an analysis on the building energy demand and the opportunities of intervention given by present technologies and a feasibility study on technical, economic and financial aspects of the possible operation. Moreover, many times it happens that the subject interested in the operation doesn’t have necessary funds to pay it and finds himself in the condition to look for a financial promoter.

A solution to the problem of necessary competence and to the availability of financial sources can be found in the ESCOs, the energy service companies. The primary objective of ESCOs is the achievement of energy savings through an improvement of energy efficiency on behalf of its customers as energy users. The peculiarity of ESCOs is that the operations needed in order to achieve the forecast efficiency are made through investments by themselves and not by the customer. The energy users are thus relieved of any forms of financial investment and should not worry about financial needs. In turn, ESCOs repay their investments, and the cost of energy services, through an amount of the saved energy generated by the intervention. The plan is that the cash flows created by the saved energy are enough to repay the investment, the maintenance costs and the financing in a reasonable time. The customer is treated as an energy and services user and is committed to pay the ESCO a fee calculated on the basis of the energy savings for a certain number of years.

The fee amount can be less or equal to the costs previously paid, according to what is agreed in the contract between the ESCO and the customer. The fee can represent a part of the obtained savings (the so-called “shared savings” contract) or a fixed amount (the so-called “guaranteed savings” contract), depending upon the return of the investment, the number of years of the contract, the risk taken by both parties and the need by the final beneficiary.

The whole energy efficiency operation through an ESCO is deeply bound to the use of a financial instrument called ‘Third Party Financing’ (TPF). In this case, the third party is the ESCO because it is the only responsible to the customer and takes care of all phases of the operation, especially the financial aspects. The financial institution gives the ESCO the assets needed in all phases of the project on the basis of a detailed economic study. Both parties, the bank and the ESCO, are bound through a contract system setting all actions and behaviours of actors in the project and through an insurance system on main risk factors.

Benefits for the Users and Critical Aspects

The TPF formula includes a number of benefits for customers that lack the capital needed, letting the ESCO take care of the whole operation as a general contractor of the installation and maintenance. Though, it must be clear that, the project is economically convenient and the customer has the capital, it's obviously more gainful to do it directly without an ESCO.
Major benefits for the final user can be summarised as follows:

– Absence of financial exposition
– Absence of responsibility on management and security of plants
– Immediate environmental improvement
– Economic savings (immediately or planned)
– Availability of a new technology whose generated savings are given to the final users after the end of the contact with the ESCO

Before contacting an ESCO, the energy user must be aware of the limits and critical aspects that such an operation implies. These are the main ones:
Precise definition of warranties and penalties to be included in the contract, to be sure of cash flows in case of energy savings less than forecasted

– Introduction of contract clauses that foresee a change in the economic plan in case of radical changes of energy tariffs that are not easily predictable, especially in the present times of energy price uncertainty.
– Potential lack of warranties on the ESCO experience and technical capacity to continue an energy saving operation and its maintenance.

The technical and financial risks of the operation are on the ESCO. This is a fundamental warranty for the user: if the intervention is technically wrong and not profitable, it's the ESCO, and not the customer, that will lose; if the interventions don't lead to actual savings, it's the energy service company that will have to cover the difference of costs.

Table 4.4.4 Direct investment from the condominium

Year	0	1	2	3	4 Onwards
	−80,000€				
Savings		+25,000€	+25,000€	+25,000€	+25,000€
Total	−80,000€	+25,000€	+25,000€	+25,000€	+400€
Cumulated total	−80,000€	−55,000€	−30,000€	−5,000€	+20,000€

Table 4.4.5 Indirect investments through an ESCO

	0	1	2	3	4	5	6 Onwards
Year	0€						
ESCO in (old bill from Condominium)		+40,000€	+40,000€	+40,000€	+40,000€	+40,000€	
ESCO out (new bill)	−80,000€	−15,000€	−15,000€	−15,000€	−15,000€	−15,000€	
Total	−80,000€	+25,000€	+25,000€	+25,000€	+25,000€	+25,000€	–
Cumulated total	−80,000€	−55,000€	−30,000€	−5,000€	+20,000€	+40,000€	–
Savings Condominium		–	–	–	–	–	+ 25,000€

Third Party Financing Example 1: The Change of the Heating System in a Condominium

A condominium comprised of 20 apartments has a centralised heating system running on a diesel boiler. The annual functioning costs the condominium are about €40,000 p.a. The residents want to replace the diesel boiler with a centralised high efficiency gas boiler with single energy accounting. It is forecasted that consumption can go down to €15,000 each year, saving about €25,000 – more than 60% of the total energy consumed.

The total investment costs are €80,000 (Table 4.4.4).

Four (4) years payback time, and after four (4) years the savings cover the initial expense.

Third Party Financing Example 2: Indirect Investments Through an ESCO

The residents contact an ESCO. The energy service company makes a precise analysis of the energy needs and the possible technological solutions, deciding it is possible to provide a useful solution. The ESCO and the condominium sign a contract, stating that:

- The ESCO makes the investment, handles the installation and takes over the maintenance.
- The residents agree to pay the same amount of the old energy bill for 5 years.
- After 5 years the boiler's property goes to the condominium (Table 4.4.5).

The condominium keeps paying the old bill (€40,000) to the ESCO. After the 6th year the property changes ownership from the ESCO to the residents, who will start to benefit of the energy savings and reduced energy bill (€15,000).

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Chapter 5
Framework conditions and support mechanisms

Chapter 5.1
Giving Priority to Renewable Energies: The German Renewable Energy Act

Ole Langniß and Dieter Seifried

Abstract The German Renewable Energy Act is an exemplary piece of legislation, one of the first effective examples that has led to an upsurge in the expansion of electricity produces from renewable energy sources. This Act has been implemented in several other countries in various forms. The German legislation is effective as it started with a fixed remuneration, providing a secure opportunity for investors and resulting in a continuously growing clean energy industry and an efficient regulated market.

Keywords Degression rate • electricity • European Emission Trading Scheme (ETS) • feed-in tariff system • instrument • regulated market • Renewable Energy Act (Erneuerbare-Energien-Gesetz) • remuneration

5.1.1 Introduction

The German Renewable Energy Act (Erneuerbare-Energien-Gesetz [EEG]) is the central instrument to promote electricity from renewable energy sources (RES-E) in Germany. It was established in 2000 and has been amended in 2004, 2006, and more recently in 2008. The EEG is a feed-in tariff system, also known as minimum price standard that obliges distribution network operators to connect RES driven power plants, to purchase RES-E and to pay a fixed remuneration (cent/kilowatt hour) to the plant operator. The level of remuneration is cost oriented, differentiated by technology, by plant capacity and other characteristics. This remuneration is fixed for 20

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years for most technologies, providing investors a high level of security in terms of planning and recouping associated costs. The level of remuneration decreases for new power plants every year (according to a vintage approach) with a technology specific degression rate to reflect technological progress and cost reductions due to learning effects. Since the degression rate is set in advance it guides plant manufactures on the expectation on cost reductions. In this respect the EEG resembles an incentive regulation of the RPI-X type (Littlechild 1983) which has been often hailed for the strong incentives it provides for efficiency in regulated markets.

5.2 Development Opportunities

The Act creates opportunities for independent power producers. They can sell the power at fixed prices and do not need to handle marketing the power. Thus it has become easier for municipalities to take responsibility for their energy supply.

The income from selling electricity via the EEG dramatically enhances the economical feasibility of small district heating networks fuelled by biomass-driven combined heat and power plants. To promote the most efficient energetic use of biomass combined heat power plants are rewarded with a higher remuneration than those solely generating electricity. For example, projects get a bonus remuneration of 3 cents/produced kWh electricity if biogas is used to fire a combined heat and power plant and the heat is used to displace fossil fuels for heating.

Since the implementation of the EEG in 2000, RES-E has more than doubled from 37 terawatt hours (TWh) in 2000 to 87 h in 2007.[1] RES-E contributed 14.2% of the total gross electricity consumption in Germany, already surpassing the targets set for 2010. In 2007, 67.1 TWh were remunerated under the EEG (without existing large hydro plants). Photovoltaic and wind power have in particular displayed dynamic growth. Germany now has more installed wind power capacity than any other country worldwide and claims at least half of the world market in photovoltaics. Due to the EEG, wind power has surpassed hydro power as the main renewable source for power generation in Germany, comprising 45.2% of all RES-E according to the Federal Ministry for the Environment, Nature Conversation and Nuclear Safety renewable energy sources figures of 2008.

The figures for 2007 are provisional from the Federal Ministry for the Environment, Nature Conversation and Nuclear Safety (BMU) report: Renewable energy sources in figures – national and international development, Berlin, June 2008.

The specific remuneration, taking an average over all technologies and all vintages was €0.114/kWh, which is approximately double the current market price. Total RES-E remuneration in 2007, which reached €7.9 billion, was five times higher than in 2001. This remuneration reflects the total costs, of which approximately €4.3 billion are additional costs, net of market value. The additional burden from

[1]The EEG does not include all kind of power generation by renewable energy sources, e.g. co-combustion of biomass or existing hydro power plants are excluded. Additionally, a size limit of 150 MW applies for instance to hydro power plants.

the EEG accounts for only €0.01/kilowatt hour (kWh) consumed, which translates into roughly 5% of the average household power price of €0.207/kWh. This means that a three-person household typical for Germany, with a power requirement of 3,500 kWh/year, has to pay approximately €3/month for an increasing share of renewable energy (Table 5.1.1).

In 2006, almost half of the total remuneration under the EEG was paid for wind power generation. Photovoltaics received 20% of the total amount of remuneration in 2006, up from a share of only 2% in 2000. Despite the increased share in remuneration, photovoltaic installations accounted for only 4.3% of remunerated electricity. The difference is due to the higher tariff for photovoltaics (€0.53/kWh in 2006) compared to wind power (€0.09/kWh). By 2013, it is estimated that renew-

Table 5.1.1 German EEG remuneration for different technologies differentiated by plant capacity in the year 2007 (Witzel and Seifried 2007) (see *Color Plates*)

	up to 150 kW	up to 500 kW	up to 5 MW	> 5 MW
Hydropower[1]	9.38	9.38	5.45	special agreements
Landfill/ Marsh Gases[2]	7.33	7.33	6.36	special agreements
Biomass	10.99	9.46	8.51	8.03

	up to 5MW	up to 10MW	up to 20 MW	>20MW
Geothermal energy[3]	15.0	14	8.95	8.03

	up to 30kW	up to 100kW	>100kW	
Photovoltaics				
on rooftops, noise protection walls[4]	49.21	46,81	46.3	
as solar facades[4]	54.21	51.81	51.3	
on open space[5]	37.95	37.95	37.95	special agreements

	without power limitation	
Wind energy[6]		
On-shore	8.19	for at least 5 years (max 20 years), afterwards 5,18 ct/kWh
Off-shore	9.10	for at least 5 years, special agreements

Reductions for construction after 2007:
[1] degression 1 %/a
[2] degression 1.5 %/a
[3] degression 1 %/a (from 2010 onwards)
[4] degression 5 %/a
[5] degression 6.5 %/a
[6] degression 2 %/a

able electricity in Germany will receive €12.6 billion in annual remuneration payments through the EEG (Verband der Netzbetreiber 2006).

But in future, electricity-production from renewable technologies will become cheaper than electricity from fossil power plants. A recently published study of the German Federal Ministry of Environment, Nature Conservation and Nuclear Safety (BMU) shows, that already by the year 2020 renewable technologies will lead to lower electricity production costs compared to a scenario with electricity production by fossil fuels only (Nitsch 2008).

Approximately 60 million tonnes of CO_2 equivalent, >7% of Germany's total CO_2 emissions, were avoided through EEG installations in 2007. It has been argued that the EEG has not led and will not lead to additional CO_2 mitigation when the interaction with the European Emission Trading Scheme (ETS) is considered. However, if the CO_2 equivalent reductions made possible through the EEG are anticipated in the National Allocation Plans by lowering the amount of total emission allowances, accordingly, this no longer holds true. Additionally, there is increasing consensus that an Emission Trading Scheme alone is not sufficient to trigger the necessary shift towards a more sustainable energy supply (Mitchell 2008). Carbon pricing, even though central and necessary to address climate change, needs to be supplemented by direct governmental intervention for technology choice and market support (Stern 2006; European Commission 2008), for example, through the EEG.

Also the overall economic impact of the German promotion policy is remarkable: in total, €11 billion were invested in RES installations in 2007 and €14 billion of turnover was due to operating RES-plants in the power, heat and fuel sector (BMU 2008). Jobs in the manufacturing and operation of hydro, wind and photovoltaic power plants in 2006 climbed to 110,000 – an increase of 20,000 over 2004 numbers (Kratzat et al. 2007).

The German Renewable Energy Act, as well as its precursor the Feed-In Law, has been proven to be one of the most effective and efficient policies to promote renewable energy-sourced electricity (Mendonça 2007). The success can be measured in new installations, generating capacity, as well as investment and employment numbers. In addition to Germany, 18 other countries in the European Union use a feed-in tariff system similar to the EEG. Feed-in tariffs have been appreciated as the most effective means to promote renewable energy according to the European Union (European Union 2005). Six EU countries are using a quota system – in theory guaranteeing a certain quantity of RES-E, but not generally resulting in a price based on different technological maturity of various renewable energy technologies. Quota systems have promoted only the cheapest RES technologies, whereas Germany's feed-in tariff system has proven to promote a broader spectrum of renewable energy technologies. The lessons learnt are that governments have to be ready to adjust the market framework to meet the challenges of rapidly evolving energy markets and to meet collective goals such as energy security, climate change and a sustainable energy system (Figs. 5.1.1 and 5.1.2).

Despite the great success of the EEG there is a constant need for adapting but leaving the constituting elements untouched. The EEG is facing new design challenges as renewable energy shares continue to increase as a part of total power supply. Incentives should be provided to adapt the RE power generation better to

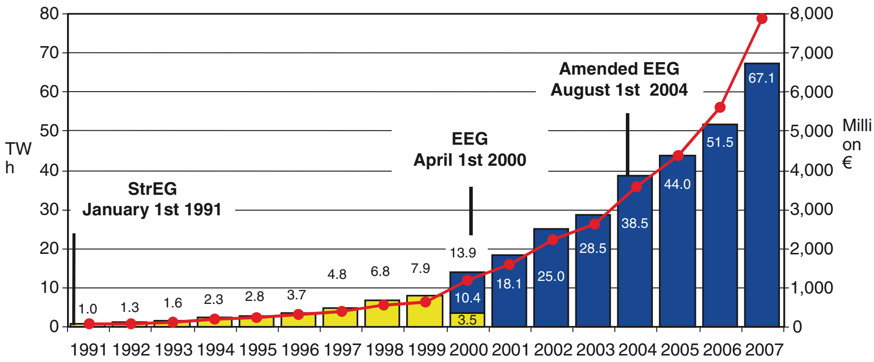

Fig. 5.1.1 Feed-in and fees under the Act on the sale of electricity to the grid and the Renewable Energy Sources Act (EEG) (see *Color Plates*)

meet the actual power demand – it is an on-going challenge to keep the costs to power customers as low as possible. Therefore, the technical and commercial integration of RES-E need to be strengthened without endangering the fast pace of renewable energy growth needed to cope with the challenges of climate change.

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Chapter 5.2
Local Climate Change Initiatives in the United States: The Primacy of Short-Term Economic Returns

Peter B. Meyer and Lauren Heberle

Abstract The article underlines the relationship between climate change and economics, presenting a jeopardised debate under the previous US government on the perspective of local governments. The result of differences between US states and the absence of a clear and homogeneous approach by the Federal government is presented, leaving local government isolated in climate change action.

Keywords: Cap and trade agreement • carbon trading compacts • Environmental Protection Agency (EPA) • national policy • Pew Center on Climate Change • standards • 'triple bottom line' • US Conference of Mayors 'Climate Protection Agreement'

5.2.1 Introduction

As is true for other issues of global importance, the United States do not have a homogeneous perspective on climate change as a whole, let alone local climate change action. Part of the reason for this national incoherence is the continued denial of the evidence from climate scientists by prominent individuals – and major industrial firms – in pursuit of short term economic gains from their distortions (Michaels 2008). A further factor is the radical decentralization of much of the power of the public sector to the 50 individual US states and, beyond them, to the localities that exist and are endowed with their powers to govern by those states. (There are over 4,000 counties in the USA, and municipalities with over 2,500 residents number well in excess of 20,000.)

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Up until this point, US localities have acted in a pragmatic manner, addressing climate change in a wide variety of ways. The actions localities chose to prioritise are mostly driven by the locality's economic conditions and their resultant cost–benefit calculations. In light of the variation in economic conditions, dependence on fossil fuels, potential for local alternative power generation, industrial mix, and the like, there has been no reason to expect any consistency in response or approach across the country. Beyond the economic pressures, the diversity of approaches, from inaction to major commitment, can be attributed to variation in the powers vested in localities by the different states (and which also can vary within states for localities of different population sizes). Issues of importance include that states limit the use of – or demand – discounting in calculations of least-cost investments, promote or permit small localities and tiers of them (counties, towns, villages, etc.) that both by their governmental structures and their geographic size inhibit regional economic or land use planning and expect a level of local reliance on self-generated tax revenues that places a premium on development and tends to encourage sprawl.

5.2.2 Impacts of Political Decentralisation

The problems faced in developing a national policy for a politically decentralised state such as the US is well illustrated by the experience of two different regional (multi-state) carbon trading compacts. Arguably, the Northeastern states' cap and trade agreement, the Regional Greenhouse Gas Initiative, has succeeded in going forward with its first carbon auction in September 2008, is that most of the states included similarly rely primarily on imported oil (Galbraith 2008). By contrast, the states included in the Western Climate Initiative (which includes both US states and Canadian provinces) with very different power sources and needs (ranging from coal-rich and dependent states to those extensive hydroelectric power and massive solar potential) have established a greenhouse gas registry, and announced goals for emissions reductions, but have yet to establish a regional cap-and-trade programme (Barringer 2008).

The narrow focus of US policy developers on just the economics of the three-legged stool of sustainable development (the 'triple bottom line') has contributed to continued reliance on microeconomic analyses of choices when confronted by evidence of anthropogenic climate change. Cost–benefit calculations continue to rely of 'market-based' discount rates for valuing future impacts that are inappropriate for assessing macro effects, including potentially irreversible social and environmental outcomes. Despite the massive uncertainties about climate changes and their impacts that are now acknowledged, even in US literatures, common practice remains the use of discount rates that render impacts even 50 years out to virtual inconsequence. The Precautionary Principle has not taken hold as a basis for climate change (or any other environmental) policy-making.

There is thus a common pattern of pursuit of 'low hanging fruit' (low cost action, or those with high immediate benefits if they are costly) in the local responses to perceived threats from climate change – and, perhaps more commonly, to the threats generated by rising fuel costs, in settings in which the climate issues are still not addressed politically. Local school districts and general government units in the state of Kentucky, for example, are authorized by the state government to borrow for energy savings investments provided that they demonstrate a 'pay-back period' (the time in which the savings on energy cost can complete repayment of the loan taken out for the investment) that does not exceed 12 years. In practice, in a climate with extremes of cold and heat such as Kentucky, this standard assures excess energy use in heating and cooling since it precludes installing double-paned insulated windows where single pane units are present in existing buildings. This is one example of how the discounting logic creates a myopia that inhibits significant responses, even if there were a national acceptance of the threats from climate change and the roles of humans in exacerbating the problem.

The pursuit of immediate returns on investment has meant that most current projects at the local level involve some pursuit of energy savings in buildings and operations. But even these efforts are constrained by the contexts in which decisions are made:

– State regulation of locality processes for purchasing goods and services constrain innovation even when it is consciously pursued. In light of extensive experience with local officials buying from their friends and relations, or from others who would return illegal payments to officials in return for their contracts, there are strict acquisitions provisions. Localities must (a) specify the goods or services they require, then (b) announce their needs publicly and accept bids from potential vendors, and then (c) pick the 'lowest cost' vendor's offer if it meets the specified need requirements. Since specifying all the dimensions of needs over time for goods to be used over an extended period (buildings, vehicles, management systems, etc.) is difficult (at least as compared to those consumed more immediately, such as office supplies), the 'needs' specifications have tended to omit the complexities of operating and maintenance costs in favour of immediate purchase prices as the basis for least cost pricing. (In some states, the specification of the 'needs' in the bidding process expressly excludes the life-cycle considerations since they may be too easily manipulated to favour a particular preferred vendor.) The purchasing process thus further limits the time horizon employed by local policy-makers.
– Neither the local governments nor the contractors that offer assurances of energy cost savings over time are willing to accept any risk in forecasting energy costs. As a result, the investments undertaken are those that meet payback period or self-financing requirements 'on the assumption that energy prices remain constant'. In effect, the experience of energy cost increases in the past is denied in investment decision-making that is so financially risk-averse that it does not permit the projection of even small secular rises in prices. (Note that this assumption would have the effect of constraining public sector demand for more energy efficient vehicles, limiting the expansion of that sector of the US automobile market, since the cost calculation on a purchase could not consider operating costs spiralling up in the future, even if true life-cycle costing on bids were permitted.)

– Since the issue of climate change is not considered a primary problem for governments and localities do not operate on any precautionary principles with respect to their environments, most local projects to date have been financed with debt capital issued by the localities themselves. (Unlike localities in other countries, US localities are roughly 80% dependent on their own taxing powers to finance their budgets. They also have the legal power to issue bonds, sometimes having to demonstrate to their states that they can repay from their investment returns, but otherwise pledging their non-inconsiderable local taxing capacities to raise debt service funds as needed.)

The narrow focus in many local initiatives on buildings and operations and the lack of attention in much of the country to land use planning and regional economic development planning as they relate to climate protection can be attributed to some other dimensions of the localities' decision-making processes:

– Because localities tend to be so small in the US (sometimes mere hundreds of residents, though the unit has full general government powers), they often have inadequate staff – only part-timers – to engage in any coherent planning. Where professional staff exist, the level of their civil service protections from political pressures is generally very limited, except in the largest cities and in those few states that mandate such protections. Moreover, even the larger units are often too small to provide a basis for coherent economic development planning, especially when travel to work distances are extended. Local level planning that could shift to a higher level of concern for climate change thus tends to be inadequately staffed, subject to political pressures, and not charged with large enough planning units to permit coherent decisions, whatever the local political will.
– Typically there is no jurisdiction below the state level that has the power to effectively engage in spatial (land use or transportation) planning. With many state boundaries defined by rivers, conurbations that emerged in association with river water power or transportation, which includes many of the oldest and largest metropolitan areas in the country, have travel to work areas that actually transcend two or more states. In those settings, state political cooperation may be a needed precondition for local collaboration and action, and that is rare. (There are multi-state urbanized areas in which decisions about a vehicular bridge across a shared river can take decades – and sometimes get done arbitrarily in the end.) Even within single states, the multiplicity of small local jurisdictions within travel-to-work areas means that there is minimal legal capacity at the local level, not just limited political will, to control sprawl and the inefficient land uses and transport systems that accompany it. While examples of urban boundary impositions and regional transportation planning can be cited in many settings in the US (including in settings that are not recognized for being politically progressive or environmentalist, such as Kentucky and Utah), they are exceptions. The norm is a form of discontinuous incrementalism in both land use and transportation planning that values flexibility and short-term political responsiveness. Even in those rare instances in which regional transportation

planning takes place and promotes public transport at the expense of the automobile, the tendency is to promote bus rather than rail systems. Buses not only cost less than light rail in terms of their up-front capital investment that may not meet short term rate-of-return expectations, but also offer flexibility to change with shifting local political winds (and pressures) that is not possible with fixed rail lines.

– Across the US, notwithstanding some assistance from federal and state governments, some 80% of localities' budgets for all their operations rely on local sources of revenue. These sources are primarily property and payroll taxes, local business and professional income taxes, and local shares of sales taxes in the states that share that revenue and/or permit localities to add additional sales taxes of their own. All these revenue streams depend on continued operations, if not growth in local business, and on the preservation if not expansion of residential and business property values. Therefore, localities will not voluntarily abandon efforts to attract new business and residents, running a sort of race against themselves, as the resources they need to provide for the resulting increase in service demands may not expand as fast as their budgets. This local revenue dependence has meant a bias against row housing and semi-detached homes, and not just because they have lower property values given US housing preferences: the real problem is that denser residential patterns produce more residents, with more demands for local services. Local taxation on residential property does not raise the funds needed to provide mandated municipal services and reliance on such funding poses exceptional problems for local school systems.

5.2.3 Shaping Pressures

Recent national and international developments will shape the context and exert pressures on future local responses to climate change. In April 2007, the US Supreme Court ruled that carbon dioxide – including human exhalations – is subject to regulatory control as a contaminant under the Clean Air Act. As a result, the federal Environmental Protection Agency (EPA) will have to establish standards and limits for those emissions and other greenhouse gases[1] (Supreme Court of the United States 2007). In late 2007, the US finally, after much debate and international criticism, agreed in principle to emissions reductions at the UN Climate Change meeting in Bali. Early in 2008, moreover, the European Union initiated consideration of imposing carbon content tariffs on imported goods and in some

[1]The 5:4 decision, issued April 4, 2007, clearly lays the legal foundation for national greenhouse gas emission control in the United States by ruling that the emissions are covered under the Clean Air Act. The reliance on a legal ruling that (absurdly) labels greenhouse gases as contaminants akin to poisons and carcinogens reflects the inability of US Congress to enact appropriate legislation to address climate change and greenhouse gas emissions.

cases, services[2] (EU Ponders Carbon Tariff on Imports 2008). All of these factors point toward a federal response – and possibly an international import climate – that will affect local power costs, and will have potentially adverse effects on the economies of localities that have not already moved forward with climate protection policies – but the majority of jurisdictions have taken little more than symbolic action so far (Layton 2008). How coherent their eventual response will be cannot be predicted, especially since the action at that point will be in the face of an immediate problem. There are grounds for pessimism in light of the limited effort to date pursued in promoting building and transportation energy efficiency at the local level despite extended experience of rising energy costs. Local responses to these standards and international pressures will vary depending upon the extent and type of local industry, employers' dependence on different energy inputs, and the spatial and organizational structures of localities, especially as those factors have shaped the reliance of local populations on individual automobile transportation.

Despite these negative observations of the prevailing norm, many localities are developing climate action plans and launching efforts in the face of federal inaction. The US Conference of Mayors 'Climate Protection Agreement' was launched in 2005 on the day the Kyoto Protocol was signed.[3] As of October 2008, some 884 mayors from all 50 states, the District of Columbia and Puerto Rico, representing a total population of over 80 million people, have signed the agreement, pledging to pursue the Kyoto emission reduction targets in their own cities and to pursue greater commitment at the state and national government levels.[4] ICLEI reports 472 members in the USA – and they range from small municipalities and low population counties to the largest cities in the nation, including Atlanta, Chicago, Dallas, Houston, Los Angeles, and New York.[5]

The Pew Center on Climate Change tracks state initiatives and promotes state level climate policies, and their data show the vast majority of states have taken some action, with 39 signatories to The Climate Registry as of May 2008, pledging to collaborate on tracking their greenhouse gas emissions (Pew Center on Global Climate Change 2008). Similarly, Stephen M. Wheeler reported in 2007 that 28 states had adopted climate action plans through legislation or executive order (Wheeler 2007). The Pew Center's state web pages exist to promote US climate change effort, so its motto, 'Working together.… Because Climate Change is Serious Business,'

[2]This issue is not the effect of international agreements, but the much easier to implement decisions of large US trading partners, domestic policy shifts over which the US has no real power. The US chemical industry has already experienced impacts on its domestic operations as the result of EU policy concerns about chemicals and cancer risks.

[3]http://www.usmayors.org/climateprotection/agreement.htm (accessed 5 October 2008).

[4]The US Conference of Mayors. Mayors' Climate Protection Center – http://www.usmayors.org/climateprotection/list.asp (accessed 5 October 2008).

[5]Membership data taken from – http://www.iclei.org/index.php?id=1387&region=NA (downloaded 5 October 2008). The list of major cities is so expansive and their accomplishments so limited, that one cannot help but wonder whether the membership is more a matter of political necessity than real intention to act on climate change.

can be taken as a reflection of its perspective. This focus is reiterated in the description of what comprise the intended outcomes of state policies: 'Such policies reduce vulnerability to energy price spikes, promote state economic development, and improve local air quality.'[6] The impacts cited are short term and there is effectively no statement of the issue as a global problem with long term effects. Clearly, Pew assumes that evidence of immediate pay-backs are what are needed to motivate local or state action.

The Pew Center data are the most readily accessible compilation of efforts at the US state level, yet they err in overoptimistic narrative on past effort and in failure to track current efforts. Kentucky, a relatively poor coal-mining state with some 4 million citizens that is 94% dependent on coal-fired electricity, illustrates the data problem – and demonstrates how much may actually be occurring that is not fully tracked. According to the Pew Center, Kentucky completed a climate action plan in 1998. In reality, that 'plan' was merely a report with about greenhouse gas emissions that relied on now obsolete measurement tools and has never been revisited. On the other hand, Pew has yet to report on two very different pieces of state legislation passed by Kentucky in 2007–2008 that shows how progress is being made. The first law authorized a massive subsidy ($300 million) to any company willing to build a coal liquefaction plant in the state (with no preconditions about available carbon sequestration capacity) and required a superficial study of alternative utility regulatory policies that might reduce emissions and energy use. The second law, passed 6 months later, actually allocates funds and requires borrowing for programs to increase energy efficiency in government buildings, provide training and technical assistance in energy efficiency management, and offers tax incentives for new private investments in both alternative energy generation and increased efficiency. In creating new state advisory bodies, the second law may also be laying the institutional foundations for far more efforts and commitments in the future. This example illustrates the emerging US pattern that not just the states, but even the localities in conservative states such as Kentucky are beginning to move toward more comprehensive climate action plans.

On the local level, in 2007, the over 700,000 citizens of Louisville, Kentucky began the process of developing its first climate action plan, 2 years after the mayor signed the US Conference of Mayors' Climate Protection Agreement to pursue the Kyoto Protocol reductions. The local effort is led by the Partnership for a Green City, originally established in 2004 as a collaboration of three major institutions: Louisville Metro Government, The University of Louisville (UofL), and Jefferson County Public Schools (JCPS, a completely distinct local government unit from the city).[7] An innovative element of this effort is the open nature of the process: Any interested citizen was

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[6]Both quotations downloaded 5 October 2008 http://www.pewclimate.org/what_s_being_done/in_the_states from

[7]The Partnership predates the Kyoto Treaty and was created originally largely for the pursuit of cost savings through the scale permitted by collaboration on certain recycling efforts, bulk purchases of products made form recycled materials, sharing refueling facilities to ease use of natural gas vehicles and related 'green' activities.

welcome to join the Climate Change Committee (CCC) or one of its sub-committees. The Partnership relies on the Louisville Metro Air Pollution Control District (APCD) as the lead staffing agency for the CCC in light of its history of hosting broadly based stakeholder task forces dedicated to protecting and improving air quality. The CCC has six sub-committees: (1) Greenhouse Gas Emissions, (2) Land Use, Transportation, Urban Forestry, (3) Energy Efficiency and Renewable Energy, (4) Education and Outreach, (5) Utility Regulations, Policies and Procedures, and (6) Local Impacts. Each includes, to varying degrees, members of city agencies, academia, concerned citizens, environmental advocates and experts, business and industry, and non-profit service providers. The committee goal is to have a draft plan complete for review by April of 2009, and participants in the process and the APCD staff have been examining the paths other communities have taken and, in some cases, learning from their mistakes.

To date, the committee has completed an initial greenhouse gas inventory with the final report is due out in mid-October, 2008. The draft of the report indicates that Louisville's emissions have increased from 1990 to 2007, coal fired energy is the largest source of emissions with transportation coming in at a close second (Pandullo and Shil 2008). The process and findings will result in understatements of the local emissions levels – and problems – since local industrial facilities were not compelled to report their emissions, and one of the known largest local emitters and employers, UPS Worldport, did not submit any data. The limited inventory means that the community wide measure will be suspect and unreliable. However, the very fact an inventory was conducted provides the community with an educational moment with a still large estimate known to be understated, and this step may open a door to a more accurate measure with required reporting from industry.[8] It also provides local industries with a preview of reporting requirements and possible actions when federal carbon taxes, cap-and-trade or other regulatory schemes get put into place.

Local officials recognize that long term solutions for Kentucky's reliance on coal must be addressed and admit that short term solutions will initially be centered on energy efficiency and new technologies as they relate to economic growth (Bruggers 2007). The conversation about energy efficiency and conservation most often occurs in terms of such efforts as alternatives to building new power plants in response to otherwise increasing electricity demand in the region. The issues rarely arise as questions regarding climate change or emissions reduction. Efficiency and conservation measures are continually framed as economic priorities. This is especially true in the context of the merged city/county Metro government that has had major budget cuts and is struggling to serve its bigger geographic area. Its partners, UofL and JCPS had their budgets severely cut in 2008 when the state cut budgets from 6% to 12% across all agencies. In difficult financial times and in the context of coal dependency, perhaps it is logical that the first solutions proposed focus on

[8]In effect, the hope is that the inventory will show high enough emissions to generate the political will to compel industry reporting of emissions, to which major local firms successfully objected when the CCC was first created.

energy efficiency and low cost technology. The first step the Partnership institutions took was to conduct energy audits of their buildings to assess possible consumption savings. UofL initiated a performance-based contract in 2008 under which energy cost savings would pay for the costs of building retrofits and rehabilitations to lower consumption. In addition, the engineering firm that will guarantee the energy savings cover the expenses will be actively engaged in changing human (faculty, staff, and student) actions on campus in order to lower energy consumption, so the contract will also serve to educate those parties as consumers about their own energy usage and possible savings.

While acknowledging the state and regional reliance on coal for energy, sub-committees of the Louisville CCC also are taking the opportunity to look beyond energy efficiency measures, examining land use and transportation planning reform. One of the sub-committees, Land Use, Transportation and Urban Forestry has tackled land use planning as an energy-saving tactic despite the city's presence in a state and regional context in which such planning is viewed as an intrusion on individual liberty. The sub-committee members understand that they cannot regulate coal usage but might be able to influence land use planning and building codes to reduce consumption and emissions, despite problems in measuring the effects of better land use and transportation plans on greenhouse gas emissions and thus the potential economic benefits of those plans.

Whether the report that will eventually be produced by the broad CCC will be acted upon by local officials remains to be seen. The Metro APCD has a history of successfully implementing innovative local programs such as it STAR program that monitors and regulates toxic emissions. The agency's experience with gaining stakeholder support for contentious regulatory programs – and the very breadth of the citizen participation on the CCC – suggest that there are grounds for hope that real action will be undertaken.[9]

In conclusion, it is obvious that the United States is clearly not making significant progress in addressing climate change at the national level. The role of the individual states in enhancing or constraining localities' capacities to take action to mitigate the growing problem has not been thoroughly examined, with symbolic state actions sometimes incorporating constraints on real local interventions. Yet there exist myriad local efforts, inadequately catalogued, that have, in sum, probably had a real impact on the total emissions of the country. There may well be more political will to act on the part of the citizenry as a whole than has been demonstrated by state and national legislative activity, constrained as elected officials are in the US by their dependence upon special, especially business, interests for the fund they need to run for re-election.

[9]The mixed results of the 'local agenda 21' efforts around the globe do not augur well for Louisville's success. The realities of rising fuel costs and the changed global recognition of the severity of the climate change problem have, however, changed the policy environment, so real action may be possible.

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Chapter 5.3
Local Action on Climate Change in England: Indicators, Targets and Much More

Joan Bennett

Abstract Now that most British local authorities have signed the Nottingham Declaration on Climate Change, the Nottingham Declaration Partnership is concentrating on helping local authorities to respond to the growing demands that they face from the UK government and general public. Most important of these are the new national indicators on climate change which monitor local performance on climate change adaptation and mitigation.

Keywords Comprehensive Area Assessment • indicators • Local Area Agreements (LAAs) • Local Strategic Partnerships (LSPs) • Nottingham Declaration on Climate Change • Nottingham Declaration Partnership (NDP) • targets

5.3.1 The Nottingham Declaration

The Delaration was launched in October 2000 in Nottingham, and signed by 100 councils up to its relaunch in December 2005. The Declaration,[1] which is signed by the council Leader and Chief Executive, commits councils to: 'Within the next 2 years develop plans with our partners and local communities to progressively address the causes and the impacts of climate change'.

The last 3 years have witnessed a massive growth in the number of councils signing the Declaration. By the end of 2008, 91% of English councils and all Scottish and Welsh councils had signed the Nottingham Declaration or its equivalent. Some other local organisations have also signed. The Local Government Association (LGA) is currently running a campaign to encourage the remaining English councils to sign the Nottingham Declaration or its equivalent.

[1]The full text of the Nottingham Declaration and a list of the councils that have signed may be viewed at www.nottinghamdeclaration.org.uk

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5.3.2 New Climate Change Indicators and Targets for English Local Authorities

The UK government has introduced a new set of 198 national indicators to track the performance of English localities. The set includes three indicators on climate change:

– NI 185 CO_2 reduction from Local Authority (LA) operations
– NI 186 Per capita reduction in CO_2 emissions in the LA area
– NI 188 Planning to adapt to climate change

From 2009 all local authorities must report their progress against the three indicators. The data for NI 185 and NI 186 will be collected by local authorities. Data for NI 186 will be provided by the UK government. The government has already published data for NI 186 for 2005 and 2006.[2]

During the first half of 2008 all Local Strategic Partnerships (partnerships of local authorities and other local organisations) negotiated Local Area Agreements (LAAs) with the government. All LAAs include at least 35 nationally agreed improvement targets. The Local Area Agreements were finalised in June 2008 and 90% include climate change targets for the 3 years 2008/9–2010/11. Two thirds of LAAs include the national indicator (NI 186) for reduction in CO_2 emissions in the local authority area. This is the fifth most popular LAA target.

The table below shows the number and percent of LAAs that include nationally agreed climate change targets. Many local areas have included more than one climate change indicator among their national targets and three areas have opted to include all three climate change indicators. In addition, NI 187 – tackling fuel poverty – is a national target in 40 LAAs. You can see more information about the targets that have been agreed on our website (Table 5.3.1).[3]

The widespread commitment to setting climate change targets heralds a step-change in local activity on climate change, but it is not all plain sailing. The indicators are still very new and many questions remain about how to measure progress against NI

Table 5.3.1 Number and percentage of LAAs with nationally agreed on climate change targets

		No.	% LAAs
NI 185	CO_2 reduction from local authority operations	35	23
NI 186	Per capita reduction in CO_2 emissions in the LA area	100	66
NI 188	Planning to adapt to climate change	56	37

[2]For more information about the indicators, including definitions and sources of data, go to: www.energysavingtrust.org.uk/nottingham/Nottingham-Declaration/Performance-Measures/What-are-the-PIs

[3]For information about the climate change targets set in the LAAs go to: http://www.energysavingtrust.org.uk/nottingham/Nottingham-Declaration/Performance-Measures/Climate-change-targets-in-the-2008–11-LAAs

185 and NI 188. There are also doubts about the accuracy of the NI 186 data. Furthermore, while nearly all local areas have agreed targets for at least one climate change indicator, they have still to demonstrate that they have adequate plans in place to achieve these targets. This is something that will be first checked within the new Comprehensive Area Assessments in 2009 (see below).

5.3.3 New Initiatives from the Nottingham Declaration Partnership

The Nottingham Declaration is underpinned by a Partnership of all of the key bodies in England that support local authority action on climate change. The Partnership was established in 2005 for the relaunch of the Declaration with the following members:

- Carbon Trust
- Energy Saving Trust
- Environment Agency
- ICLEI – Local Governments for Sustainability (ICLEI), as regional and international partner organisation
- Improvement and Development Agency (IDeA)
- Local Government Association (LGA)
- Nottingham City Council
- UK Climate Impacts Programme (UK-CIP)

Until recently the Partnership has concentrated on increasing the number of councils that have signed the Declaration. But now that the vast majority of English authorities have signed, the Partnership's focus has shifted to helping local authorities to deliver on their commitments. As local authorities focus on achieving their LAA targets and gear up for Comprehensive Area Assessments, the partnership has recognised the need for practical support and guidance.
Joint initiatives by the partners include:

(i) During autumn 2008 running a series of regional workshops on indicators NI 185, NI 186 and NI 188.
(ii) In October 2008 launching a greatly improved website.
(iii) Developed advice for localities on evaluating their climate change performance as part of the new Comprehensive Area Assessments.

5.3.3.1 Two Streams of Regional Workshops

These were held in the nine English regions during autumn 2008 – a total of 18 workshops – that focussed on delivering local targets for the two mitigation indicators (NI 185 and NI 186) and the adaptation indicator (NI 188). Nearly every English local authority attended the workshops.

5.3.3.2 New Website

The new website (www.nottinghamdeclaration.org.uk) is designed to act as a gateway to all available advice and support for local authorities on both adaptation and mitigation. The website:

- Provides links to advice and support for local authority services on both adaptation and mitigation
- Explains how climate change is tackled within local performance management including the National Indicators and Local Area Agreements
- Has the latest news on what is happening in the world of climate change
- Provides updated guidance on developing a Climate Change Action Plan for both adaptation and mitigation, including case studies and downloads
- Has a section for councillors on what action they can take
- Has links to local authorities' climate change strategies and upcoming climate change events.

5.3.3.3 Comprehensive Area Assessments

Comprehensive Area Assessments,[4] to be introduced in 2009, will be an annual assessment of local areas' performance by independent inspectors. Where Local Strategic Partnerships (LSPs) have identified climate change adaptation or mitigation as a local priority (and most will at least have identified mitigation), then inspectors will assess and report on how well the area is planning for and achieving its goals. The inspectors will draw on a range of evidence, including performance against the national indicators and "Self-Evaluations" undertaken by the LSPs.

The Partnership has developed a guide for LSPs on how to evaluate their performance on climate change adaptation and mitigation. This was piloted with a number of local authorities.

5.3.4 Conclusion

The introduction of the new national indicators has led to a significant increase in the attention that English local authorities and their partners are giving to climate change. But it is still too early to say whether this will be followed through into a genuine strengthening of action. This should be clearer by November 2009 when the first Comprehensive Area Assessment reports for each local area will be available.

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[4]For more information about Comprehensive Area Assessments go to: http://www.energysavingtrust.org.uk/nottingham/Nottingham-Declaration/Performance-Measures/What-is-the-local-performance-framework/Comprehensive-Area-Assessment-CAA

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Part II
Local Climate Action Case Studies

The cases shared Chapter 6 deal with the implementation of initiatives, policies and instruments by local governments or in communities. These include several interesting cases where other levels of government, different organisations or the business sector play a role in motivating or driving change in communities. Replicable factors are highlighted, and, in many cases, the reader will be presented with a diverse range of actions are implemented with different motivations – with the message that all communities can engage, need to consider their own situation, and respond in their own unique manner.

The case studies are loosely grouped according to a thematic perspective, although there is obviously an overlap and the approach is not strictly categorised:

– *Policy and comprehensive strategic approach,* focussing on the role of councils to promote and implement innovative policies for climate protection. The examples show that there is a focus beyond short term political aims, and show different approaches used in the exemplary communities of Växjö (Sweden), Güssing (Austria), Tilburg (The Netherlands), Almada (Portugal) and Woking (UK).
– *Technology and measures,* introduces the management and implementation of technical solutions by local governments from a sustainable energy and resource scarcity perspective – from photovoltaics to heating/cooling of buildings and proper waste management. The cases presented include Gelsenkirchen (Germany), Varvarin (Serbia), Freiburg im Breisgau (Germany), Heerlen (The Netherlands) and the Province of Rovigo (Italy).
– *People and lifestyle* remain central to success in energy and climate action. Examples illustrate different approaches used in communicating with people, policy options that were implemented, and how the responsibility of citizens plays a fundamental role in local initiatives, especially in a number of small, advanced communities, namely Malmö (Sweden), San Sebastián (Spain), Casalecchio di Reno (Italy), Viernheim (Germany), Stockholm (Sweden), and the Veneto Region (Italy).

The range of cases presented in this book represents a selection of initiatives by local governments that can be regarded as a ‘third industrial revolution’, or perhaps a ‘revolution of necessity’, opening a new era of substantial change in the relationship between the global and the local level. Certainly over the last few years communities have gained in prominence in the global climate dimension, yet their value and important role has not yet been formally recognised.

The book concludes with a glossary of the main used terms and abbreviations used, with an index of names and subjects, as well as annexes of relevant documents.

Chapter 6
Selected case studies illustrating the three streams of action

Chapter 6.1.1
Fossil Fuel Free Växjö: Moving Towards the Vision of Zero Emissions (Växjö, Sweden)

Henrik Johanson

Abstract Växjö, a city in southern Sweden, aims to become free of fossil fuels, and is taking its responsibility to minimise its impact on global climate change seriously. The core of Växjö's climate strategy is based on the knowledge that the climate is changing and the ability to identify solutions to problems. This has lead to a common understanding among politicians, companies, inhabitants and organisations that there is a need to stop using fossil fuels. Already in 1996, the local politicians unanimously decided on the long-term vision of a fossil fuel free city. This goal covers the entire geographical area, meaning that all inhabitants, companies, non-governmental organisations (NGOs) and public authorities have to contribute to achieve this vision. To reach the goal a wide range of actions have been identified, and are being carried out – in particular to ensure that the use of heat, electricity and transport becomes more climate friendly. Excellent results have already been achieved – between 1993 and 2007 the CO_2 emissions per capita were reduced by 32%. This is an exemplary city that is also keen to share its strategy and developments to encourage other communities to follow suit.

Keywords Ambitious targets • bio-energy • biomass-based energy supply • cross-party political consensus • energy security • financing projects • forestry • lifestyle change • long-term vision • stable energy prices

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Table 6.1.1.1 Växjö municipal profile

Municipal profile	
Population	80,000 (2008)
Area	1,925 km^2 (87% land, 13% lakes)
Municipal budget	€250 million (2007)
Targets	Decrease CO_2 by 70% per capita until 2025, compared to 1993 Long-term vision to become a completely fossil fuel free Växjö

6.1.1.1 Växjö in Context

Växjö is the central city of the county of Kronoberg.[1] The city's name probably comes from the place where roads reach the local lakes, with the lakes still playing a central role in local life. Until some decades ago, the lakes were severely polluted, but after massive restoration work, the city of Växjö is integrating the lakes into the townscape again. The city has a university and around 8,000 companies. The service sector, together with the commercial and educational sectors, form the basis of local business. Of Växjö's total population nearly 60,000 people live in the city and the rest live in the countryside or smaller adjacent urban areas. The municipality area contains forests and lakes, and agriculture is pursued to a limited extent. Access to surrounding forest – as a great source of local bioenergy – and the influence of the lakes form the basis for the climate politics of Växjö (Table 6.1.1.1).

6.1.1.2 Goals

It is well established that the burning of fossil fuels contributes, among others, to an increased greenhouse effect and results in higher temperature and an increased frequency and intensity of storms, rainfall, droughts and floods. On the international arena, governments are trying to agree on GHG reduction targets, while most actions to reduce emissions are implemented on a regional and local level. The City of Växjö[2] is taking its global responsibility seriously, and intends to show other local authorities that one can achieve good results on the local level, with or without national and international agreements.

To understand why Växjö decided to become a fossil fuel free city, and how it was possible to make such a decision in 1996, it is necessary to go further back in history. Växjö is situated in an area with lakes scattered all around, also in the city centre. These lakes have suffered severely from eutrofication and pollution during the twentieth century. To be able to develop the city, the lakes were restored during

[1] www.lansstyrelsen.se/kronoberg

[2] www.vaxjo.se

the 1960s. With the quality of water improved, citizens enjoy fishing and swimming in the central-most lake, and the lakes can be nicely incorporated in the city planning. This success story has characterized and influenced local politicians. They learned that real commitment and having a long-term vision to what they want to achieve, brings success. This happened once again in the mid-1990s, with the decision to become a Fossil Fuel Free Växjö.

6.1.1.3 Taking the First Steps

So why did Växjö's politicians dare to take such a decision? The first steps towards a biomass-based energy supply were taken already in 1980. After the oil crises of the 1970s, the municipality owned energy company, Växjö Energy Ltd. (VEAB), wanted to find a way to be less vulnerable and less dependent on what was going on in the world. Alternatives to oil were to be found – alternatives that would guarantee a secure supply, and with more stable price. The answer turned out to be biomass. Växjö is surrounded by forests, and the forestry industry could provide VEAB with wood chips and saw dust that they did not need. This material was also cheaper than using oil. In 1980, Växjö was the first city in Sweden to start using biomass in the production of district heating, even though the majority of the energy still came from oil. However, during the decades, the share of oil has been minimised to only 1% in year 2007.

The reason behind starting to use biomass for heating in Växjö was to be more self-dependent on energy. There were some positive side effects though; for example, it was more environmental friendly (even if almost nobody talked about climate change in those days), it could generate more local jobs – which would also generate more tax income to the city. And also in the beginning of the 1990s, when the national CO_2 tax was introduced, the use of biomass turned out to be a really good solution from a financial point of view. This also meant cheaper energy to the citizens connected to the district heating system, compared to using oil in a larger extent.

6.1.1.3.1 Time to Make a Decision

In 1995, the City of Växjö started a cooperation action with Sweden's biggest environmental non-governmental organisation (NGO), the Swedish Society for Nature Conservation (SSNC). Växjö hoped to start a number of environmental projects, but wanted someone to verify that the correct actions were taken. The cooperation was to last initially for 3 years, and included seminars and workshops, as well as an intense dialogue between the SSNC, city staff and the politicians. A number of roundtable meetings were also arranged where companies, other NGOs and citizens could attend and contribute their ideas. This was the true start of the local Agenda 21 work.

During this cooperation, the SSNC wanted to see if Växjö could be unique in some way. Together the staff and politicians they saw the potential when it comes to local work on a global problem – climate change caused by emissions of greenhouse gases (GHGs). This was in 1996, the year before the Kyoto Protocol was written. The climate debate started to become intense in the international arena. Locally, Växjö had already had good experience with the use of biomass for production of heat and electricity, Växjö University was well-known for its biomass research, and also some companies were working actively within the bio-energy or forestry sectors. In Växjö, there was a potential to achieve good results, if everyone participated.

A seminar was arranged, in which experts talked about the importance of reducing the CO_2 emissions and companies and other actors explained their views on a fossil fuel free Växjö. In the end of the day, the Mayor said that it is not possible to continue using fossil fuels. And very soon, a unanimous political decision was taken, which included:

– Växjö shall be a fossil fuel free city (in its own organisation and in the total geographical area).
– Fossil fuel CO_2 emissions shall be reduced by 50% per capita until 2010 compared to 1993 levels.

There was no decision defining the time when Växjö should be totally free from fossil fuels, however, there is a regional target for the County of Kronoberg, stating that it shall be more or less fossil fuel free in 2050 (Länsstyrelsen i Kronobergs län 2007), which means that Växjö should have achieved its vision in the same timeframe. In 2006, when adopting a new Environmental Programme, the CO_2 reduction target was complemented with a reduction of 70% per capita until 2025. After the Fossil Fuel Free Växjö decision, the national and international media coverage of Växjö started, and when it was time for the Kyoto Conference, several reports were made from Växjö. People wanted to find out why a small city decided to stop using fossil fuels, since it would clearly not have any big impact on global emissions. But since the global emissions of GHGs are the sum of all local emissions, it means that every effort made at the local level is important. Växjö has recognised this and acts upon it.

6.1.1.4 Strategy for a Fossil Fuel Free Växjö

It is important to consider that at the time the decision to become Fossil Fuel Free was taken, no one really knew whether it would be possible to achieve the goal for 2010, nor what kind of actions needed to be carried out. Also, since the baseline year was 1993, it meant that Växjö's GHGs were already at quite a low level due to the introduction of biomass in the heating and electricity production in the 1980s. In 1993, the CO_2 emissions were only 4,630 kg per capita – and this included emissions from heating, electricity and transport. The goal set for 2010 is 2,315 kg per capita, which is a very ambitious goal.

It became obvious that some kind of action plan was needed. In 1997, the Government of Sweden announced that it would allocate around €600 million to local environmental investments. A municipality could apply for financial contribution to a wide range of projects in a Local Investment Programme (LIP) for ecological development (Swedish Environmental Protection Agency – www.naturvardsverket.se/lip) The programme could consist of projects owned by the city administration, companies or NGOs. This turned out to be a good opportunity to gather local actors on different thematic dialogues to discuss:

– What kind of projects could be part of Växjö's LIP?
– What actions would be implemented in a local Agenda 21 strategy?

This was the start of drafting a local action plan for a Fossil Fuel Free Växjö. Many of the climate related projects in Växjö have been financed partly, either by the Swedish Government or by the European Commission (EC) financing programmes. To achieve effective CO_2 emissions reductions, it is necessary to implement a range of different actions. Växjö's strategy to achieve a fossil fuel free community comprises of a combination of changing behaviour, improving energy efficiency, and transition to renewable energy in heating, electricity and transport.

It is very difficult to change the behaviour of people if it means financial sacrifice and change of lifestyle. Yet Växjö has shown that the transition to biofuels and energy efficiency can be profitable, and when it comes to district heating it is even a convenient solution. The aim is to make it easier to live without fossil fuels. This can, for example, be achieved through cheap(er) and convenient district heating, attractive public transport and good walking and cycling paths. Making opportunities to change attractive, instead of dealing with 'punishment' seems to be an effective manner to bring about lifestyle change. The best type of energy is the one that is never used, which makes energy savings and energy efficiency important subjects. Several studies and actions have shown that a 20% reduction of energy consumption is possible.

The potential of cost-efficient actions is another angle that should contribute to large-scale change. There is tremendous potential for companies and public administration, as well as individuals. Within the EU-project SESAC,[3] for example, the public housing sector and private companies are working together to build energy efficient wooden houses.

In Växjö, heating is mainly based on forest products, and contributes a large percentage to electricity production. There is also a potential of increased use of solar energy, for heating and electricity. Oil and electricity for heating is increasingly being replaced by district heating both in the city and in the smaller urban areas. In the countryside, wood and pellet boilers are replacing oil boilers. About one fourth of the electricity used in the entire municipality is produced within Växjö's geographical borders. The remainder is imported. But with continuous efficiency work, Växjö can become more self dependent also in electricity production.

[3]www.concerto-sesac.eu – Sustainable Energy Systems in Advanced Cities (SESAC)

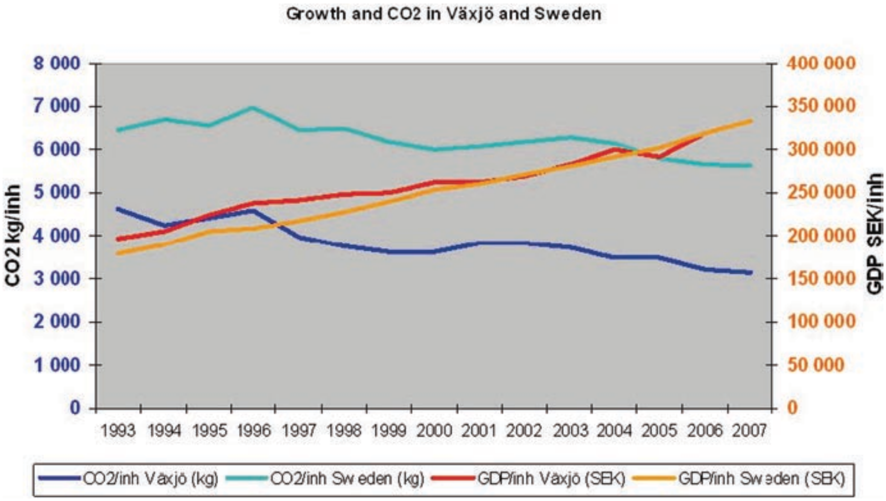

Fig. 6.1.1.1 Decoupling of economic growth from CO_2 (Courtesy: Växjö kommun and SCB) (see *Color Plates*)

The transport sector contributes 80.48% (statistics of 2007) of all the CO_2 emissions from Växjö. Transport is not a sector where there had been dramatically rising emissions, but it remains a challenging sector for GHG reductions It has been easier to reduce emissions from heating and electricity sources. It is clear that there is a need to improve transport efficiency and to replace fossil fuels with biofuels. The City of Växjö is currently improving cycling paths and public transport, as well as taking steps to improve transport efficiency with City Council staff and the fleet vehicles, thereby also making the municipality as an exemplary organisation (Fig. 6.1.1.1).

6.1.1.5 Activities to Move Towards the Strategy

6.1.1.5.1 Actions for Renewable Heating and Cooling

In the heating sector, and important sector in a cold climate, the main achievements have been attained so far. In 2007, 91% of the energy for heating came from renewable energy sources, mainly biomass. Some of the implementation actions that have been carried out, or are planned are mentioned below.

6.1.1.5.1.1 District Heating

The municipal energy company VEAB, has been providing the city with district heating since the early 1970s. Since then, connections to the district heating have increased steadily, and nowadays, almost the entire city is heated from district heating.

At the same time, the share of oil in the system has been reduced from 100% to 1%. A big reduction of oil came in 1997, when the new biomass boiler was taken into operation. While the energy plant in Växjö is a combined heat and power plant, the four smaller district heating plants in Braås, Ingelstad, Rottne and Lammhult only produce heat. Also in these smaller district heating plants, over 90% of the energy supply comes from biomass. The district heating plant in Lammhult is owned by a private energy company, E.ON. These plants were built between 1997 and 2000. Even though district heating originally was an option for buildings that needed a lot of heat, such as offices, schools, apartment blocks and industries, it can also be a feasible solution for single family houses. District heating is popular in Växjö, so many house owners have connected their homes to district heating, even the ones who used to have electric heating and had higher conversion costs.

6.1.1.5.1.2 Private Homes

In Växjö, many households are situated in the countryside, where it is not possible to have district heating. To make them a part of Fossil Fuel Free Växjö, the city obtained funds through the LIP from the Government, and used this for a 25% subsidy for households which removed their oil boilers and installed a pellets – or wood boiler instead. There was also a 35% subsidy available to households who installed solar panels. Around 275 households were given the pellets and wood subsidy, while around 60 households were given the solar subsidy.

6.1.1.5.1.3 Solar Energy

Even though Växjö is not famous for sunshine, solar energy can be and is used for heating! In the 1980s, a research project started in Ingelstad, to implement a solar heated district heating system. This project failed mostly because it was started as a research project, and the solar panels were not efficient enough, correctly dimensioned or maintained. Since then it has been hard to re-introduce solar energy in Växjö. Except for a number of households, the biggest solar heating site is on the roof of the public swimming hall, where it heats water for the showers.

6.1.1.5.1.4 Biogas from Sewage Waste

At the sewage treatment plant in Växjö, biogas is produced in the process. This is then used for heating in the plant, and has made it possible to reduce the oil use in the plant substantially. A further oil reduction will also be undertaken in 2009, when the industry Lantmännen Reppe Ltd. changing to grain waste as a heating source, instead of oil.

6.1.1.5.1.5 Renewable Energy Cooling Solutions

In addition to global warming already experienced in Sweden, lighting and electrical equipment have also increased the need for in-door cooling, especially during the summertime. District cooling based on absorption cooling is one way of reducing the electricity requirements from air conditioning systems. The absorption technique is driven by district heating, which means that VEAB can produce cooling out of biomass. Already, a demonstration installation is located at the combined heating and power (CHP) plant, but larger chillers are planned in other parts of the city.

6.1.1.5.2 Actions for Renewable Electricity Production

Approximately, 73% of all electricity used in Växjö is imported from other parts of Sweden or Northern Europe, equally sourced from nuclear power and hydro power sources. The electricity that is produced locally is mainly produced from biomass and peat in a combined heat and power plant. VEAB was the first company to produce electricity from biomass when it started in 1983. There are plans to maybe turn one of the smaller district heating plants into a combined heat and power plants in the future. About one % of all electricity in Växjö comes from local hydro, wind and solar power. These ways of electricity production could actually benefit from a changed climate with more rain and wind. There are a few smaller hydro power plants in Växjö, either owned by the city or by private companies. The hydro power plant could probably give more power if they were made more effective. There is currently only one wind turbine in Växjö, which is privately owned. However, there are plans for installing more wind turbines in the southern and eastern parts of the municipality, even though the permission process can be time-consuming. At the end of 2008, the first PV plant was started in Växjö, on top of a roof of a school. Now it provides about one eighth of the school's energy requirements. The PV plant is also used in the educational syllabus of the school. PV are also planned to be installed at another school and on passive houses during 2009 and 2010.

6.1.1.5.3 Actions for the Efficient Use of Energy

Even should Växjö manage not to use any fossil fuels, there remains a need to use energy efficiently in order to have as little impact as possible on the environment. Many energy efficiency actions are quite simple and actually only require improved awareness among the community.

Almost 20% of the city administration's energy usage are used for powering street lighting. In Växjö old light bulbs were replaced by more energy efficient and environmental friendly alternatives, which resulted in reduced power usage of 50%.

One way of reducing the use of power is to make everyone aware of what they are paying for. In the apartments and the student lodgings, individual metering systems are installed, instead of collective metering systems, which were previously used. Results indicate that this reduces the power use by roughly 20%. In one of the newest built areas, the individual metering system was connected to a display installed in every apartment, which includes energy information. Residents can therefore follow their energy usage immediately, providing an incentive to reduce their usage. Compared to similar households in Sweden, energy use is on average 34% lower in these houses.

In the SAMS project, the City of Växjö, VEAB and the public housing companies are working together to try to reduce household electricity use by 5% in a few years. This will for example be done through awareness raising campaigns and competitions. Through the web based program Energikollen, people can follow their energy use, and compare it with other time periods or alternatively with their neighbourhood.

But the residents of a house or an apartment can not influence all the energy usage in the building. They can change their behavioural patterns to some extent, but other things must be implemented already in the construction phase. When land owned by the city is sold to contractors who want to develop housing estates, there are requirements which have to be met based on a maximum use of energy per square meter. This means that the contractors need to think carefully about insulation, ventilation and other influencing issues. This could lead to higher costs during the construction phase and a higher renting cost for the resident, but residents will benefit from lower energy bills.

Many energy efficient buildings are being constructed in Växjö within the framework of the EC supported project SESAC. In this project, the buildings must have an energy use between 30% and 40% lower than national regulations. In the Välle Broar area, the houses are not only energy efficient, but are also made of wood. These four eight-storey wooden buildings now are Europe's highest buildings made of wood. During 2008, the municipal housing company Hyresbostäder, started to build Växjö's first passive houses. These are unique, as they will also be eight-storeys high and constructed of wood. These residences will use less energy when compared to concrete and steel constructions, and also function as a carbon sink (Fig. 6.1.1.2).

6.1.1.5.4 Actions for Renewable Fuels for Transport

For a long time, the transport sector has been dominated by the use of petroleum products such as gasoline and diesel. Most of the activity to obtain a higher share of renewable fuels depends upon what happens on the national and international level, and is also linked to fuel demand and availability. In Växjö, 4% of all energy for transport comes from renewable energy.

Fig. 6.1.1.2 New concepts in development – eight-storey high wooden buildings constructed within the CONCERTO SESAC project (Photographer: Anders Nordenskiöld) (see *Color Plates*)

In 1999, the first fuel station for ethanol was established in Växjö. A company in Växjö modified a car to use ethanol, which in turn led to the need for a fuelling station. The number of cars and fuel stations for ethanol continued to be quite low in Växjö for some years, but since 2002, the amount of ethanol sold has doubled for every year. In 2007, ethanol was available in 11 places, though still no fuel stations were present in the countryside. Since 2003, the total use of ethanol in the transport sector has increased mainly because ethanol is now blended into gasoline. Almost all gasoline contains approximately 5% of ethanol. Also, diesel contains approximately 5% of biofuel, mainly sourced from rapeseed oil.

Even though biogas was being produced at sewage treatment plants, it was not until 2007 that it was used in transport. The interest in using biogas is very high in Växjö, however, there is only enough biogas to provide fuel for approximately 80 cars. Within a few more years, the collection of biological household waste may help to increase production of biogas, sufficient enough for the city buses and many more cars.

Since the end of the 1990s, Växjö has also been involved in different projects together with Växjö University, Volvo and others to develop a second-generation biofuel. The idea is to put biomass into a gasification plant and retrieve the gas that can be used to produce DME (dimethylether), methane, FT-diesel (Fischer-Tropsch diesel) or even hydrogen. The main focus from Växjö's point of view has been on DME. Even though the project has had many problems on its way, it seems as if there will be a fleet test with trucks using bio-DME in 2009, and then a local DME fuel station will also be established. However, it is still a long way to go before the final decision on when, where and if a gasification plant should be built in Växjö, and what kind of fuel would be produced.

6.1.1.5.5 Actions for Reduced Climate Impact of Transport

The transport sector contributes approximately 80% of CO_2 emissions in Växjö. In a short time-scale, it is not possible to replace all the fuels with biofuels, and in the long run, even that would not be the solution. Therefore, it is necessary to consider if transport can be more efficient or if the modal split can change. In 2004, a travel survey was performed in Växjö, showing that approximately 60% of all transport use is made by car, and that half of the car trips are shorter than 5 km. Many of these journeys can be replaced with a bicycle, walking or using public transport. During the period 2002–2004, there was a Mobility Office set up with the task to try to change peoples' behaviour and attitudes towards transport.

In Växjö, there are over 150 km of cycle paths, which makes it easier for people to use a bicycle. However, more is needed to make it even easier and safer to travel by a bicycle. In the city planning, more focus is needed on the bicycles. Bicycle highways are being discussed, which would allow people to go by bike from residential areas to the city centre without crossing any streets. Sign posts by cycle paths inform the cyclists on which way to go. Also, Växjö produces a very popular map for cyclists.

Public transport (buses) is frequently used by the citizens, but there is potential to increase the number of passengers. During the coming years, actions to make public transport more attractive have been given high priority. According to the national statistical agency, 46% of the families in the City of Växjö do not own a car, which makes it very important to develop initiatives and improve public transport and bicycle facilities.

During the last decades, the community' behaviour is becoming increasingly based on consumption, which also means more transport of goods. In Växjö the intention is to optimise the transportation of goods to the city centre, by building a reloading centre where transport companies can deliver their goods, which will then be reloaded and delivered by other vehicles to the centre. The same kind of system is planned for the goods used by municipal organisations. Some of the transport companies in Växjö have also started to use positioning systems in order to be more efficient. The same has been done by a taxi company which managed to reduce its fuel use by 20%.

When it comes to car travels, the City of Växjö has tried to encourage citizens and companies to use environmental friendlier cars. In 2002, free parking for environmental friendlier cars was introduced, and it quickly became very popular incentive.

To speed up the development, Växjö introduced a subsidy to everyone who bought an environmental friendlier car. Due to this incentive, in 2004, Växjö had the highest sale of ethanol-driven Ford Focus per capita in Sweden, and the highest sale of the hybrid car Toyota Prius in Europe! In the end of 2007, approximately 2.5% of all private cars in Växjö were environmental friendly, most of them using ethanol. This subsidy is now available as a national subsidy and as such, the local version is therefore no longer in use.

Key replication aspects

Why has Växjö succeeded? Three key aspects are relevant and recommended for replication:

- The first, and probably the most important one, is political commitment and political unity. All political parties have agreed that environmental issues, not only those concerning climate change, are very important. They managed to agree upon clear and long-term goals, which make it easier for the municipal staff to implement the goals into action. Unlike many other cities, the environmental policies are not depending on who wins the elections.
- The second aspect is the broad cooperation of individuals and companies. The Fossil Fuel Free Växjö programme was developed through intensive dialogue with local NGOs, companies, the university and citizens. In 2007, a local climate commission was started, in order to identify actions that needed to be carried out to reach the goal. The commission consisted of representatives from politicians, city administration, Växjö University, Växjö Energy Ltd., Energy Agency for Southeast Sweden, and three other companies. The climate commission found out that it will be hard to reach the desired goal by 2010, though it is possible. It also identified a number of actions that are needed to be carried out, and in some way pointing out who should do it. But cooperation can also be sharing ideas and experiences with other cities, for example within the Swedish climate network Klimatkommunerna, the international networks like ICLEI, or the European-based ones such as Energie-Cités and Union of Baltic Cities.
- The third aspect is financing. Växjö has managed to receive funds for many of the actions implemented. Some of the funding has come from the national government, other funding has also come from European Union. The national and international financial contribution would probably be much less if Växjö didn't already have the political commitment and the broad support from others. Also, Växjö has always been able to show concrete results when it comes to CO_2 emissions reductions.

6.1.1.5.6 The SESAC Project

The Sustainable Energy Systems in Advanced Cities (SESAC) project is part of European Commission (EC) CONCERTO. Initiative within the Sixth Framework Programme for Research and Development. In the project, which runs from

2005 to 2010, Växjö, the Dutch City of Delft and the French City of Grenoble are demonstrating different projects that contribute to a more sustainable consumption and production of energy. In Växjö the project includes the building of energy efficient houses, individual metering systems, increased biogas production, a PV plant constructed at a school and absorption cooling. Dissemination of experiences, improvement of energy management policies, monitoring and technical visits are also important parts of the project.

6.1.1.6 Results

6.1.1.6.1 CO_2 Reductions

The goals to become a Fossil Fuel Free Växjö has two interim steps, namely CO_2 emissions are to be decreased by 50% per capita by 2010 and then by 70% per capita until 2025, compared to the 1993 baseline. Thanks to all the actions mentioned above, and many more that are impossible to keeping track of, the result is so far a reduction of 32% until 2007. However, one should remember that 32% wouldn't be so much if Växjö wouldn't have done anything before 1993; but the CO_2 levels were low already in 1993. In 2007, the emissions were 3,131 kg per capita in Växjö, compared to 4,630 kg per capita in 1993. This means that already in 1993, Växjö had less emission level per capita than Sweden has today.

Taking a closer look at the emissions breakdown, it is identified that 80% comes from transport, 11% from heating and 9% from electricity. Compared to the 1993 levels, the CO_2 emissions per capita from transport are 10% higher. However, the highest level was in 2001, and since then, the emissions from transport have again been reduced. The reason for this is the higher share of biofuel blended into gasoline and diesel, more environmental friendly cars, and possibly changed behaviour. The traffic itself is estimated to have increased by more than 10%. The emissions from heating have decreased by 83% and the emissions from electricity use have decreased by 38% compared to 1993. The reasons were presented above, but in general were due to the easy conversion of the heating systems, and make more efficient use of energy.

6.1.1.6.2 Energy Results

Taking a look at the energy balance, Växjö was supplied with approximately 2,400 GWh in 2007. Transport, heating and electricity was supplied by roughly one third of the energy each. Of all the energy, 54% comes from renewable energy sources, 35% comes from fossil fuels and the rest is non-renewable power, mainly nuclear power imported from other parts of Sweden.

The level of self-dependence when it comes to energy security was also considered. Estimating this is not very easy, but by considering that all biomass and peat is sourced from local or regional sites (within a radius of 80 km from Växjö), it means that the level of energy independence becomes approximately 43%. Then, biomass, peat, local wind and hydro power, heat pumps, solar energy and biogas are included. The rest consist of all the energy for transport (33%) and the power that is not produced locally (22%).

6.1.1.6.3 Socio-economic Results

It is not possible to quantify the monetary savings due to the Fossil Fuel Free Växjö programme, as the goals and statistical information used is based on the overall energy consumption. This means that it is not possible to indicate who has become more efficient or why this is the case at this stage. The general improved efficiency – changing from old systems to new systems (boilers, cars, etc.) – and the change of fuel certainly also contributed to financial savings and stable energy prices.

But one development is particularly interesting, namely the decoupling of economic growth and CO_2 emissions in Växjö, with economic development in no way suffering from the shift to biomass-based energy. This is important to show to anyone in the world claiming that you first have to get economic growth, and then commence with CO_2 emissions cuts. But since the CO_2 cut in no way means less production for us (the companies that used to have district heating based upon oil, now gets district heating based upon biomass – it doesn't mean any new investments for them). The big investments have been in the energy production facilities where new biomass boilers needed to be installed instead of oil boilers.

6.1.1.7 Conclusion

Since taking the political decision on moving towards a Fossil Fuel Free Växjö, there has been a steady stream of visitors (mostly foreign, including journalists, politicians, representatives of cities and governments, etc.), who wanted to learn more about the work and actions carried out here. Nowadays it is common to have four visiting delegations each week. This interest shows that many people are interested in finding out about initiatives which can be replicated in their own cities and countries. The general interest in climate protection and engaging as many others as possible is of real interest to Växjö, which is also eager to share its experience with others – thereby making the global result more powerful.

In February 2007, Växjö received the Sustainable Energy for Europe Award[4] within an energy campaign run by the European Commission. The concept of

[4]www.sustenergy.org

Fossil Fuel Free Växjö was recognised as a critical motivational strategy that could be replicated on any other European city. Växjö agrees with this perception: the level of replication depends highly on the political, geographical and social structure of the city – but everyone can do something. As Fossil Fuel Free Växjö is a programme covering the strategic direction of the municipality, and as such impacts on everyone and everything within the geographical borders of Växjö, the financial costs cannot be specified. Yet the political commitment and support from many actors also means that is the strategy is continuously supplemented by new actions – moving forward strongly.

The work has not yet ended. So what more is to be done? Although a large percentage of oil has been removed from the district heating systems, around 25% of all oil used in Växjö is still used there. In the combined heat and power plant, around 5% of all energy comes from peat, which also contributes to the greenhouse effect. Much of the oil has been replaced due to increased oil price and national CO_2 taxes, and this will continue contributing to switching to a higher share of renewables.

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Chapter 6.1.2
Self-sufficient Community: Vision or Reality? Creating a Regional Renewable Energy Supply Network (Güssing, Austria)

Dean Marcelja

Abstract Once the poorest municipality in Austria, Güssing has succeeded in becoming one of the most prosperous after abandoning fossil fuels in favour of regional renewable energy sources (RES). Güssing is the first community within the European Union (EU) to produce its whole energy demand – electricity, heating/cooling, fuels – out of renewable resources all originating from the region. Moving away from imported fossil fuels to using locally/regionally produced sustainable energy, the town has developed into a model 100% renewable energy community.

Keywords 100% Energy self-sufficient • 100% regional energy supply network • direct gasification of wood chips • energy export • least developed region • new forms of added value • regional development • Fischer-Tropsch (FT) process

6.1.2.1 Güssing in Context

Burgenland was, some 15 years ago, the poorest and least developed region of Austria. The Güssing region was one of the poorest within Burgenland. Güssing, a major town in south Burgenland, is a capital of a district with around 27,000 inhabitants. Due to its former unfavourable geographical location near the 'Eastern bloc' border, Güssing had no major trade or industrial businesses and no transportation infrastructure (neither railway nor highway) within the district. This resulted in a

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Table 6.1.2.1 Güssing municipal profile

Municipal profile	
Population	Approx. 4,500 (2007)
Area	45 km^2
Municipal budget	>€9,000,000/year, based on municipal tax income
Targets	Replace fossil fuels with regionally available energy sources

scarcity of jobs, with 70% of inhabitants as weekly commuters outwards, and a high rate of migration to other regions. The major problem was a substantial capital outflow from the city caused by energy (oil, electricity, fuels) that had to be bought from outside (imported), while existing resources (45% forest) remained mainly unused.

6.1.2.2 Goals

As a first step the aim was set to supply the Town of Güssing, and subsequently the whole district, with energy generated from regionally available renewable energy sources (RES), thus providing the region with new forms of added value.

6.1.2.3 History

6.1.2.3.1 From Problem to Solution Pre-EU Time

The benefits of such an energy turnaround, i.e. the transition from importing energy from conventional and fossil sources, into becoming an energy producer using a regional supply of renewable sources – were enormous. Today (2009) Güssing is one of the most prosperous regions within Austria. To appreciate the enormity of this achievement, it is necessary to go back in history to 1988/89 when Güssing was one of the poorest areas in Austria. At that stage the European Union (EU) did not yet officially exist.[1] Why is this important? On various occasions the author was asked what financial help the Town of Güssing received from the EU to start the process of becoming energy self-sufficient. The magnitude of the undertaking is recognised by people, and there is a general belief that it must have been subsidized

[1] The history of the EU begins in 1957 with the establishment of the European Economic Community (EEC). The EU as we know it today, was formally established when the Maastricht Treaty came into force on 1 November 1993.

from the ‘outside’. This is however not the case. Subsidies for regional development in the form of various programmes such as are available today, were initiated after the Maastricht Treaty and Copenhagen criteria were in force. Austria joined the EU in 1995, and was thus only eligible for funded programmes after this date. At that time the Town of Güssing was already well under way to being energy independent.

6.1.2.3.2 Impact of the Cold War

Güssing is located some eight to ten kilometres from the Hungarian border. At the end of the 1980s and begin of the 1990s the era of the Cold War, where the Eastern bloc borders were almost hermetically sealed – with steel fences, armed vehicles, and the military in control. No trespassing, no traffic, no trade or exchange of any kind was allowed. Situated next to this ‘dead’ border, as Güssing was at that time, at the very edge of Europe, one could say it was lost in a ‘double periphery’. The community itself relied on small-scale agriculture, with farmers selling corn, sunflower oil and timber to make a living. On account of this political-geographically unfavourable location near the border, major trade or industrial businesses did not exist at that time. It was of no interest and by no means economically feasible for any company to establish its production or offices here. In order to reach markets and sells products from Güssing, one had to drive across the entire length of Austria. For the same reason, regions near the Germany and Swiss borders, and, to a lesser extent Italy, developed strong industrial and service activities. When considering the highly developed areas around Linz or Salzburg, or the whole of Vorarlberg, the standard of living at that stage was ten times higher than that in Burgenland, and Güssing in particular.

A further negative impact on regional development was due to a complete lack of transportation infrastructure. It still takes a 40-min drive to reach the highway, and the railway closed its lines to and from Güssing at the beginning of World War II (WWII). There was no demand and no customer base for a basic services industry, which was also almost non-existing: the town had nothing to offer. As for other regional potentials, the main (or only) attraction was a twelfth-century castle built by Hungarian nobles. This, in spite of a beautiful surrounding landscape, was by far not enough to attract sufficient visitors as to initiate development of tourism. Overall this resulted in a scarcity of jobs, with the consequence that some 70% of the population were weekly commuters to Vienna (160 km away), and there was a high rate of migration to other regions. The municipality was losing its population, especially younger and educated people who headed to large cities or were even emigrating, looking for better careers, job chances and a higher living standard. For Güssing, these people were lost and the region’s average population was getting older, with the danger of becoming a ‘dead’ town. The town was deeply in debt due to this situation, and could hardly honour its regular financial obligations.

6.1.2.4 Starting a 100% RE Community

At the end of the 1980s, a small group of people in Güssing recognised the situation and decided to undertake measures to revert the negative trend on the then Town Council member, Peter Vadas, and a young engineer, Reinhard Koch. They recognised a simple fact, namely to get the things moving, the municipality had to start thinking like a business – there had to be a workable business model. It took quite a number of discussions and sleepless nights until the proposal was born. The basic idea was simple: to make a turnover and consequently a profit, the municipality had to create its own product that could be sold to the district population, as a service that is required (Koch and Hotwagner 2006).

6.1.2.4.1 Identifying the Problem

The region around Güssing municipality has a beautiful landscape. The area is quite flat, with some small hills and slopes, half covered by forest and the rest consists of fields and meadows. It offers nature and plenty of space. Members of a group of 'reformers' who regularly hiked, noticed that most of woods were not well maintained. In part this was due to the small size of plots where the owners were not specifically interested in upkeep. With on the one hand a lot of usable resource material simply left to rot in the woods, and on the other an urgent need for a product to start some municipal business and earn money, a solution was found. The group placed wood on their list of raw materials that could potentially resort under direct control of the city. Wood can be used as an industrial raw material, as an energy source, or both. Koch and Vadas took a very unusual step for that time, as energy was not traditionally considered to be a part of the municipal budget (it was a paid service to an external service provider), by changing the standard approach (Table 6.1.2.1).

On examining the Güssing budget, which was repeatedly closing with a negative balance sheet, they obtained confirmation that most of the capital needed was to cover the costs of energy – for heating and electricity. Taking into account energy prices of 1992 and translating these into today's figures it comes to an amount of around €6,000,000 for 1992 – a significant sum of money for a small community of only 4,000 inhabitants. The group realised that such substantial capital outflow from the region was due to the town's energy imports, despite existing resources, e.g. 45% of forest land, remained largely unused. To abandon fossil energy, start using abundant local wood resources, and subsequently selling clean energy to the citizens (customers), the town could keep € 6 million in the town or region – and drastically change the situation of the community. It was decided to perform a detailed analysis of local energy demand, to obtain a clear image of the situation – all energy forms had to be considered: electricity, heating and fuels (gas etc.). Based on such analysis a workable model of substitution of fossil fuels with energy production out of renewable local resources could then be proposed.

6.1.2.4.2 Council Decision

Based on this, in early 1990 a policy was proposed to the Town Council which called for a complete abandonment of fossil-fuel based energy. The objective was to supply, in a first step, the town of Güssing and subsequently – in the long term – the whole district with energy from regionally available sustainable sources. The Council accepted the proposal with an absolute majority of votes. At that stage no one could imagine the consequences of such decision for the town. The main motivation behind the idea of self-energy-production was simply to earn some money and try to get out of financial crises, but what happened since then has been substantial. Today, after almost 20 years, the 1990 decision of the municipal council is still considered to be the most important one within the history of modern Güssing. The election of Peter Vadas as mayor in 1992 accelerated the process, in particular when he appointed Reinhard Koch to assess how the town could benefit from its natural resources, and to handle the management of the whole project. Koch, relatively fresh out of university and not quite willing to share the destiny of many local commuters to Vienna, was ambitious, had new ideas, and started implementing the measures proposed previously to the Town Council.

6.1.2.4.3 From Savings to Renewables

As a first step the concept foresaw energy savings measures in all public buildings. This may sound simple today, yet in 1992 few people were thinking about energy savings. This first step showed results soon, and according to the steady monitoring of public buildings a total average energy savings achieved was between 40% and 50% per year, with resulting financial savings. The energy demand was reduced by adding rigorous new insulation of all buildings, installation of new windows with a good k-value, and conducting a thorough check of all systems, pipes, fittings, etc. This first success acted as motivation to proceed with the plan and official support of the Town Council was confirmed.

In 1991 the Güssing rapeseed-mill went into service to produce bio-diesel for the local population. Local and national data showed that transportation contributed to 30% of energy consumption, following heating (some 50%). Whereas the thermal load of the region was rather constant, with a minimal potential to increase (except for new industrial facilities to be constructed later), energy consumption for transportation and mobility was steadily rising. The idea of producing biofuels from local crops was in accordance with the master plan to make the region independent in covering its own total energy demand. The rapeseed plant had a capacity of 840,000 l/year. This was so-called first-generation bio-diesel. As research and development in Güssing took off fast, the plant was closed in 2005 in favour of newer, more efficient technology (third-generation of biofuels). Soon after, the first biomass plant was built, as part of local district heating under development. This Glasing plant went into service in 1992, with 350 MWh/a capacity. Initially the system had fewer than 30 users. As a pioneer project, the town had difficulty to finance the undertaking, which required negotiation, convincing, and giving personal warranties to get the necessary capital and construction started. The first operating results and economy of the plant were good. By word of mouth new users were soon found.

This encouraged the town to immediately proceed with the implementation of the sustainable region plan. The second similar small-scale biomass plant in another part of Güssing, the Tschantschendorf plant, went into service in 1993. This time, financing and other negotiation process went somewhat smoother and faster, with the operating results of the first plant useful to illustrate success. In the following years other small-scale local district heating biomass plants were built, as part of the realisation of the whole regional concept.

In this phase public information work played an important role, helping to gain the first avant-garde group of local district heating users. Initially it was not easy to convince them as there were no comparable practical references, only calculations on paper. Also, the whole idea of renewable energy and local supply were new concepts. The standard was to have centralised and monopolised energy, and thus such radical change was not easy to explain and market. In 1996 a biomass district heating plant went online, with a yearly output of some 45,500 MWh/a. Although relatively small compared to what is possible today, this was the largest biomass plant in operation in Austria at that stage. The plant and a newly placed heating pipeline, totalling around 30,000 m, was a major step towards energy independence of the municipality.

6.1.2.4.4 Reaching Energy Independence

The final independence of the town was achieved in 2001, when a new co-generation biomass plant went into service. This plant is still today one-of-a-kind in Europe. Delivering some two MW of electrical output and about 4.5 MW of thermal output, the plant was the first to use a new technology: direct gasification of wood chips instead of burning the biomass. The technology is based on the scientific work of a scientist from Vienna Technical University, Professor Hofbauer. In 1998, Koch and Vadasz saw a presentation of Hofbauer and were convinced that was the right technology for their project in the Güssing municipality.

The plant works on the principle of fluidised bed steam gasification technology. The gas obtained from direct wood chips gasification is subsequently cooled and purified, so it can be directly used in a gas engine. With a fuel thermal performance of 8 MW, a district heating output of approximately 4.5 MWth (megawatt thermal), and an electrical output of approximately 2 MWth, after 7 years of operation the plant still works with an 82–84% average efficiency. For a technical machine of this size it is an exceptional achievement (Rauch et al. 2004.)

The fundamental idea of gasification system is to physically separate the gasification reaction and the combustion reaction in order to gain a largely nitrogen-free product gas. Endothermic gasification of wood chips takes place in a stationary fluidized bed, connected via a diagonal chute to the combustion section, which is operated as a circulating fluidized bed. Here, transported along with the bed material, any non-gasified fuel particles are fully combusted. The heated bed material delivered there is then separated and brought back into the gasification section. The heat required for the gasification reaction is produced by burning carbon brought along with the bed material into the combustion section. The gasification section is fluidised with steam, the combustion section with air and the gas flows are separately streamed off. Thus a nearly nitrogen-free product gas with heat values of over 12.000 kJ/Nm^3 (dry) is produced. Further advantages of this method of production are its compact construction and by using steam as the gasification medium, there is a smaller tar content in the product than when using air (Fig. 6.1.2.1).

Another advantage of this system is the automatic equilibrium between combustion and gasification reactions, thus one can keep the operation running stably without excessive regulation and adjustment. As already mentioned, the gasification reaction is endothermic. If the temperature in the gasification section drops,

Fig. 6.1.2.1 The first co-generation biomass plant to use direct gasification of wood chips instead of burning the biomass (Courtesy: EEE/RENET) (see *Color Plates*)

less fuel is fully decomposed and this leads to an increasing proportion of carbon or non-oxidised fuel in the combustion section. By virtue of the increased combustion, more energy is transferred to the bed material and this supplies in turn more energy back to the gasification section. A renewed temperature rise in the gasification section is the result (Rauch 2007). Other plants of different sizes were constructed and strategically positioned in different parts of the municipality – considering an optimal location near the demand area and not far from the resource area. Thus, all micro-systems have low logistical costs and then the system itself is simple. This is reflected in the price calculation and feasibility as well. Research and development continued. Today Güssing plays host to a number of innovative technologies, solutions and patents, while a team of highly trained technicians and 'imported' scientists are working in Güssing.

A major further breakthrough in technology was achieved with the upgrading of an old process of 'distilling' wood into liquid fuels. The Fischer-Tropsch (FT) process was optimised by Güssing scientists. It is now possible to produce liquid diesel fuel with a higher cetane value than that of diesel from fossil fuels. The gas – a product of wood chips gasification in the combined heat and power (CHP) plant – is used as a fuel for the FT reactor. The favourable characteristics of the CHP-plant product gas (low nitrogen content, high hydrogen content, H_2:CO ratio of 1.6–1.8) allow also other usages of this gas. Research projects concerning the production of SNG (synthetic natural gas), Fischer-Tropsch Diesel and electricity in a SOFC (solid oxid fuel cell) are all well under way, and have achieved excellent results so far. Construction of the Fischer-Tropsch reactor is in the final stage, reactor is expected to be put in operation within the first half of this year (2009). A bypass flow of about 10 Nm^s/h should be converted via Fischer-Tropsch synthesis into diesel. The gas will be taken after the existing gas treatment, compressed to 20–25 bar, with sulphur and chlorine components removed, and converted in a slurry reactor to wax. From the wax diesel will be produced via hydro-treating.

6.1.2.5 Results

What effect has this approach had on the area? A special scheme that revolves around stable energy prices, fuel/costs not linked to oil and gas, guaranteed long-term approach of 10–15 years, promoted the establishment of enterprises in the area. It resulted in 50 new enterprises with more than 1,000 direct and indirect jobs in the town (excluding the regional impact here). Güssing has developed into an important location for industries with high energy consumption, such as parquetry production or hardwood drying. The highlight is Blue Chip Energy, first high-efficiency solar cell production in Austria, as a joint venture with an industrial investor group around Solon AG, which came to Güssing only because they can power the plant with clean energy coming from the renewable resources.

Some results in brief:

- Values remaining within the region
- New jobs (and generating income tax)
- Less traffic due to a reduction in commuter numbers
- Independence from external energy
- Long-term stable energy prices
- secured energy supply
- CO_2 reduction

In the Town of Güssing the results helped the development of the town, with:

- 50 New companies
- Over 1,100 new jobs
- net municipality income of >9 Mio. EUR/year
- Energy sales volume >14 Mio. EUR/year
- Wood consumption of >20,000 t/year

It was a logical next step to expand the renewable energy project to the region; there are today over 30 decentralized power plants within Güssing county. Güssing today has an energy turnover of about € 14 million/year. Part of the profit is reinvested into renewable energy projects. According to the master plan, it is expected to turn the whole region energetically autonomous within the following 2 years as of now (2009). The county already reached up to 55% self-sufficiency in the total energy supply (the region already profits ~ € 20 million p.a.), and according to forecast with the potential to become 100% self-sufficient over the next 2 years it will generate an income of more than € 37 million/year.

Achievements of Güssing are internationally recognised, with many prizes awarded, among others:

- Global 100 Eco Tech Award
- Energy Globe Austria 2005
- Climate Alliance Award 2004
- Austrian AND European Solar Prizes 2004 from Eurosolar (as a model region)
- Most Innovative Municipality in Austria 2004
- Most Environmental-Friendly Municipality in Austria 2002

With these results Güssing is a respected partner and consultant in many other municipalities nationally and internationally. The Güssing Method of conception and projecting a sustainable region is truly unique, because it is based on 17+ years of practical experience and theory (Koch and Hotwagner2008). It is important to share these experiences with other municipalities which decide to take the sustainable energy road. Güssing and its inhabitants are conscious about resources and keen to take care and look after the surrounding forest to ensure a good supply of renewable energy for the future. In addition to this, the town is currently using around only half of its yearly wood growth supply to feed its power plants, and is thus not depleting resources.

As a side effect, extra income is being generated through international eco-tourism. Visitors from around the world come to gain inspiration from the town, to see how it functions – from scientists, to technical experts and ‘ordinary’ tourists, who are simply curious to spend some time in a sustainable town. With >40,000 visitors/year (and a steadily increasing number) two hotels, numerous cafés and restaurants, infrastructure advancements and upgrades within the town and area were made.

6.1.2.6 Lessons Learned

All in all, the overall quality of life in the region has significantly improved, and the project has had many benefits. The replication of this concept by other communities should positively influence the regional job market and essentially improve the professional qualification level within the region. Acceptance of the project is likely to be high and regional self-confidence can be strengthened. The publicity of the region as a sustainable energy centre increased, which has led to new possibilities for tourism, culture and sport. Developments such as the establishment of regional companies, institutes, training and research institutes – active in local and internationally cooperation – have had positive repercussions for the region.

Güssing has become a model for other towns, cities and regions (Ruppert et al. 2008). In the current climate and energy situation the creation of such energy autonomous region may serve as important impulse for decision-makers. The aim is to extend the model also to other regions, sharing achievements and know-how.

The most important target groups regarding implementation of an energy-autonomous district project are the inhabitants of the district. They need to be informed and involved. When developing the sustainable implementation of the concept, target groups should be integrated in the preparation of the concept at an early stage. Discussions should take place not only with the communities but also with potential operators or constructors. One of the most important aspects of such a project is probably providing proof that a self-sufficient energy supply of a region (size of a district) is possible. However, it is also essential that there is a realisation that such energy-self-sufficiency can only be achieved when energy savings, the sustainable handling of resources, and the rational use of resources and technologies are considered. By switching to 100% energy from RES, CO_2 emissions in the region can be decreased by up to 90%.

The ‘Golden Rule’ is to invest 20% of own capital, at least 30% of subventions (e.g. from the EU, local governments) and 50% from the bank or private equity lenders. This applies to handling the administration, conducting the study and construction of necessary infrastructure.

Key replication aspects

Each municipality can be considered as unique, and thus the organisation works on a one-to-one basis. There is no single recipe for success, and a thorough analysis specific to the region has to be done. Some aspects to consider include the following:

- Key persons who need to be involved are the mayor, as the main political stakeholder who should bring the issue to the city council, who should then ideally back up the whole conceptual project. Without firm political will of the municipality leaders, such project is impossible.
- The municipality (the mayor) should appoint one person as an 'energy manager', preferably an engineer or technician (but this is not specifically required, with other positive experiences with non-technical people), who will be the person exclusively in charge in dealing with the sustainability project in all aspects (and not be involved in other tasks).
- Budgeting for an energy manager pays off quickly if one considers that this person is likely to achieve changes on the municipal energy map, with savings of at least 10% in energy expenditure.

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Chapter 6.1.3
A multi-sector Network Approach for an Integrated Local Climate Policy: Think Global, Connect Local (Tilburg, The Netherlands)

Maartje Hazebroek and Hans Schneider

Abstract The City of Tilburg has put in place plans for an ambitious, integrated and effective local climate policy. Ambitious as the city wants to be climate neutral and climate resilient by 2045. Integrated as it includes both mitigation and adaptation, and with the aim that the policy is integrated in a broad range of policy fields managed by the city councillors. Effective in the sense that it will be assessed on the projects, infrastructure, changes and results present in a complex existing urban society.

Tilburg has recently made substantial progress towards the realisation of an integrated climate programme. The factors contributing to its success have included:

– Continued political backing of climate policy as a priority
– Earlier successes and rewards, building on these
– Early involvement of stakeholders
– Clarification of main issues through research
– Broad and timely communication
– Participation in local, national and international networks

This case study illustrates how the establishment of a multi-sector network helped to mobilise the civil forces needed to realise climate neutrality and climate resilience.

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Keywords Adaptation scan • CO_2 neutral target • Energy Service Company (ESCO) • environmental protection • integrated long-term climate policy • local climate alliances • multi-sector network • sustainability • public–private partnerships (PPPs) • stakeholders

6.1.3.1 Context of the Municipality

Tilburg, centrally located in the Province of Noord-Brabant, is the sixth largest city in the Netherlands.[1] It is a modern city that came to prominence at the end of the nineteenth century with the rise of its textile industry. Following this industry's decline in the 1960s, the city and surrounding area succeeded in the development of a hugely varied local economy. An economy which, partly thanks to its diversity, is thriving and increasingly making its mark in the Netherlands. Time and again foreign companies choose to locate their Dutch or European headquarters in the city. The knowledge-based economy and creative entrepreneurship are gaining importance, a process aided by the city's three higher education institutions. Currently, the three main economic sectors from a regional perspective are leisure, logistics and life sciences.

Protecting the environment is one of Tilburg's top priorities. Tilburg is focused on improving the quality of air, water and soil, and looks to local politicians to promote and protect the city's green areas and surrounding countryside. The fact that Tilburg was elected the most sustainable town in the Netherlands several times in a row is a testament to how strongly the city feels about protecting the environment. An example of Tilburg's commitment to limiting pollution is its 'clean lorry traffic' policy which bans environmentally-unfriendly trucks from the city centre. The climate programme discussed below is related to all these subjects and has been developed to support cooperation with other interested parties and stakeholders (Table 6.1.3.1).

Table 6.1.3.1 Tilburg municipal profile

Municipal profile	
Population	200,000+ inhabitants (2008)
Land area	119.15 km^2
Municipal budget	€903,7 million (2008)
eCO_2 targets	To become climate neutral and climate resilient by 2045

[1] www.tilburg.nl

6.1.3.2 Goals

The objectives of the local climate programme are to reduce CO_2 emissions. The city aims at being CO_2 neutral in 2045, and to adapt to the impacts of climate change. In order to reach these goals a multi-sector network is being formed involving all relevant parties. This network was initiated by the City Council, with involvement by other organisations.

6.1.3.3 Starting Point

Tilburg has been on the road towards sustainability and energy efficiency (EE) for many years. This has resulted in many eye-catching projects and programmes. For instance the city uses heat and cold storage in the ground in several places and has a modern public lightning policy (dimming at night instead of turning off half the lights, and using light-emitting diodes [LED] lighting). This was in line with an agreement with social housing corporations which are steadily implementing EE renovation. Other energy saving achievements include district heating, waste heat recovery, as well as bicycle lanes and routes throughout the city to encourage a reduction in car dependency. Although city officials were already convinced that climate change was demanding serious action, in the beginning of 2006 it was realised that action to protect the city should be handled in an even more thorough and structural manner.[2] The observation that the climate is already changing and will continue to change, even under low carbon scenario's, led to the question whether Tilburg could and should become climate resilient and be able to seize opportunities emerging from climate change. A third aspect was whether all the parties potentially affected by climate change or potentially needed for mitigation and adaptation actions would share the sense of urgency, understand and agree to further involvement.

In order to answer these issues several activities were executed. As a first step a stakeholder process was initiated through interviews, a series of stakeholders' conferences were organised, a website was developed and a newsletter compiled. Secondly, two studies were commissioned: a back-casting[3] study for a carbon-neutral city and an adaptation scan.

6.1.3.4 The Tilburg Roadmap Towards CO_2 Neutrality

A background study called 'The roadmap towards a CO_2 neutral Tilburg' was undertaken in 2007. It identified current emissions, energy demand and emission trends, and all the required and achievable energy savings and renewable energy

[2] www.localclimateprotection.eu/437.html

[3] Backcasting scenarios reason from a desired future situation and offer a number of different strategies to reach this situation. Terminology source: http://glossary.eea.europa.eu (EEA 2000)

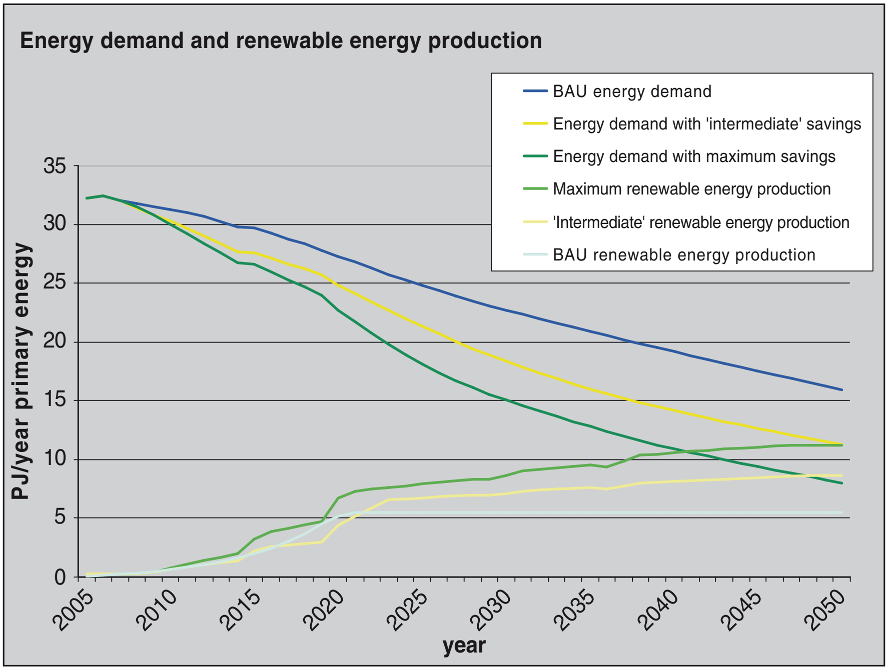


Fig. 6.1.3.1 Scenarios for CO_2 neutrality in Tilburg (Braber et al. 2007) (see *Color Plates*)

Table 6.1.3.2 Timeline of the Tilburg stakeholder process

Stake-holder process	'Old' environmental policy	2005
	Start investigations into city CO_2 neutrality	**2006**
	First local climate conference	**2006**
	Researches 'Tilburg CO_2-neutral' and 'Adaptation Scan'	**2007**
	Interviews with stakeholders	**2006**
	Second local climate conference	**2007**
	Building multi-sector network	**2007–ongoing**
	Start working on an integrated long-term climate policy	**2008**

(RE) options. In a business-as-usual scenario Tilburg would reach CO_2 neutrality somewhere around 2090. With a 'pull-out-all-the-stops' programme CO_2 neutrality could be reached in 2045. The roadmap describes all the necessary actions required to reach that goal (Fig. 6.1.3.1; Table 6.1.3.2).

The above mentioned table shows how a 'pull-out-all-the-stops' programme could achieve CO_2 neutrality in 2045 (or even 2042). As can be seen, energy consumption and sustainable energy production are equal by the year 2045. The roadmap report includes a year-by-year programme of all feasible, but necessary local actions to reach CO_2 neutrality. This programme contains actions ranging from promoting zero energy buildings, solar, wind and biomass power production, heat and cold storage, heat capture to new funding schemes and new energy service concepts. In total, the report substantiates a realistic storyline towards CO_2 neutrality in 2045.

6.1.3.5 The Adaptation Scan: Investigating Local Climate Change Impacts

Although Tilburg is situated 14 m above sea level, the city still has to cope with impacts of climate change such as increasingly intensive rainstorms and the urban heat-island effect. With software from the Dutch Meteorological Institute (KNMI) four local climate scenarios were developed for the year 2050 (e.g. the period 2035–2065) based on local historical meteorological data. The year scenarios for 2050 indicated drier and warmer summers, more heat waves, more heavy showers and warmer temperatures in winter. The table below illustrates a selection of the average effects of summers around the year 2050 compared to summers around 1990 (Table 6.1.3.3).

A list of approximately 100 impacts, selected from Dutch climate research literature, was compiled and checked for applicability with the local Tilburg situation. Impacts proved to be both threats and opportunities. The image below shows a selection of positive (green), negative (red) and neutral (grey) impacts of climate change for Tilburg as used in internal discussion sessions (Fig. 6.1.3.2).

All impacts of relevance for Tilburg were discussed with local experts and categorised as ‘urgent’, ‘not urgent’ and ‘to be investigated’. The last category listed a number of knowledge gaps both with respect to the nature and seriousness of the impact and also to possible adaptation measures. One interesting outcome was that adaptation to climate change also brings the potential to realise new economic opportunities. For instance with respect to the leisure industry in Tilburg and its surroundings, including both a large amusement park as holiday resorts, camp sites, outdoor activities, restaurants and some cultural festivals. Another unexpected finding was that for some issues (like heat casualties) discussion arose about which was

Table 6.1.3.3 Example of local climate scenario: Tilburg summers 2035–2065

Mean summer temperature	0.9–2.9°C warmer
Mean of daily highs	0.9–2.9°C warmer
Hottest summer day	1.1–4.3°C warmer
Number of days > 25°C	4.8°C to 17.1 extra days (27–96% more)
Number of days > 30°C	3.5°C to 10.7 extra days (117–356% more)
Mean daily precipitation	5% more to 20% less
Number of rainy days	1.7–19% more
Maximum amount of precipitation	3–20% more

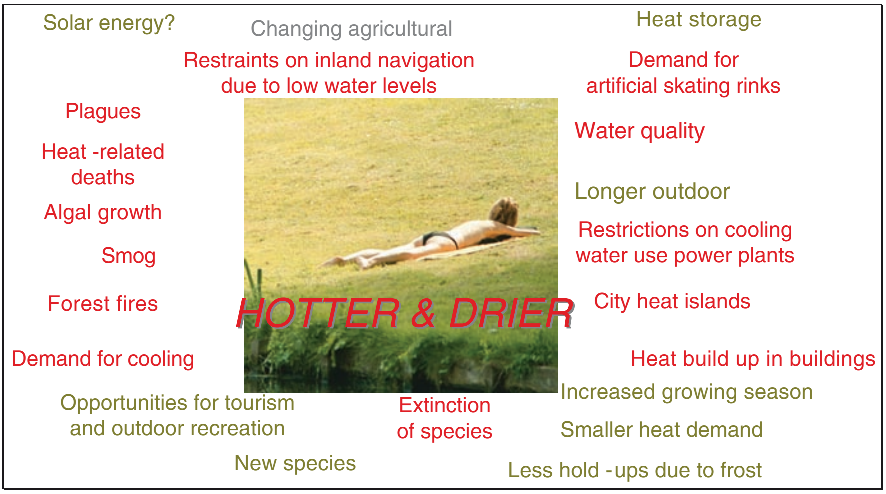


Fig. 6.1.3.2 Mood-board with climate change impacts for Tilburg (see *Color Plates*)

the primarily responsible organisation. For some impacts measures were foreseen (like sewer overflows) but not yet sufficiently executed. Other 'new' impacts like city heat build-up still require a lot of research on the size of the problem and to identify effective measures. Follow-up actions were identified and will be implemented through the Tilburg Climate Change programme.

6.1.3.6 Building a Multi-sector Network

6.1.3.6.1 Consequences of the Climate Conferences

The realisation of a transition towards a local CO_2 neutral energy supply within four decades is an enormous task which requires many practical local solutions. Besides this mitigation effort, the city will also have to cope with the local impacts of climate change. More and more organisations are feeling the responsibility and urgency to act on climate change. Discussions with local stakeholders have demonstrated that the local government is not seen as the only 'owner' to the problem. Because of the broad impact on several fields like water, housing, nature, recreation and health care, it is recognised that climate change directly affects more organisations in their core business and is not just the responsibility of the public.

Hence, the municipality of Tilburg organised two local climate conferences. The first conference – organised in December 2006 – was to determine and exchange initial views. It was attended by a diverse group of organisations from the region.

Climate change turned out to be a topic of broad interest. After this first local climate conference the event participants were interviewed about their specific view on climate change and what to do about it. They were found to be aware of the effects of climate change and its urgency to act upon the effects or find ways to cope with them. Some of them also saw business opportunities emerging from the climate change issue: for instance the sale of renewable energy and energy saving services. Others saw possibilities arising from a longer and warmer outdoor season, for instance an amusement park which considers staying open all year because of the better weather.

It was also determined that they were most willing to participate in a multi-sector network to deal with the challenges climate change offers. In this network all participants would strive for a common goal next to their own mission. For example, interviewees from private organisations want to engage in profitable activities. During the second conference – held in October 2007 – groups were formed according to their interests. Themes around climate change topics (in line with these interests) were agreed upon and workshops were held. In these small groups the initial ideas about collective projects were identified, as well as the fundamentals of the future structure of the network.

From that moment on the municipality, in cooperation with BuildDesk consultancy, started building a multi-sector network in an open dialogue with 25 interested public, private and non-profit organisations in and around Tilburg. This method was chosen because success in the institutionalisation of a network as described above can only be achieved when the goal formulation and the decision of participation is not dependent of one party or some parties (Milward and Provan 2006). The network will strive to accomplish the climate programme with the two ambitious goals stated in that programme: being a CO_2 neutral and resilient city in 2045.

6.1.3.6.2 Inter-organisational Cooperation

Research literature shows that dealing with immense societal problems can be tackled through inter-organisational cooperation (Pearce and Doh 2005). Provan and Kenis (2007), in their article about Modes of Network Governance, perceive a network as 'a group of three or more legally autonomous organisations that work together to achieve not only their own goals but also a collective goal'. This description has a very significant aspect that corresponds to the Tilburg situation, in which each individual goal is recognised next to the establishment of a common ambition. The network of local organisations that will participate in the support of the goals of the climate programme is a multi-sector network. That means that the actors from civil society, business and governmental institutions come together in order to find a common solution to a problem that affects all of them (Roloff 2008). The multi-sector network described above addresses the issue of climate change on a regional level, Tilburg and its surrounding region, in a climate programme.

6.1.3.6.3 The Multi-sector Network

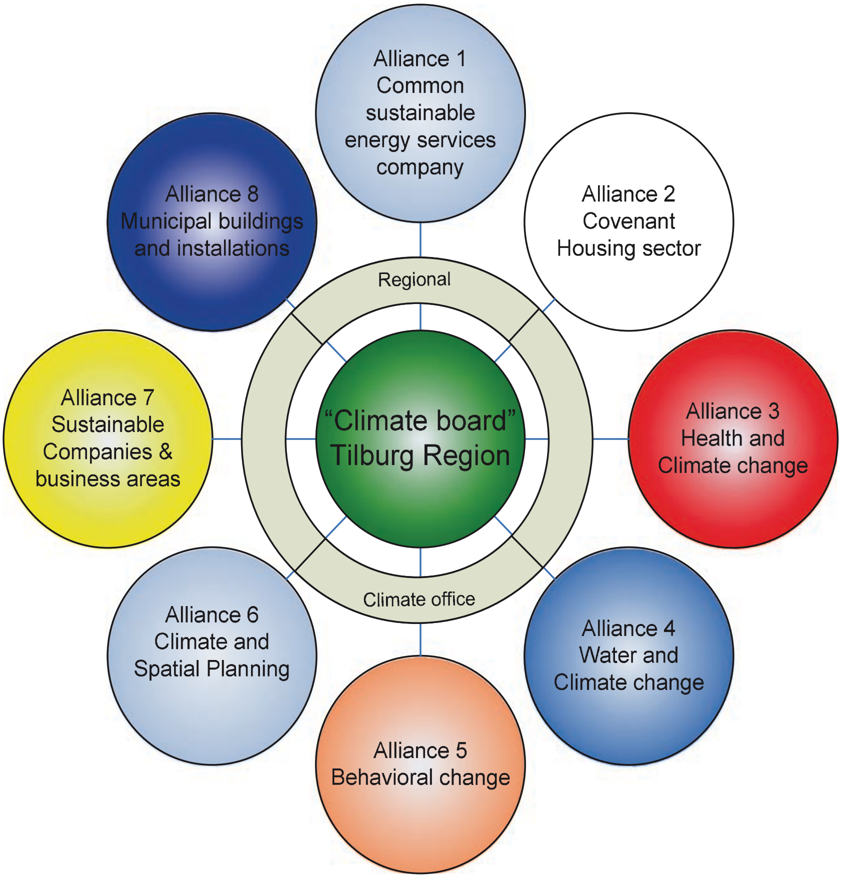
Next to becoming a CO_2 neutral and climate change resilient city in 2045, the establishment of the multi-sector network itself is a principal challenge of the climate programme. The multi-sector network is based on the environmental social capital to solve a future-oriented problem. It is formed by participating parties form the public, private and non-profit sector: a broad range of organisations, all with their own networks and their own goals. The fundamentals of the multi-sector network are its alliances, with several parties collaborating on one theme. The alliances of the programme are represented in the eight circles (the structure of the network) in the figure below:

– A common Sustainable Energy Service Company (ESCO)
– A covenant for an energy efficient housing sector
– An alliance tackling health impacts
– An alliance tackling water impacts
– An alliance aimed at behavioural change
– An alliance tackling spatial planning issues
– An alliance supporting socially responsible companies and sustainable industrial areas, and
– An alliance aimed on energy efficient and climate resilient public buildings and installations.

According to Milward and Provan (2006) the best way to organise such a network is to set up a separate administrative entity specifically to support the network, its alliances and activities. Such network facilitating entities are mostly initialised to realise large regional goals (Gebauer et al. 2004; Slob et al. 2007). The administrative entity (or network broker), here called the 'Climate Board' plays a key role in coordinating and sustaining the network. The form chosen in Tilburg is supported by the earlier interviews in which the parties clarified that they preferred to operate in a network that is supported by an independent project office. Subsequently, a project office will be specially set up to facilitate the network (Provan and Kenis 2007). In the figure below the grey circle around the green sphere represents the project office in the Tilburg case. The aim is to have a formal executive project office fully operational in 2010. The main tasks of the (estimated four) future employees will be acquiring funding for the alliances, maintaining communications and network exchanges, and monitoring and reporting.

The participants in each alliance have the sometimes difficult task of obtaining commitment in their own organisations. One way to achieve this commitment is to manage the shared responsibility in the network (Pearce and Doh 2005), to make sure that the parties are equal to each other (Provan and Kenis 2007) and that they all recognise the goals of the network (Milward and Provan 2006). From this perspective Tilburg has chosen a structure similar to that of the 'Conference of the Parties' (COP), derived from the United Nations Climate Change Conferences. The COP is the most important decision-making body in realising the network goals. It is the collection of all parties which have committed themselves to participate in the network. The members of the network intend to come together once a year to decide upon the goals, visions and agenda for upcoming year.

The central board of the climate programme consists of about seven members with their own expertise. Currently this central board still operates as a 'management team', initiating all necessary tasks to keep the process going, and is under the direction of an alderman (councillor) of the municipality of Tilburg. This chairmanship will probably change over time after elections. In the near future the central board should operate as a board of governors appointed by the 'COP', and the network is intended to be more independent from the municipality. Then the municipality of Tilburg will be just a participant, like the other participating organisations in the network. The 'COP' will then attain the legal entity of a non-profit cooperative society (in Dutch: Vereniging), 'owned' by its members, as the parties participating in the 'COP'. The members elect the board of governors, which will be responsible for the day-to-day operation of the network and its alliances and which will govern the regional climate office (Fig. 6.1.3.3).



Organisation scheme of Tilburg "Climate Board" and asociated Climate Alliances

Fig. 6.1.3.3 Multi-sector network Tilburg, showing the organisation scheme of Tilburg's 'Climate Board' and associated local climate alliances

An analogy to the traditional water board is made. The complete multi-sector network will be coordinated by a 'climate board' (in Dutch: 'klimaatschap'), named after the Dutch water boards (in Dutch: 'waterschap'). Water boards in the Netherlands are public bodies specifically aimed at addressing water quality and water quantity management. The water boards have a history of many centuries and have their own democratic controls through elections and representation. The analogy made here is that the 'climate board' should be an organisation aimed at realising a CO_2 neutral future and protecting citizens from climate change impacts, similar to the 'water board' as is an organisation aimed at realising clean and sufficient surface and ground water and protecting citizens from flooding. The 'climate board' should be a separate body in order to be able to act in a focused and decisive way, but should also have some democratic controls in order to represent all the stakeholders involved. The above mentioned 'COP' will provide these controls.

6.1.3.7 Results

The results of the process in Tilburg so far include:
- A roadmap towards a CO_2 neutral Tilburg in 2045 outlined
- Climate change scenarios for 2050
- A broad awareness amongst local professionals of the expected impacts of climate change in the decades ahead
- An overview of threats, opportunities and knowledge gaps with respect to climate change impacts and adaptation measures
- The commencement of a committed multi-sector network allied to a non-profit cooperative society
- Stakeholders working together on climate change issues in local climate alliances
- An organisational structure safe-guarding long-term continuity against potential short-term political changes of interest
- A Local Sustainable Energy Service Company (one of the local climate alliances; currently under construction and discussion)
- A 5-year integrated local climate policy (currently under construction: to be adopted by the City Council in late 2008 or early 2009)

6.1.3.7 Lessons Learned

From the recent development of Tilburg's integrated climate policy and the 'climate board' we can draw the following lessons – seen as important success factors:

- The long-term political and professional commitment towards environmental and climate change policy

– Regularly achieved successes and reporting this, e.g. public appraisal, winning prices, receiving good press coverage – which in turn reaffirms to politicians and civil servants that things are moving and provides encouragement to continue on the chosen road
– 'Internal' support for the policy from within the city policy-making community
– External funding – without funding from national schemes like BANS[4] & KvR,[5] this process would have been too expensive for a medium-sized city; substantial support either with money of with knowledge and manpower is indispensable

The use of external expertise at specific moments along the road

In addition the following insights were gained:

– Complete CO_2 neutrality is hard to reach for a city like Tilburg. Tilburg is densely built, has a large existing building stock and some energy intensive industrial and logistic activities. Although 35 years to reach the goal of CO_2 neutrality may seem a very long time it is actually rather short for such a massive task.
– Unorthodox solutions need to be conceived and deployed to reach CO_2 neutrality within this ambitious time scheme: e.g. public-private partnerships (PPPs), exceeding national building codes, creating new funding schemes (revolving fund), more than traditional civil involvement.
– There are still a lot of knowledge gaps regarding climate change impacts and adequate adaptation measures.
– There is a lot of human capital, creativity and knowledge available within city boundaries. For instance within the city educational and research institutes and within companies and organisations. It proves to be achievable and worthwhile to mobilise this human capital on the condition that you have consulted people and organisations properly, respect for their interests and supply them with good quality and understandable information.
– Dealing with networks is important and indispensable for a multifaceted tasks such as achieving climate neutrality and resilience.
– The internal process is as important as the external process and sometimes even more so. It proved to be important to create internal as well as external 'ambassadors' of the ambitious climate change policy.

[4]BANS (and it successor SLOK) are national subsidy schemes which offer a 50% co-financing of municipal climate change policies.

[5]'KvR' (Klimaat voor Ruimte – Climate changes Spatial Planning) is a Dutch research programme in which Tilburg received a "hotspot" status. As a result it could use funds to interactively apply scientific knowledge with respect to climate change to the local situation.

Key replication aspects

Political ambition and willingness to act.

- The realisation of short-term successes and the perspective of an attractive long-term outlook.
- Continuous and effective 'missionary work' within the town hall.
- A sufficient budget (from multiple sources).
- Parallel and coordinated action on: knowledge build-up, stakeholder process, dissemination of results, policy development and acquisition of long-term funding.
- Involvement of outside resources – both national (research programmes, universities) and local (university, colleges, water board, energy companies, health care organisations, companies, etc.).

6.1.3.8 Budget and Financing

The preparation and development of the local climate programme and the development and realisation of the multi-sector approach including the 'climate board' and its 'climate alliances' has been, and still is, a time consuming and costly process. The City of Tilburg invested two to four fulltime equivalent for many years for programme management and many working hours within city departments. Apart from that, consultants and experts had to be hired for specialised tasks. All these costs could only be handled by making use of multiple funding sources: the city budget, national support schemes for municipalities (BANS, SLOK), European project funding (like the EU framework programmes for preliminary research issues and EU implementation programmes like SAVE and CONCERTO for developing specific local policy solutions), and a subsidy form the national programme Climate Change Research (CCSP) in which Tilburg received a 'hotspot'-status (Schneider et al. 2006).

In order to execute the four (4) year climate change programme 2008–2012 again multiple funding sources will be needed. Currently the following sources are identified:

- €500,000 co-financing subsidy from the national 'SLOK' scheme
- Budgeted labour costs within the City of Tilburg
- 'The Sustainability Impulse' of the City of Tilburg, including budget for public communication and involvement and the establishment of a Revolving Fund for energy efficiency investments and
- Additional project related subsidies, contributions and co-financing – to be received during the coming years

6.1.3.9 Conclusion

Tilburg is one of the forerunners in municipal climate policy in the Netherlands. The results achieved seem to inspire other cities, towns and villages in the Netherlands. Several other communities are investigating the concept of CO_2 neutrality and many cities have adopted a local climate policy in one way or another. The national co-financing scheme for local climate policy development (BANS) certainly contributed to this situation. As yet no city to our knowledge implemented an ambitious integrated climate policy tackling both adaptation and mitigation, and no city developed included a multi-sector network in the way Tilburg is doing in order to realise that policy.

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Chapter 6.1.4
Tourist Destination Handling Climate Change: A Mediterranean Experience (Almada, Portugal)

Catarina Freitas, Carlos Sousa, Nuno Lopes, and Pedro Machado

Abstract The City Council of Almada developed its 'Local Strategy for Climate Change' in the framework of its Local Agenda 21, addressing both mitigation and adaptation to climate change. As a growing tourist destination with coastal vulnerability and an import fishing industry, the impact on the marine ecosystems and coastal dunes were among the issues that were studied. Risk charts were developed, and integrated into the urban and master plans.

Keywords Climate change mitigation and adaptation • coastal vulnerability • energy consumption • fishing industry • land use models • Mediterranean region • marine ecosystems • regional and local planning tools • risk maps • tourism sector

6.1.4.1 Context of City

The scenarios based on climate models highlight the Mediterranean region as more vulnerable to climate change than other European regions (Table 6.1.4.1). The difference and magnitude in expected impacts in comparison to central and northern Europe, namely a change in rainfall patterns and heat waves, will force the adoption

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Table 6.1.4.1 Almada municipal profile

Municipal profile	
Population	160,000
Area	72 km^2
Municipal budget	€110 million
eCO_2 targets	20% by 2020

of specific adaptation measures in this region. This is extremely relevant since economic activities related to tourism have a strategic importance and ensure revenue in several of the Mediterranean countries. Portugal, with is high density coastal cities, is facing this challenge in particular.

Almada is a growing coastal city and a tourist destination. Its extensive coastline makes it a vulnerable system. Its particular location within the Lisbon Metropolitan Area, a territory bordered by water and with a high population density, have prioritised municipal intervention in the field of local climate action. The fishing industry is also an important sector, and monitoring climate impacts that influence this are necessary. This is particularly relevant to Almada, because of its particular biogeographical location in the transition of Mediterranean and subtropical zones to a temperate climate. It is expected that the rise in the average water temperature in coastal areas will lead to a gradual increase in appearance or greater abundance of species with a tropical and warm temperature affinity, and a decrease in those species with an affinity to cold temperatures.

Climate change as a result of human activities, is clearly a major problem and challenge governments and societies have to face in the twenty-first century. Europe is leading the global fight for the reduction of greenhouse gas emissions (GHGs). In this region, it has been possible to obtain consensus in terms of common goals and associated different mitigation and adaptation strategies, according to the characteristics of countries and their urban centres. In the various levels of policy-making, political decision and governance, there is awareness about the need to achieve economic and social development integration principles to move towards climate sustainability. The need for effective reduction of GHGs and implementation of adaptation measures, forced significant changes, often structural, in the organisation of institutions, in economic production and in the consumption of goods and services.

The different countries and European local authorities have responded to common goals with different commitments and strategies. Municipalities in particular are seen as platforms to implement many policies to deal with climate change. Local authorities have been praised and recognised as front-runners in reducing GHGs emissions due to:

– Their proximity to economic stakeholders, especially consumers – resulting in favoured dialogue channels, being capable of achieving consensus and influencing behaviour
– The competence to licence and verify projects of new buildings and refurbishment works, as well as other activities that can have a direct impact on GHGs and

– The responsibility to decide, design and implement projects with an impact on GHGs, such as urban planning, traffic management, public lighting and the construction of schools

6.1.4.2 Expected Climate Change Impacts in the Mediterranean Region

The European Mediterranean region is highlighted as more vulnerable than other areas in Europe, especially due to a change of rainfall patterns (a decrease is expected), accompanied by an increase of heat waves in terms of frequency and intensity, as well as more drought periods. The scenarios based on climate models also show a reduction in the availability and quality of water resources, with impacts on agriculture and land biodiversity (European Commission 2007). Furthermore, the rise of the seawater level will mean the loss of some coastal territories, which in the Mediterranean region are typically highly occupied and serve as the base for tourism activities. The increase in average seawater temperature will have significant consequences as well, with relevant changes in Mediterranean ecosystems and sea communities predicted – namely an increase in number and variety of species that are characteristic from lower latitudes and the loss of others that migrate northwards. The impacts on health caused by heat waves, flooding, air and water pollution, and by the wider distribution of viruses from the southern hemisphere, will likewise be very relevant in southern Europe.

The difference and magnitude in these expected impacts in comparison to central and northern Europe, will force the faster adoption of specific adaptation measures in these territories. This is extremely relevant in particular as tourism activities have a strategic importance and ensure economic revenue in Southern Europe and Mediterranean regions. The scenarios of expected impacts developed for Portugal, clearly stress the vulnerability of its long coastline, in particular of its high density coastal cities, and the need to adopt specific adaptation measures.

6.1.4.3 Almada Develops a Local Strategy on Climate Change

In the absence of regional strategies to deal with climate change (eventually the most appropriate scale to deal with adaptation and mitigation problems), the City Council of Almada proactively developed its own instruments and defined a “Local Strategy for Climate Change” in the framework of Local Agenda 21. The goal is to reduce environmental impacts and carbon intensity of the activities developed by the City Council and the Municipality as a whole, as well as adapt to the climate change specific consequences that will predictably arise in Almada.

Almada's Local Strategy for Climate Change was started in 2001, with the development of the first municipal-wide GHG emission inventory – the 'Municipal Inventory of Greenhouse Gas Emissions in Almada (CMA, AGENEAL e FCT/UNL 2001) – which identified energy consumptions by sector of activity and related GHG emissions in the Almada Municipality. This strategy was developed in the framework of the Local Agenda 21. From the energy and carbon data collected, an action plan was produced for the mitigation of GHG emissions, incorporating policies for the reduction of energy intensity and environmental impact of the economic sectors of activity, as well as measures for each sector.

In 2007, after the approval of the National Plan for Climate Change, Almada Municipality decided to update its Local Strategy for Climate Change (CMA, AGENEAL e IST/UTL 2008), in the light of the national and European legislation and available technical tools. Relevant work in the area of adaptation is currently under development, along with the inventory's revision, the definition of goals for the different scenarios and projections, and the identification of potential policies and measures. The evaluation of coastal vulnerability, including the identification of pressure sources on marine ecosystems and the response of the existing coastal dunes is addressed here.

6.1.4.3.1 Vulnerability of Atlantic Coastal and Riverfront Areas

Located on the southern bank of the Tagus estuary, Almada is 1 of 18 municipalities in Lisbon's Metropolitan Area, with an extensive coastline and a population density of 2,000 inhabitants/km^2. The population is about 160,000, distributed in a geographical area of 72 km^2, with an additional 70,000 fluctuating population. Water encircles the territory, with over 35 kilometers (km) of shoreline:

– 13 km of Atlantic beaches, from Fonte da Telha to Trafaria
– 20 km of river front to the north, from Trafaria to Cacilhas
– 2 km of river front to the east, from Cacilhas to Alfeite

Its Atlantic shore to the west, is a very popular tourist destination in the Lisbon Metropolitan Area, increasing the demand for many services supplied by the Municipality. The northern river front of Almada, opposite the totally artificial northern bank of the Tagus River, still harbors natural species of great biological value, as it is the northern border of distribution of some Mediterranean species. Being a transitional zone between subtropical and Atlantic climates, it is a haven for very climate sensitive species (regarding temperature and moisture), as well as for Mediterranean climate species.

The closing of industrial and harbor-based activities that occurred over the last decades of the twentieth century, caused extensive abandoned and degraded areas. Now these areas present an enormous potential for urban regeneration because of the location close to the river, allowing the development and strengthening of activities related to tourism, recreation and leisure. The growing relevance of

Almada as a tourist destination, as stated in regional and local planning tools (e.g. Regional Master Plan, Almada's Master Plan, Polis of Costa da Caparica) and other strategic planning tools, comes from the shift to the tertiary sector of the local economy.

However, the Atlantic beachfront and the river areas of Almada that constitute the most interesting tourism zones, are also the most vulnerable to erosion and present a higher risk of water levels rising and flooding (Fig. 6.1.4.1).

For this reason, one of the priority areas for intervention by the City Council has been the creation a local strategy for climate change, together with conducting a

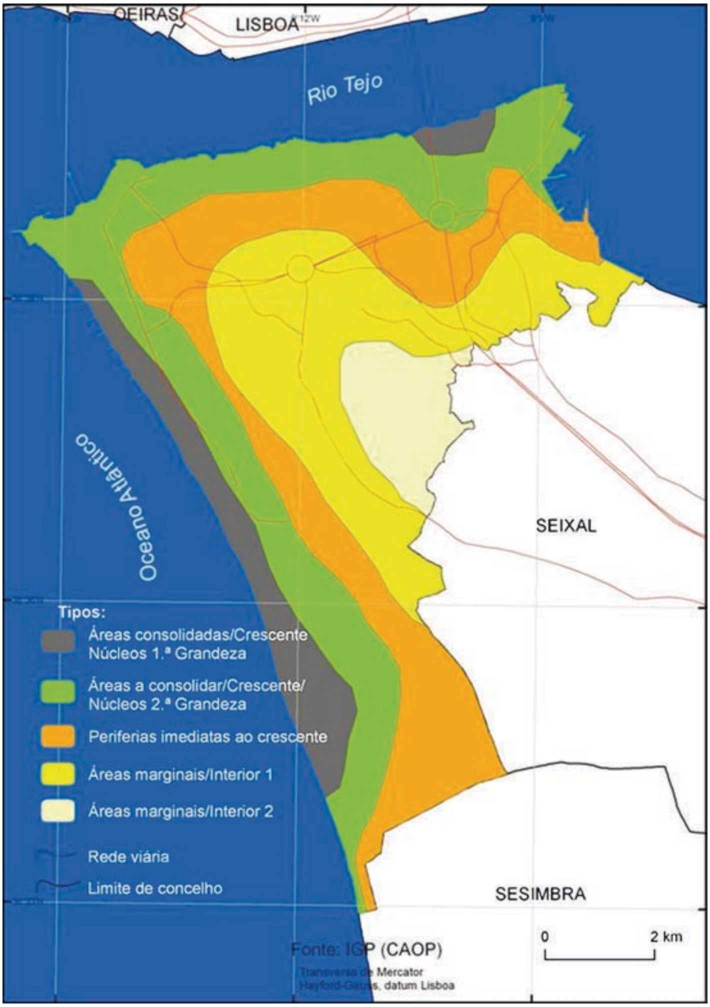

Fig. 6.1.4.1 Characterisation of potential tourist areas in Almada (From Plan of Touristic Valorization of Almada– 1st Phase Report: Characteristics and Diagnosis, Almada City Council, 2007) (see *Color Plates*)

GHG inventory, making projections and considering mitigation measures. Additionally, the monitoring and testing of indicators and biomonitors for changes in sea and coastal ecosystems, allowing to creation of risk charts, is also present in Almada's strategy.

6.1.4.3.2 Mitigation in the Local Strategy

The mitigation component of Almada's Local Strategy on Climate Change started with a meticulous diagnosis conducted to identified the main sectors contributing GHG emissions. Projections of likely developments, and a coherent set of measures to reduce GHGs were developed. The close relation between energy consumption and GHG emissions required an energy matrix, as an essential instrument to gain a correspondent GHG matrix. The first energy matrix with annual updates, was developed in partnership with AGENEAL, the Local Energy Management Agency of Almada. The inventory revealed the transport sector as having the highest GHG emissions in Almada. In fact, daily commuting in Almada, as well as in the Lisbon Metropolitan Area, is mainly based on private car use. In 2001 the public transport network was based on a limited bus transport network, complemented by two boat links and an urban train line connecting Almada to Lisbon. Pedestrian areas were scarce and cycling was seen as being too dangerous.

In 2003, following the inventory, the Local Strategy for Climate Change was developed by a multi-disciplinary team, proposing a set of measures and actions by sector for the reduction of environmental and energy intensity. This was approached from the various domains of economic activity, with a particular focus on the mitigation of emissions from transport and buildings, as well as the diffusion of alternative energy production solutions. With the mitigation strategy, sustainable mobility became a key subject in local policies, although new municipal policies addressing buildings (service and residential sectors) were also developed.

Today, several transversal projects are being implemented locally to promote sustainable mobility. The main tools to support this strategy include a Mobility Plan and the Almada Cycling Plan. It also contains the conversion of the City Centre into a pedestrian zone, together with the implementation of a Light Rail System (LRS).[1] A robust sustainable mobility communication and promotion plan, with other powerful tools such as the Children's Local Agenda 21 and the European Mobility Week are other tools. The new tram – easily and directly interconnected with other public transports modes, namely bus, boat and train – and the implementation of safe and comfortable conditions for daily bicycle use, car restrictions in the city centre, the creation of parking lots in most public transport interfaces, and a friendly public space, are expected to promote a strong modal shift from private car use in the coming years (Fig. 6.1.4.2).

[1] The 3 lines of the new LRS (19 km), are expected to result in a decrease of 30,000 vehicles/day and an estimated reduction 15,000 t CO_2/year.

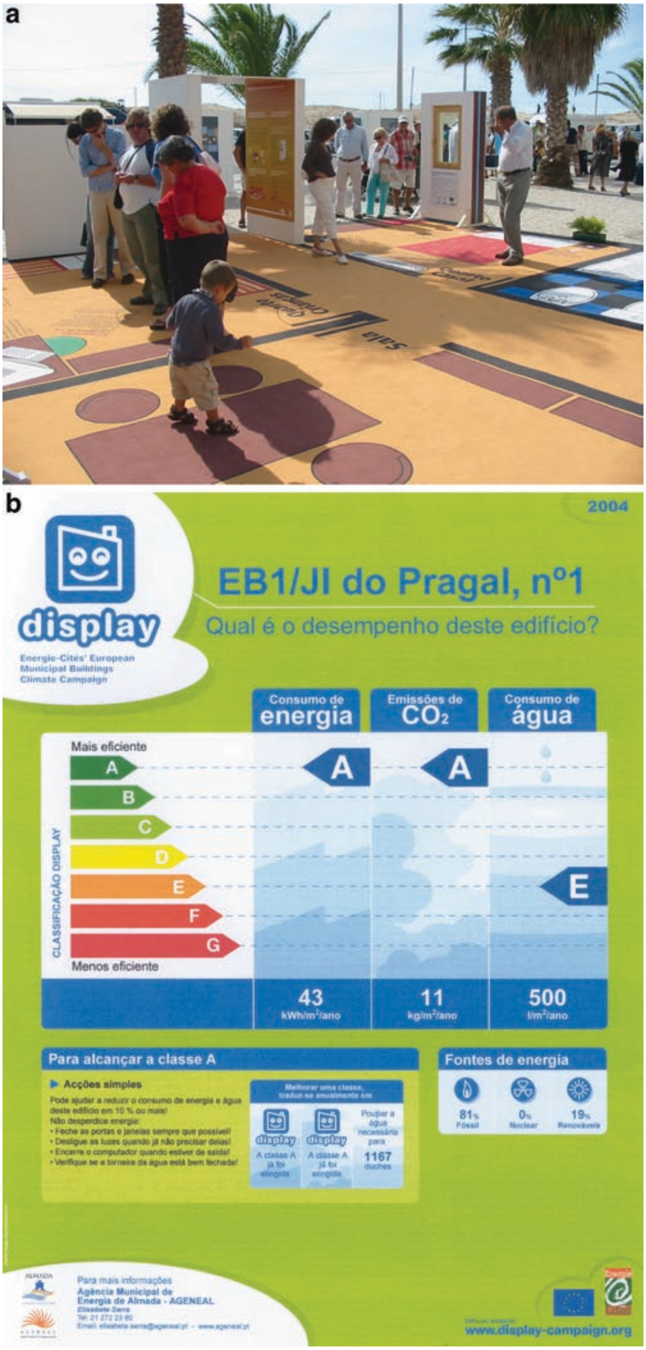

Fig. 6.1.4.2 (**a** and **b**) Awareness-raising action on energy efficiency targeting children and the display of an energy efficiency classification system (From Almada City Council and Local Energy Management of Almada)

To tackle GHGs in the building sector several measures were put in place. These include two important examples, namely the verification of compliance of new building projects with national thermal regulations (something rarely done in Portugal) and the creation of the Municipal Urbanistic Regulation of Almada, a document strongly anchored in energy efficiency issues. The Municipal Urbanistic Regulation of Almada focuses on strategies for energy consumption reduction, from building orientation and design, to construction, use and demolition. Issues like the optimisation of solar and wind resources, the promotion of passive solutions, and the best use of thermal efficient insolating materials, as well as the micro-production of heat and electricity from renewable sources (including obligatory use of thermal panels) are some examples that are promoted. Furthermore green roofs, indoor parking spaces for bicycles, outdoor spaces for clothes drying and a Building Energy Book, where all energy related characteristics of the building have to be identified.

The evaluation of environmental efficiency of the measures defined in the Local Strategy for Climate Change, the level of implementation and suitability to Municipal competencies, drove the City Council to review this document. Almada's Municipal Observatory of Greenhouse Gas Emissions was created, with a tool for easily updating the inventory. The adaptation component, further explored below, was developed in the framework of the current master plan review and through the introduction and implementation of new local adaptation measures.

6.1.4.3.3 Adaptation Added to the Local Strategy

Significant areas of Almada's territory are extremely vulnerable to climate change impacts. Due to this the Almada City Council has started building in-house capacity to evaluate the vulnerability of coastal areas and ecosystems, looking at related pressure sources, as well as potential responses to extreme climate events. Multidisciplinary teams started working on the evaluation of local vulnerabilities and the design of adaptation measures, to be incorporated in strategic and territory planning tools. This is done within the scope of the Almada' Master Plan revision, and implementation is expected in the near future.

Studies were carried out to identify the coastal system pressure sources and the response of existing dune communities to these pressures, using specific checklists (Fig. 6.1.4.3).

A second line of work consisted of botanical studies to analyse the consequences of several sources of disturbance on the ecosystems and conduct research of indicators of disturbance/recuperation. It was observed, for example, that botanical species most resilient to wind or sea disturbances are natural to frontal dunes, like marram (*Ammophila arenaria*) or sea holly (*Eryngium maritimum*). As a result, all planning work carried out that affects coastal territories, now contemplates the introduction of these two key indigenous species, insuring the resilience and continuity of dune systems, needed as a natural barrier.

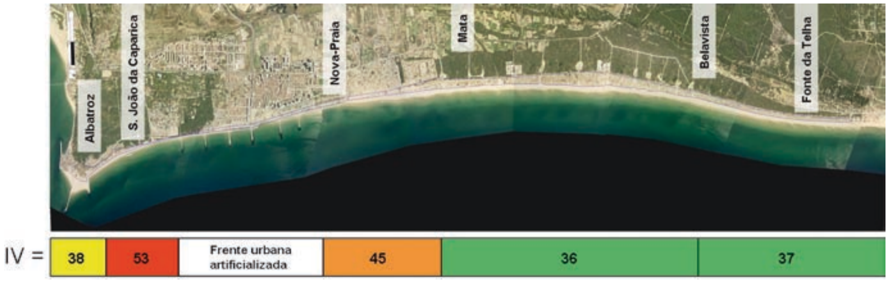

Fig. 6.1.4.3 Coastal vulnerability assessment, with the colour variation representing the vulnerability level to disturbances and alterations in coastal ecosystems (green – low to average vulnerability, yellow – average, orange – average to high vulnerability, and red – high vulnerability) (From Almada City Council) (see *Color Plates*)

Monitoring of fishing activity, such as beach seine fishery, should also be highlighted as it has economic relevance for the fishing community of Almada. The evaluation of possible impacts on fishing stocks and on patterns of occurrence and abundance of ictic communities, caused by the increase of average seawater temperature, is being evaluated. Preliminary data indicate, among the 60 fish species identified there is an increased occurrence of frequency of subtropical species captured, like the meagre (*Argyrosomus regius*) and the senegal seabream (*Diplodus bellotii*), more typical of lower latitudes. Concerning the growth in biomass of species with more tropical affinities, these results are clearly due to the significant increase of the chub mackerel (*S. japonicus*), which might be related with changes in currents and dominant oceanic winds. On the other hand, it is relevant that cold temperate climate affinity species were not spotted in 2008, like the flounder (*P. flesus*) or the fivebeard rockling (*Ciliata mustela*) which had been captured in previous years. These results are in accordance with other studies carried out in Tagus estuary, which pointed out a decrease in abundance of these two species since the decade of 1980. This may be due to the climate changes verified in this coastal zone. This information is of extreme importance in the evaluation of environmental impact and potential rise in average seawater temperature, and of its implications in the structure and function of existing communities.

Finally, understanding territory vulnerability and sharing this knowledge with land use and values, helps provide data for creating risk charts. Risk charts are obtained by merging the vulnerability of the territory with the functions and values of ecosystems, as well as the present human uses and functions. The associated risk level for each territory comes from the balance of natural and human values, with its vulnerability towards the predicted alterations. This methodology was applied in a strategic study plan for the Trafaria zone (CMA 2008), based on the elaboration of detailed plans, with a risk analysis regarding erosion and seawater level rise, and combining the definition of solutions of adaptation to ensure the plan's proper implementation. The coastal area that includes S. João beaches, has been labeled as highly vulnerable, as the natural processes of wind and sea are the main sources of disturbance on an already degraded geomorphologic structure. For this reason, a vulnerability chart was developed concerning sea flooding, considering the geomorphology of this territory (distance to coastline, physical and morphological features) and the value chart (natural, cultural, socio-economical and antropic), which resulted in the present risk chart.

Based on this methodology, it is possible to build land use models and establish risk-reduction measures, whether by physically removing the valuable elements (e.g., the communities living in highly vulnerable areas), by creating measures to reduce vulnerability, by restoring the system of natural protection (e.g. dunes), or even by improving drainage systems that can help to diminish vulnerability to flooding.

6.1.4.4 Conclusions

The evaluation of the effectiveness of measures included in the Local Strategy for Climate Change, the degree of implementation, and considering municipal competences, have lead the revision of the document by the Municipality of Almada. It developed an adaptation component, in parallel to the mitigation strategy. Although Almada's Local Strategy for Climate Change was first designed in a specific timeframe, with specific evolution scenarios and defined targets, it should be considered as a dynamic tool that needs to be been constantly adapted and updated.

Throughout the years, new measures and actions that contribute to the mitigation of GHG emissions or favor the adaptation of Almada to climate change impacts have to be designed and implemented. Some examples of adaptation include the evaluation of coastal vulnerability, with the identification of sources of stress on the coastal system, and the response of existing dune communities, the monitoring of fishing and fishing-net manufacturing, as well as the elaboration of risk maps. The on-going ecological monitoring should be maintained in order to obtain data over a period, to consider the effect of global climate change vis-à-vis natural variations.

In the present framework of revision of the Almada Master Plan, and in the context of elaborating a set of tools for territorial planning and management for the shoreline areas of Almada, it is a pressing matter to establish local adaptation measures that will reduce the vulnerability of the territory. The final purpose is to obtain a better balance between the values, frailties, functions and needs of the territory.

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Between 1996 and 1998 she had the opportunity to work as a Senior Officer in the Water and Waste Water Management Services of Almada, a Public Utility Company, developing studies on fresh water availability of natural springs and boreholes, as well as designing measures to upgrade Wastewater Treatment Plants. Currently, among other important activities, she coordinates the development and implementation of the Local Strategy for Climate Change and the Local Agenda 21 of Almada, and in that framework, she is also responsible for the technical and financial management of several European projects and partnerships. Catarina is author and co-author of several presentations and papers on municipal energy and environmental management, energy efficiency, climate change and urban sustainable mobility.

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***Pedro Machado** has a Bachelor of Engineering from Glasgow University and a Degree in Mechanical Engineering on Applied Thermodynamics from Technical University of Lisbon. From 1998 to 1999 he had a research scholarship with the Research Group on Sustainable Energy Development, working with Professor Maria da Graca Carvalho as supervisor. From 1998 to 2002, Pedro worked at IrRADIARE, in R&D Engineering and Environment, initially involved as Project Manager in different areas, addressing architecture, development and installation* *of environmental monitoring, and control system, and over the last 2 years as General Manager. From 2003 to 2004, he was Project Coordinator and Tool Developer on energy, environment, transports and mobility, and obtained a Scholarship in 2003 to do specific research on programme modelling at the North Carolina State University. Since 2004, Pedro Machado has been a Project Coordinator at AGENEAL, Local Energy Management Agency of Almada, conducting work in the fields of the energy and environment: climate change (including Almada's Local Strategy for Climate Change), renewable energies, consumption reduction plans, energy efficiency on buildings, energy optimisation on transports, mobility management, urban planning and air quality. Throughout his career, he has been author and co-author of several papers, given talks in several countries, done training sessions in different energy related issues and coordinate locally numerous environmental and energy related European Projects.*

Chapter 6.1.5
Climate Change Strategy: Thinking Globally, Acting Locally (Woking, United Kingdom)

Lara Curran

Abstract Woking Borough Council's Climate Change Strategy has provided a politically and corporately supported foundation for action to address climate change locally. This case study aims to show the impact that the strategy is having across Woking's community, and includes a wide range of action examples, with projects selected because they:

- Demonstrate where the Council has worked hard to raise awareness of climate change through community engagement and delivered results through this engagement
- Demonstrate the importance of adapting to the inevitable impacts of climate change in the local area
- Have required a high degree of innovative partnership working and have built capacity across the Borough's community to tackle climate change
- Illustrate leadership by example, with the Council taking action to reduce emissions across its own estate and engaging its staff in this agenda and
- Recognise the need to engage the community in taking the Climate Change Strategy forward and to meet emissions reductions targets

Keywords Adaptation • business involvement • changing lifestyle and behaviour • Climate Change Strategy • community engagement • environmental footprint • flood defense scheme • innovative partnerships • political and corporate support • sustainable development • sustainability

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Table 6.1.5.1 Woking municipal profile

Population	91,400 inhabitants (mid-2007)
Land area	64 km^2
Municipal budget	€18.17 million (budget requirement for 2008/09)

6.1.5.1 Woking in Context

Woking Borough is a local government district with borough status in the west of Surrey in South East England (Table 6.1.5.1). Woking lies 25 miles south west of London in the county of Surrey. It has an unemployment rate 1.2%. The town of Woking has a population of 62,796. The rest of the borough is divided into five areas located around a village. These villages within the borough are: Brookwood, Byfleet, Knaphill, Mayford and West Byfleet.

With its combination of attractive environment, excellent transport links and high standards of education and workforce skills, the Borough is a considered a high quality place in which to live and work. This is further enhanced by its reputation as the most energy-efficient local authority in the United Kingdom (UK).

6.1.5.2 Goals

The implementation of Woking Borough Council's Climate Change Strategy is resulting in practical actions to reduce emissions and adapt to unavoidable climate change. Climate change is being considered in the development and implementation of all relevant strategies, plans and policies within the authority. It is widely recognised that the climate is changing and adaptation is needed now.

Woking Borough Council's Climate Change Strategy was first adopted in December 2002. There has been significant progress since the strategy was first adopted both in terms of local activities and national policy development. The revised strategy (2007/08) has taken account of this and has seen the introduction of three new themes reflecting the wish to expand and strengthen Woking Borough Council's approach to mitigation and adaptation, namely water, community and business. The overall objectives are the reduction of carbon dioxide (CO_2) emissions; promotion of sustainable development; and adaptation to climate change.

6.1.5.2.1 Water

Reducing water consumption and improving water efficiency is the focus of this theme together with how the Council can help in achieving local and regional water consumption reduction. This looks at how the Council can extend its community leadership role in encouraging and advising the Borough's residents and businesses to ‘do their bit’ to meet local and regional targets for reducing consumption. Three Valleys Water and Waterwise have agreed to support the development of this theme.

6.1.5.2.2 Community

The Council has demonstrated leadership by example in reducing carbon emissions and developing an adaptation strategy for its own operations. In refreshing the strategy, the Council has introduced a theme for the community, to support residents and community groups to play their part in tackling climate change. The theme is informed by views of residents and community groups. Focus groups and surveys have already sought to gauge what residents currently do to tackle climate change, what they feel the barriers are to doing more and what the theme should include to help them.

6.1.5.2.3 Business

Helping the business community within Woking to tackle climate change is the focus of this theme. The Council has worked closely with Business Link and Woking Chamber of Trade and Commerce to develop the theme and offer guidance and support for Woking’s businesses to play their part.

6.1.5.3 Themes of a Sustainable Woking

Sustainability is high on the Council’s agenda as a cross-cutting issue. Sustainability has been integrated across corporate activity through a variety of checklists and processes, based around a set of ‘16 Sustainability Themes’ which cover a comprehensive range of environmental, economic and social aspirations. ‘Factors that contribute to Climate Change’ is one of these themes. Guidance has been developed for staff to undertake sustainability appraisals for projects, procurement activity, performance management, committee reports and service planning.

The Council’s approach has been recognised as good practice by the Chartered Institute of Public Finance and Accountancy (CIPFA) in the 2006 publication ‘Sustainability: A Reporting Framework for the Public Services’. In 2007, Woking Borough Council was nominated as the ‘Surrey Exemplar Council for Sustainable Procurement’ by South East Centre of Excellence (SECE) and is participating in a regional sustainable procurement project with SECE and eight other Exemplar Councils from the south east region.

Woking Council is one of country's leaders in adopting greener energy technologies. Several combined heat and power stations provide district heating and electricity, and electricity is also provided by a combination of hydrogen fuel cells and solar cells dispersed throughout the borough. These are linked via an innovative private electricity distribution system operating completely off the public power grid. Sustainability is also relevant to the approach 'Thinking Globally, Acting Locally'. The Woking Borough Council has been recognised for its progress and innovation in tackling climate change at the local level. Some planning and mitigation achievements that are directly relevant to sustainable energy include:

- The development of a comprehensive Climate Change Strategy.
- The development of a town centre Combined Heat and Power (CHP) station that provides electricity, district heating and cooling directly to local customers.
- The use of a 200 kilowatt-electric (kWe) sustainable energy fuel cell that provides heat and power to Woking Park's swimming pool and leisure centre.
- Range of innovative small scale renewable and sustainable energy solutions in Council owned buildings installed through its energy and environmental services company Thameswey Energy Limited.
- The refurbishment of a house to demonstrate a range of water and energy efficiency measures to show local residents how they can install measures in their homes and gardens to adapt to climate change and reduce CO_2 emissions.

6.1.5.4 Adapting to Climate Change: Planning and Managing Flood Risks

Flooding is one of the key threats the Borough faces when considering the changing climate, and avoiding or minimising damages is a priority. The Hoe Valley Scheme provides a robust example of climate change adaptation. Granted planning permission in April 2007, the scheme combines flood alleviation and tip reclamation. Following extensive flooding in the Hoe Valley in autumn 2000, a report was commissioned by the Environment Agency to investigate the flooding which occurred and the possibility of providing flood defences and alleviation measures for residents at risk. The report concluded that the flood had an estimated return period of 15 years. Over 100 properties were affected and it was estimated that as many as 300 could be at risk of flooding for a more serious event with a one-in-100-year flood. As part of a comprehensive Environmental Impact Assessment, Woking Borough Council commissioned a detailed feasibility investigation into a flood defence scheme to protect as many properties as possible in the Hoe Valley. This work has been undertaken in close consultation with the Environment Agency over the last 3 years, working to the latest development guidelines and standards. The Council has concluded that a proposed housing development on the former Westfield Tip is the best means of providing most of the funding for the flood defence scheme.

To pursue any new residential development, the flood defences had to be designed to protect against a one-in-100-year flood event plus an allowance of 20% for climate change and an additional 'free board'. This is in accordance with the requirements suggested in Planning Policy Guidance note 25 (PPG25) for development and flood risk. The Council and the Environment Agency also required a model that demonstrated that the proposals did not increase the risk of flooding to any third party land owner, so predicted 100-year flood water levels had to be maintained or reduced on all land outside of the Borough's ownership both upstream and downstream of the proposal site. The flood defence scheme will defend 198 existing homes, 63 gardens, 14 community buildings, 153 new homes and seven public roads all to the extreme one-in-100-year standard (including an allowance for climate change). The scheme comprises a combination of landscaped earth bunds, architecturally enhanced flood defence walls, channel improvements, bridge improvements and replacement and provision of flood storage. The alignment of the defences has been designed to avoid sensitive features wherever possible and they range in height from 0.5 to 2.4 m. Some of the key features of the defence scheme also benefit the community in other ways. The construction of a new Elm Bridge on Kingfield Road will improve the flow of water in the Hoe Stream. The road will be widened and new pedestrian and cycle ways integrated within the construction. Replacement of the Woking Park access bridge to increase water flow capacity under the bridge will mean an improved load bearing capacity in this area. New flood storage areas will play a vital role in times of flood. These will take the form of landscaped ponds, wetland features and wildflower meadowland to be enjoyed both by members of the public and riverside wildlife during everyday flow conditions.

6.1.5.4.1 Additional Benefits

The Hoe Valley Scheme combines flood risk management measures with added health, ecology and leisure benefits. The Hoe Stream is a Site of Nature Conservation Importance (SNCI), designated because of its flora and fauna and its various important habitats including wet grassland, ponds, broad-leaved secondary woodland and meadows. These form a valuable wildlife corridor that connects the south-west of the Borough with the east via the urban area. The Hoe Valley corridor also includes a number of associated SNCIs and two Local Nature Reserves at Mayford Meadows and White Rose Lane.

The scheme will provide a publicly accessible wildlife wetlands reserve and increase the biodiversity of the area. It includes attractive walk and cycle ways running between Barnsbury and Westfield and the northern end of Woking Park – along the Hoe Stream. It also opens up further woodlands in Woking Park. Almost 58 acres of green leisure space will be revitalised for public use. The development of new 'wetlands' in the Hoe Stream floodplain area will be a significant opportunity to enhance wildlife, landscape and informal recreational opportunities in the

Fig. 6.1.5.1 Photovoltaic array at the station (Courtesy: ICLEI) (see *Color Plates*)

area, while also achieving restoration of the former tip land and provision of additional flood plain capacity to help alleviate the future threat of flooding in the Westfield area.

The Hoe Valley experienced extreme flooding in autumn 2000. The Woking Park pond restoration scheme includes increased flood storage capacity of the area adjacent to the Hoe Stream thanks to a water storage and recycling system. This also allows the water level of the ponds to be topped up during periods of drought and has been developed to re-use stored rainwater for the irrigation of the park's flower beds. Around 170 m of specially engineered trench with a clay lining have been installed to help retain the water in the ponds and bring the water levels up. The ponds will be kept full using the 300 m^3 of rainwater that is collected from the roof of the swimming pool and stored in a high-tech underground tank near the swimming pool (Fig. 6.1.5.1).

6.1.5.5 Environmental Footprint, Planning and Sustainable Development

In connection with development and land use the concept of an 'environmental footprint' is considered. This refers to the CO_2 equivalent emissions that land use, be it a field, office block or housing estate, produces from heating, methane generation, etc. The aim is to encourage a lower, less harmful level of CO_2 in a site's environmental footprint, with the overall objective that any new land use must see a reduction of CO_2 emissions by 80% compared to the previous use. This would mean that if an office block was replaced with a housing estate, the housing estate would have to incorporate sustainable/renewable energy uses which result in significantly lower CO_2 emissions than produced by the office block. This will be considered further as local planning policies and frameworks are developed.

The way in which developments are regulated, planned and built and the way in which resources are used to do this can determine whether or not they are sustainable. Simply by re-evaluating how and where we build things we can reduce emissions and help adapt to some of the issues climate change will bring about. As one of the key objectives of the Climate Change Strategy is to promote sustainable development, the Planning system is an ideal tool through which we can work to address issues relating to climate change. The Council was pleased that their good work in this area was recognised through it being awarded Beacon status for Promoting Sustainable Communities through the Planning System 2007–2008.

Essentially there are four main elements of sustainable development which can be taken account of in the local planning system:

- **Location –** Nearly half of all households in the Borough of Woking has two or more cars. The location of new development, in respect of the need for people to travel to places of work, shops, schools and entertainment can have a significant impact on CO_2 emissions. Planning provides guidance on factors that should be considered when selecting land for development. By locating new development near to public transport services, the need to travel by private carbon-fuelled vehicles can be reduced.
- **Layout** – The layout of a site and its buildings can be devised so that it is more sustainable. For example buildings or windows can be positioned to take advantage of passive solar gain (warmth generated from sunlight). Terraced housing and flats are also more environmentally sustainable as compared with detached and semi-detached housing because heat loss through walls and roofs is minimised through such schemes.
- **Landscape** – The landscape around a development can help to reduce energy consumption. For instance, trees, hedges and shrubs can create shelter from the wind, reducing heat loss; or they can create sun traps reducing the need for heat and providing shading in summer to reduce the need for artificial air conditioning. But trees can also have a negative impact by creating overshadowing against south facing developments which limits passive solar gain during colder times of the year. The siting of vegetation in relation to a development is something to be considered, both in terms of siting new development near already established vegetation or conversely planting new vegetation near already built development. It is also important to consider the effect that the planning system can have in protecting landscapes from changes in climate.
- **Sustainable construction measures** – CO_2 emissions produced through energy use in buildings providing services such as water, heating and lighting can be

reduced through tackling water efficiency, e.g. storing rain water; installing renewable energy sources as a means of power, e.g. photovoltaic cells (solar panels) or wind turbines; installing community heating or Combined Heat and Power; improving insulation and thereby reducing loss of heat; and through the minimisation of waste. Sustainable development in terms of planning will be sought through existing legislation, standards and guidance. The Council advocates a range of good practice measures that enable new development to have reduced (or neutral) risk from changes in climate. In preparation of its Local Development Framework the Council will produce a Climate Neutral Development Supplementary Planning Document (SPD) which will provide guidance on how to incorporate climate neutral technologies (such as solar panels and sustainable drainage systems) within new developments. When adopted the SPD will become a material planning consideration, and will be taken in to consideration when decisions are made on planning applications.

An example that illustrates the above is the development of 54 apartments and town houses St. Peters Convent, Maybury. This development of 34 one- and two-bed apartments and 16 three-and four-bed houses (including eight social landlord homes) was completed with high environmental credentials. It achieved a 32% reduction of CO_2 emissions based on 2006 building regulations through the installation of a biomass boiler to provide space heating for the development and a small scale gas-fired CHP engine to supply domestic hot water and electricity. Critical Planning considerations for the Council were how and where the biomass fuel would be stored and how the CHP and biomass boiler would work in tandem. C Plan, a software system adopted by the Council, was used to model the carbon savings that would arise from supplying CHP and biomass heating for the entire development.

6.1.5.6 Engaging the Business Community

Woking Borough Council recognises the important role that the local business community can play in both mitigation and adaptation to climate change. The Council has sought to develop partnerships with local service providers, experts and business networks in order to provide Woking's businesses with access to support and information to address climate change. The Council signposts local businesses to these information sources, for example through the 'Business in Woking' web pages on www.woking.gov.uk, the Council's contact centre, and Council publications such as 'Woking Magazine'. The newly updated Climate Change Strategy has accounted for the need to involve local businesses in the strategy, so includes a new 'Business' theme. A representative from Woking Chamber of Trade and Commerce was invited to join the Climate Change Working Group in 2007, in order to represent Woking's business community in discussions regarding the development and implementation of the strategy.

6.1.5.6.1 Innovative Partnership with Woking Chamber of Trade and Commerce

Woking Borough Council has supported an exciting partnership led by Woking Chamber of Trade and Commerce, also involving Surrey County Council, Business Link Surrey and Woking Local Agenda 21. The partnership sets out to develop a programme to raise awareness of sustainability, climate change and environmental management issues amongst local businesses during 2006 and 2007. The partnership established a sub group which has met monthly to take these objectives forward. The programme commenced in November 2006 with a Breakfast Meeting for local businesses regarding environmental management systems, involving a presentation from Envirowise. This was followed by a second Breakfast Meeting in May 2007 when the Environment Agency spoke to delegates regarding sustainable waste management and environmental regulations. Both meetings attracted more than 40 delegates from local businesses.

The partnership has recently celebrated the launch of ‘Making Woking a more sustainable and profitable place to do business’. This guide provides Woking’s business community with an introduction to running a green business and a reference outline of current environmental legislation and responsibilities for the future. The guide was sponsored by Woking Borough Council, Surrey County Council and Envirowise. The publication was launched in October 2007 at the ‘Woking Means Business’ exhibition. The guide has been posted to members of the Chamber and placed on the Woking Chamber website. The partnership intends to meet again in January 2008 to consider how to build on this success.

6.1.5.6.2 Working with Business Link Surrey

Woking Borough Council supports Business Link Surrey by signposting local businesses to the Sustainable Business Service. The Council is in regular contact with Business Link’s Sustainable Business Adviser, and promotes relevant activities and events through the contact centre and the www.woking.gov.uk website. One upcoming example is Business Link’s free ‘Marketing your Green Credentials’ seminar in Woking on 18 December 2007. The service provides local businesses with access to assistance which can help them to address mitigation and adaptation to climate change and other sustainability issues.

Business Link’s Sustainable Business Service can help businesses become more sustainable by assisting them to reduce costs, see how operating in a more sustainable manner will help them find more customers, and understand how environmental legislation affects their business. The service is delivered on the ground by a Sustainable Business Adviser located at Business Link Surrey’s headquarters in Woking. Business Link’s brokerage role is to refer customers to specialist partners, suppliers and support providers. The Sustainable Business Service is free and many of its brokerage partners’ services are also free.

The service also includes proactive campaigns to reach key sectors such as care, tourism, and construction and to assist start up companies providing environmental goods and services. Broader reach campaigns focus on issues such as resource efficiency, social responsibility and climate change. The service focuses on two main areas – resource efficiency and social responsibility. Businesses are encouraged to tackle these issues for sustainability and profitability reasons. By addressing resource efficiency, customers can find ways to save money and increase profits. By addressing social responsibility, companies can improve staff retention, raise their profile in the community, and support the local economy. The Sustainable Business Service can also help companies comply with legislation that stems from both resource efficiency and social responsibility issues.

6.1.5.6.3 Business in the Community

In March 2007, the Council hosted an event for Business in the Community (BITC). The event, which was attended by HRH The Prince of Wales, the President of BITC, sought to showcase local authority and business examples of climate change action, and included a seminar which used local authority and business case studies from Woking Borough Council, Shropshire County Council, Cornwall Sustainable Energy Partnership and Marks and Spencer.

6.1.5.7 Working with Schools

Under the theme of 'Education and promotion', Woking Borough Council's Climate Change Strategy includes an action to identify opportunities to work with schools and educate school communities regarding climate change. The Council has facilitated a range of activities to address this aim.

6.1.5.8 The Green Education Task Group

The Council's Environmental Overview and Scrutiny Committee convened the Green Education Task Group in 2005, with a specific remit to consider and develop strategic proposals to further education regarding climate change within the Borough's schools. The task group reported its findings to the Council's Executive Committee in 2006, where it was agreed that provisions would be made within the Thameswey Business Plan to resource educational programmes, in consultation with the Climate Change Working Group. This provides the Council with resources and a remit to develop further partnerships and initiatives with schools to address climate change.

6.1.5.8.1 Promotion of Eco Schools

The Climate Change Working Group identified the ENCAMS ‘Eco Schools’ Scheme as an effective model for delivering and embedding climate change issues within primary and secondary schools. In partnership with Surrey County Council, all schools in the Borough were contacted in 2004. Schools were encouraged to sign up to the programme and to access support that was available through a range of local agencies. To date, 10 of 39 schools in the Borough have achieved at least the ‘bronze’ Eco Schools award, with Oaktree Infant School having achieved the coveted ‘Green Flag’.

6.1.5.8.2 The ChangeLAB initiative

An exciting partnership project was set up in 2006 as part of the European ChangeLAB (Changing Lifestyles and Behaviours) initiative. This seeks to transfer projects that have successfully influenced behaviour in EU member countries. One such initiative was ‘The Wishing District’ where schools in the Netherlands had worked with local decision-makers to raise local awareness about particular issues. A partnership involving Woking Borough Council, Surrey County Council, Woking Local Agenda 21, Three Valleys Water and Byfleet Primary School was set up to deliver ‘The Surrey Water Project’. The initiative delivered a range of outcomes for Byfleet and the wider community.

- Three Valleys Water delivered several lessons on water conservation, setting out the links to climate change, and engaging children in the subject.
- A ‘sign-up’ day was held, where the school and local decision makers signed pledges to demonstrate their commitment to the project.
- The school children developed a local poster campaign to raise community awareness of the need to save water. The school engaged the local press and radio in order to spread messages from the project more widely. The project culminated with a successful and well attended exhibition in Byfleet Village Hall.
- The children displayed their learning from the project, and set up stands to help local residents to understand the implications of water consumption.
- CD-Rom video and photographic case study was funded by the project partners. This was produced in July 2007, to demonstrate the positive outcomes from the project and encourage other local schools to pursue similar projects.

6.1.5.9 Woking Local Agenda 21

At the Earth Summit in Rio de Janeiro in 1992, local authorities world-wide were challenged to address global environmental concerns by taking actions locally, under community-led Local Agenda 21 (LA21) programmes. Since then, Woking residents have engaged with and pro-actively promoted environmental and sustainability issues in the Borough. Section 7 details how Woking Local Agenda 21 has helped progressed actions within the Council's Climate Change Strategy. Woking's Local Agenda 21 (LA21) initiative has succeeded in translating the community's aspirations for a more sustainable Woking into a range of practical and community-led initiatives. LA21 has delivered a range of successful projects, many with clear, tangible outcomes, and it has made a major contribution to the Council's Climate Change agenda, particularly with regard to engagement with the community.

6.1.5.9.1 Council Support for LA21

The Council supports the LA21 Group in a number of ways. A Woking Borough Council Officer provides a basic level of administrative support to the Chair of LA21 and the LA21 Steering Group. This enables LA21 to undertake large communications, organise public events, and manage communications with the wider community. When scoping, developing and delivering particular projects, LA21 Members are expected to take full ownership of the initiative, and to take responsibility for the work.

The Council has used Committee 'Provision For Flexibility' monies to provide financial backing to LA21 projects that are agreeable to the Council. LA21 is expected to formally approach the Council to request release of this money, and the Council has put processes in place to ensure appropriate sign-off from Members and Officers. A sum of £20,000 was designated in 1999. This was used to deliver the Gardening For Life, Green Pages, and Greener Homes projects. The funding provision has enabled LA21 to source match funding for the projects from sources such as National Lottery, and Landfill Tax funding schemes. The Council's Executive Committee resolved to allocate a further £20,000 to LA21 in September 2007.

An important contributor to the success of LA21 has been the on-going dialogue between LA21, Council Officers and Councillors. This dialogue is facilitated through the quarterly LA21 Liaison Group. This group comprises Councillors from the main political parties, a number of Officers from relevant Council service areas, a County Council representative, and community members of the LA21 Steering Group. This meeting is an opportunity for feedback and discussion between the Council and the community, and has been the catalyst for a number of successful projects. This group ensures that the Council is aware of and supportive towards LA21 work, and vice versa. LA21 is also represented on the Council's Climate Change Working Group, which gives the group significant input to the development of the Climate Change Strategy. LA21 volunteers have developed a range of projects which they can be proud of, and have made real contributions to promoting a sustainable Woking. The initiatives have required significant volunteer resources and successful partnership working.

Fig. 6.1.5.2 Brockhill retirement village with a huge photovoltaic (PV) array on the roof and a residential Combined Heat and Power (CHP) system (see *Color Plates*)

6.1.5.9.1.1 Greener Homes

LA21 developed Greener Homes in 2005, as a guide to environmentally sound home improvements and renovations. The hard-copy and Internet versions of the guide were given a high-profile local launch. Jonathon Porritt (Chair of the Sustainable Development Commission) stated: ‘I think Greener Homes is really excellent. It succeeds in setting the wider context, and then offering very practical and clear advice as to how people can start to make their homes so much more environment friendly.’ The project has also attracted positive feedback from an online form posted on the Greener Homes Internet page (Fig. 6.1.5.2).

6.1.5.10 Communicating Climate Change

Woking Borough Council has recognised the importance of communicating the need for local action to tackle climate change. The Council referenced this need through a of Climate Change Strategy Actions, which aim to send clear messages to a range of audiences including Council staff, residents, schools, developers, and suppliers.

6.1.5.10.1 Communicating with Council Staff

The Council aims to lead by example and inspire groups and individuals to take action to address climate change. There is a need for all Council staff to be engaged in climate change as an issue, and to be able to communicate this across the community. Several initiatives have been undertaken to encourage staff to embrace the climate change and sustainability agenda.

6.1.5.10.1.1 The Staff Transport Plan

The key aim of the Staff Transport Plan is to reduce CO_2 emissions that result from staff travelling to and from work and when undertaking travel on Council business. Following a review and staff survey, a series of new measures have been introduced in 2007 to continue the progress already made, and to encourage further staff participation. A series of targets have been agreed by the Council to enable the progress of the plan to be measured. Transport Plan initiatives include accessible flexible working policies, cycling incentives, journey planning assistance, public transport ticket loans and discounts, and membership of a car share network (through a Local Public Service Agreement project). The Council's HR team will be implementing a number of changes to the leased car scheme and the payment of mileage allowance for journeys undertaken on Council business.

These changes will directly benefit staff who choose more environmentally preferable modes of travel. The Council is currently in the process of procuring a Car Club operation for Woking Town Centre. The Car Club will use low-carbon vehicles, and will be the principal means for Council Officers to access car travel for business journeys from September 2008. The Transport Plan is promoted through hard copy and Intranet-based literature, supported by regular promotions covering particular aspects of the plan. A staff survey will be carried out bi-annually in order to monitor progress towards targets and capture staff feedback.

6.1.5.10.2 Communicating with Residents

The Council has taken steps to communicate climate change issues to residents through a range of media and projects, often involving innovative partnership working.

6.1.5.10.2.1 Woking Solar Frontier (WSF)

Woking Solar Frontier is delivered in partnership with the Energy Centre for Sustainable Communities (ECSC). Launched in January 2007, WSF encourages residents of Woking to make energy saving improvements to their homes and to help make the Borough a pioneering low carbon community. Through the scheme, householders in the Borough have access to a free, expert advice service which can provide guidance on a wide range of energy saving issues and measures.

Furthermore, for those who are interested in making improvements to their home, the Woking Solar Frontier can refer homeowners on to a network of trusted, vetted installers who can provide a very high level of service at fair, monitored prices.

The project also aims to encourage dialogue between residents who are interested in solar water heating and those who have already installed the technology through a number of events in the local community and open home days. WSF places an emphasis on community involvement. Verbal advice provided by trained energy advisors is shown to have a greater impact than simply distributing literature (hence the emphasis on this type of advice by the Energy Saving Trust). Over the course of the project, WSF advisors have been present at a number of events including Woking Uncovered, Woking Means Business, the Pyrford and Wisley Flower Show, CIOB 'Keen to be Green' and a number of standalone engagement events in town centre areas.

With the support of the Local Agenda 21 Group, WSF has run a number of Open Home Days. These events allow those in Woking with an interest in solar water heating to visit properties with the technology installed and speak with the owners. Encouraging community interactions such as these helps to lay the foundations of a low carbon community and encourage new networks between residents.

6.1.5.10.2.2 Woking Magazine

The Council's quarterly Woking Magazine has been an important channel for communicating climate change issues to local residents. The magazine is distributed to every household in the Borough, so is an excellent vehicle for engaging with residents (some 39,000 households). Council Officers and partners have written informative articles about a diverse set of climate change issues and solutions, including energy efficiency, light pollution, the Freecycle network, cycle routes, and green gardening.

6.1.5.10.2.3 Go Green Woking

Woking Borough Council has supported the Woking News and Mail's weekly 'Go Green Woking' column. This was established by the News and Mail to demonstrate how climate change issues are being tackled locally, and show readers how they can make their own contributions to mitigating and adapting to climate change. The Council provides information and contacts to the News and Mail to help make the column a regular feature of the newspaper. Woking News and Mail is a paid-for local newspaper with a local circulation of more than 9,000 copies per week. 'Go Green' has included articles about food miles, landfill sites, renewable energy, allotments, stand-by culture and carbon management. The articles are also available on the Woking News and Mail website.

6.1.5.10.2.4 Waste Prevention

Woking's Climate Change Strategy recognises the relevance of sustainable waste management to climate change, and has placed high importance on the promotion of 'waste prevention'. The Council's Local Services Team communicates regularly with residents regarding waste and recycling collections. Communications include annual calendars, local press advertisements and exhibition stands. These provide an opportunity to promote waste prevention schemes that the Council has established.

The Council has facilitated the distribution of more than 3,400 wormeries and composters to Woking households since 2005. October 2007 saw the commencement of a trial reusable nappy pack promotion scheme with Surrey Real Nappy Network, which will further continue to contribute to this objective.

6.1.5.10.2.5 Planet Woking

The Planet Woking web pages are a central source of information on climate change issues for Woking residents, and are just one click from the www.woking.gov.uk homepage. The area includes information about the Climate Change Strategy, Woking's green initiatives, the Council's approach to sustainability, details of key environmental services, links to Woking Local Agenda 21 and the latest environmental news. The Planet Woking area regularly receives in excess of 800 unique visitors per month. The structure and content of the pages are currently being revised as part of the Council's review of its website.

6.1.5.10.2.6 Demonstration House 1 Oak Tree Road

Work is currently under way at a site in Knaphill to transform a detached, three-bedroom house into one of the most water and energy efficient dwellings in Woking Borough. The house in Oak Tree Road has been acquired by Woking Borough Homes Limited, a wholly-owned subsidiary of the Council's company, Thameswey Ltd, as a showcase for a wide range of water and energy efficient measures. Over the next few weeks, the Council's building contractor, Mansell Plc, and the Energy Centre for Sustainable Communities (a second wholly owned subsidiary of Thameswey, Ltd.) will ensure the safe installation of measures including:

– A significant photovoltaic (PV) system which aims to provide at least 50% of electricity requirements
– A 3,500 l sub-surface water tank which will collect rainwater to be used for watering the garden, flushing the toilet and running the washing machine
– Energy efficient lighting, fittings, controls and appliances
– Water efficient fittings such as an aerating shower head, reduced flow taps, dual flush toilet and water butts

– Renovation to meet and exceed the Decent Homes Standard[1] with the aim of achieving a 60% reduction in carbon emissions associated with energy use on site.

In addition, members of the Local Agenda 21 Group and Three Valleys Water will be consulted to ensure that the garden is both low maintenance and drought resistant. The project will seek to test and monitor the installed technologies and provide information to people who are looking to adapt their homes and take additional steps to tackle climate change. The transformation of the house is due to be completed in autumn 2008, after which the Council will set up a series of viewings and tours for members of the public. The property is likely to remain a test house for at least 1 year to give the Council time to monitor the water and energy efficiency of the various installations.

Key replication aspects

– Ensure climate protection has corporate and political support at the local level.
– Local sustainable and renewable energy solutions can be small or large scale, the pooling of all actions will lead to substantial achievements.
– Persistance is essential – even when facing set-backs the plan should not be abandoned but rather adapted if required to make it realistic, and to achieve results through step-by-step action.
– Sharing information and learning from experiences in delivering strategy and projects is key.
– Working in partnership is essential, and can be promoted by providing a challenge in combination with elements that address the different targets groups directly – i.e. offering them added value.
– Community engagement and consultation is vital. Without widespread community involvement there will only be very slow progress.

[1]Decent Homes Standard: Decent homes are important for the health and well-being of those living in them. Poor housing helps an area to get a bad reputation, making it an unpopular place to live, which in turn may lead to the breakdown of communities. In short decent homes are a key element of any thriving, sustainable community. In order to be decent a home should be warm, weatherproof and have reasonably modern facilities. The UK Government believes that everyone should have the opportunity to have a decent home. It is aiming to make all council and housing association housing decent and also wants to improve conditions for vulnerable households in privately owned housing, particularly those with children. In 1997 there were 2.1 million houses owned by local authorities and housing associations that did not meet the decent homes standard. Local authorities had a £19 bn backlog of repairs and improvements. A decent home is expected to meet four criteria:

(a) The current statutory minimum standard for housing

(b) The house is in a reasonable state of repair

(c) The house has reasonably modern facilities and services and

(d) The house provides a reasonable degree of thermal comfort

Further information can be obtained from the Communities and Local Government website (www.communities.gov.uk/housing/decenthomes)

References

Woking Climate Change Strategy www.woking.gov.uk/environment/climate/Greeninitiatives/climatechangestrategy/climatechange.pdf

Climate Neutral Development Guidance www.woking.gov.uk/planning/planningapplications/publications/cnsummary.pdf

Tackling Climate Change Beacon Case Studies www.woking.gov.uk/environment/climate/Greeninitiatives/beacon/tacklingclimatechangecasestudies.pdf

Sustainable Energy Case Studies http://www.woking.gov.uk/environment/climate/Greeninitiatives/sustainablewoking

Themes of a sustainable Woking http://www.woking.gov.uk/environment/climate/Greeninitiatives/sustain/themes.pdf

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Chapter 6.2.1
From Industrial Area to Solar Area: The Redevelopment of Brownfields and Old Building Stock with Clean Energy Solutions (City of Gelsenkirchen, Germany)

Wolfgang Jung, Armin Hardes, and Wilhelm Schröder

Abstract A former coal mining and steel production hub, this case study on Gelsenkirchen shows that the concepts of renewable energy and energy efficiency can be attractive, also for a city with a declining population and rapid changes in economic structures – rather typical for cities in former European coalfield regions. The city's urban planning policy is to explore and implement clean energy options in particular for the revitalisation of coal mine brownfields and the renewal of buildings connected to the coal mine industry. Specific projects implemented in Gelsenkirchen that are shared in this article vary from individual industrial buildings with energy efficient architecture to solar housing estates for approximately 2,000 inhabitants, in addition to the development of a new city district, under construction on the grounds of a former mining area.

Keywords Brownfields • declining population • district heating • holistic urban planning concept • housing estates, • industrial area • joint efforts of the local and state government • life-cycle assessment • Local Agenda 21 (LA21) • solar city strategy • urban planning

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6.2.1.1 Gelsenkirchen in Context

The City of Gelsenkirchen lies in the Ruhr region (German: Ruhrgebiet), which has 5.3 million inhabitants (2008) and is Germany's largest conurbation and a former centre of coal mining, steel production and electricity generation.[1] The region lies in the centre of the State of North-Rhine Westphalia, Germany's largest and most densely populated state with an overall population of 18 million inhabitants. The vast hard coal resources along the Ruhr River were the basis for rapid growth of the region – an industrial area stretching from Duisburg in the west to Dortmund in the east (Table 6.2.1.1).

In 1840, when coal resources were first discovered within the current local government boundary of Gelsenkirchen, the population was only 7,000. Coal mining started in the 1850s, followed by steel production in the 1870s, and the population grew rapidly to 340,000 by the 1920s. With the rise of oil production after World War II and the emergence of new overseas competitors, the region's coal, iron and steel sectors came heavily under pressure during the 1950s and 1960s. Overall employment in these fields fell dramatically from 650,000 (65% of all industry and 28% of overall employment) around 1960 to 73,000 by 2006 (3.5% of overall employment). Today 20,000 people are employed in the mining sector. In 2007, the Federal Government together with the State Governments of North-Rhine Westphalia and Saarland agreed to phase out coal subsidies (currently €3.5 billion/year) by the year 2018. The remaining eight mines (seven in the Ruhr region and one in the Saarland) will then be closed.

Since 1960, employment in the service sector rose from 900,000 to 1.5 million, at a rate well below the state average and insufficient to compensate for the job losses in industry. As a consequence, the unemployment rate increased to 13% in 2007. Serious secondary effects include a continued decline in population and an aging trend above the state and national average (Fig. 6.2.1.1).

With a high dependence on the traditional industry sectors, the crisis hit Gelsenkirchen and its neighbouring communities exceptionally hard. Since 1960, Gelsenkirchen has lost more than 30% of its population. This trend is expected to continue at least for the next two decades: projections carried out by the State of North-Rhine Westphalia expect a further 16% decrease between 2005 and 2025 – the

Table 6.2.1.1 Gelsenkirchen municipal profile

Population	265,700 inhabitants (2008)
Area	105 km^2
Municipal budget	€750 million (2008)
Targets	Under development on the basis of Climate Alliance targets: halving per capita emissions (baseline year 1990) by 2030

[1] The Regional Association Ruhr (Regionalverband Ruhr, RVR) administers the region. Founded under different name in 1920, the RVR is the oldest and with 53 members one of the largest associations of local governments in Germany.

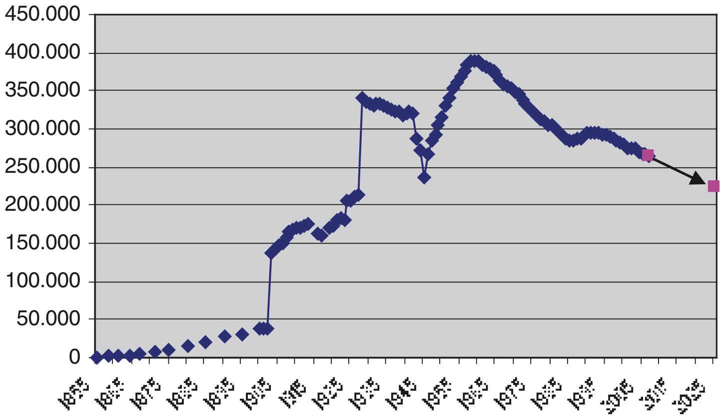

Fig. 6.2.1.1 City of Gelsenkirchen's population between 1855 and 2007 with a projection for 2025 (Landesamt für Datenverarbeitung und Statistik Nordrhein-Westfalen and City of Gelsenkirchen) (see *Color Plates*)

highest in the Ruhr region (average decline of 9.3%). The unemployment rate (15% in August 2008) is approximately double the national average (7.6% in August 2008). The home ownership rate in Gelsenkirchen is extremely low – only 15.6% of the population are owners of the housing they live in, compared to a state average of 39% (according to the Landesamt für Datenverarbeitung und Statistik Nordrhein-Westfalen) and an EU-average of 63% (Norris and Shiels 2004).

Environmental degradation became a public issue as early as late 1950s when lung cancer rates doubled due to significant declines in air quality. During the early 1960s, dust emissions from coking plants, steel mills and coal fired power plants led to permanent grey skies and frequent smog conditions. The goal of restoring 'the blue sky above the Ruhr' (a phrase coined by Chancellor Willy Brandt during the election campaign in 1961), initiated the start of environmental policy in Germany. Almost three decades later, in the late 1980s, after numerous legislative efforts on both national and local level and billions of Euro invested in filter technologies, the air quality in the Ruhr region finally reached acceptable levels. Today's problems with air quality such as photochemical smog (high near-surface ozone concentrations) and fine particulate matter are largely caused by traffic and industrial pollution, and is comparable to other metropolitan areas.

6.2.1.2 Goals

When considering that the built environment accounts for approximately 40% of Europe's total energy consumption, it is important to consider this area for climate protection (EC DG TREN 2003). To reduce greenhouse gas emissions (GHGs) in communities, strategies should be developed for housing estates, districts and the whole city level. Clean energy solutions can be designed for residential buildings, office and industrial buildings, also considering integration with local transport and waste strategies into holistic concepts.

Previously a coal mining and steel production hub, with more than half the workforce employed in these sectors until the 1960s, the City of Gelsenkirchen is now on a track towards a clean energy future. This future is based on utilising renewable energy sources (RES) and improving energy efficiency (EE). A key element of the city's urban planning policy is to explore and implement clean energy options in particular for the revitalisation of coal mine brownfields and the renewal of buildings connected to the coal mine industry. Opportunities for such concepts tend to be considered in communities with rapid population and economic growth, for example where new housing estates and business/industry parks are being developed. Yet, these concepts can be equally attractive for shrinking cities with rapid changes in the structures of the economy – as is the case for many European cities in former coalfield regions. Local governments of these cities face particular challenges. They have to support the development of new industry sectors and employment opportunities and, at the same time, improve the quality of urban life to mitigate further losses in population. Developing clean energy concepts for both the redevelopment of industrial brownfields and for the renovation of old building stock is thus a key element of climate-friendly urban planning policies in such cities.

In 2008 the City Council of Gelsenkirchen decided to develop a coherent climate protection strategy, joined ICLEI's Cities for Climate Protection ™ (CCP) Campaign and Climate Alliance. The City of Gelsenkirchen addresses climate protection and improves the share of renewable energy, by considering changes in urban planning and industry development, with a particular focus on the redevelopment of brownfields and old building stock with clean energy.

6.2.1.3 Results from the Greenhouse Gas Inventory

The GHG inventory of both the City of Gelsenkirchen and the Ruhr region are dominated by CO_2 emissions from the power sector and other big industries. The region remains a major centre for power production from coal. Within the borders of the Ruhr Regional Association (RVR), 19 coal-fired power plants each with an installed capacity larger than 50 megawatt (MW) are operated today, causing 55 million tonnes of CO_2 emissions, corresponding to 17% of emissions from Germany's power sector. Yet, this area accounts for only 6.4% of Germany's total population (EPER 2004). The climate impact of these plants is reduced by using the considerable excess heat produced for space heating and as process energy in industry. Two regional and seven local utilities operate a district heating network stretched throughout the region and serving several hundred thousands of households.

Gelsenkirchen is home to one of the largest coal-fired power plants in Europe. The Scholven power plant (Kraftwerk Scholven) has an installed capacity of 2,200 MW

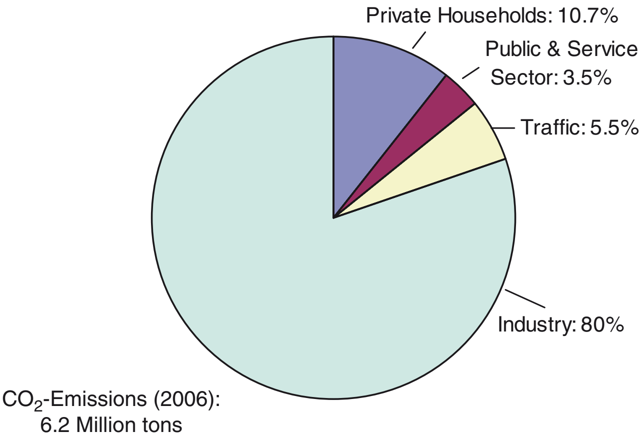

Fig. 6.2.1.2 Sectoral CO_2 emissions in Gelsenkirchen in 2006 (Energy consumption data from the City of Gelsenkirchen) (see *Color Plates*)

and annual CO_2 emissions of 12.9 million tonnes (EPER 2004). This figure is not reflected in the city's CO_2 inventory, which calculates emissions based on energy consumption in industry, traffic, private households, public and service sector. According to this method, CO_2 emissions in Gelsenkirchen amounted to 6.2 million tonnes in 2006, a 22% decrease against 1990 levels, which is the base year of the Kyoto Protocol, and is used by the city (Fig. 6.2.1.2).

With 23 t/capita/year, emissions in 2006 were well above the German average of 10.6 tonnes. This high value is dominated by emissions from industry. Two large oil refineries alone account for more than 4 million tonnes of CO_2 per year,[2] i.e. almost two thirds of the city's total emissions. When excluding these two plants from the calculations the per capita emissions are 8.2 tonnes. As a consequence, climate protection policy in Gelsenkirchen is not focused on cleaning up existing big industries, but rather on issues in which the core competency lies with the local government and issues accessible to public private partnership models with local reach.

6.2.1.4 A New Paradigm for the Energy City

During the late 1980s, when industrial decline was at its peak and unemployment rates rose to 17%, the local government together with the State Government of North-Rhine Westphalia (NRW) conceived the idea to steer the structural change

[2]The volume of production and CO_2 emissions from these plants are largely depend on international fuel markets. There is significant temporal variation for example from 2001 to 2004 emissions increased by more than 600,000 t (+18%), i.e. about the size of total emissions from private households in Gelsenkirchen. Emissions from the two refineries are regulated through national and European law (EU Emissions Trading Directive) and hardly responsive to local activities.

into a new, positive direction while also addressing the roots of economic development in the region, namely energy. Thus Gelsenkirchen, the ‘energy city’, the ‘city of a thousand fires’ should instead become the ‘city of a thousand suns – a solar city’. The main goal was to create new business and employment in a modern industry sector and to improve the image of the whole region in order to attract investment capital and skilled labour, not only in the energy sector.

6.2.1.4.1 Starting Point: Science Park Gelsenkirchen

The starting point for the new programme was an idea to build a modern technology park – Science Park (Wissenschaftspark) Gelsenkirchen – on the land of a former steel foundry close to the city centre. The idea was first conceived in 1989, and linked to the development of the Internationale Bauaustellung (IBA) Emscher Park – a 10 year multi-billion Euro investment programme for the regeneration of the whole Ruhr region, with individual projects co-funded largely by the state of NRW and the European Union (EU).[3]

Science Park Gelsenkirchen was inaugurated in 1995 and became a flagship project of both the IBA Emscher Park and Gelsenkirchen’s solar city strategy. In the centre of the 45 ha park area, a 300 m long technology centre was built, offering 12,500 m^2 space for offices and laboratories. The building has won several awards for its industrial architecture and was rated as ‘one of Europe’s best business centres’ at MIPIM, the international real estate fair in Cannes in 1995 (MIPIM, 1995). The state-owned Landesentwicklungsgesellschaft Nordrhein-Westfalen (LEG NRW) and the City of Gelsenkirchen were co-builders and initially co-owners of the project (In 2007 Science Park Gelsenkirchen GmbH became a 100% subsidiary of the City of Gelsenkirchen). An extensive part of the overall investment of 50 million Euro came from the EU through its Regional Development Fund, the State of North-Rhine Westphalia and federal level funding.

In 1996, a 210 kilowatt (kW) photovoltaic power plant was built on the roof of the technology centre, the largest of its type in the world at this time. The three million Euro investment for this was co-funded by the State of North-Rhine Westphalia, the EU and the local utility. The spectacular architecture and the high profile of the building supported targeted recruiting of research institutions and businesses as tenants of the technology centre. As one of the first tenants, the Institute for Applied Photovoltaics (INAP) was founded in 1996. INAP carried out research on a new generation of dye-based solar cells, an activity later taken over by Freiburg-based Fraunhofer Institute for Solar Energy Systems (FhG ISE). Research, development and marketing of renewable energy technologies have become one of several activities in the Science Park. Today, eight of the 45 companies and institutions based in the technology centre and the start-up centre, work in the field of clean energies (Fig. 6.2.1.3).

[3]For a brief overview of the programme see: Ingrid Helsing Almaans (1999): Regenerating the Ruhr – IBA Emscher Park project for the regeneration of Germany’s Ruhr region. In Architectural Review, February 1999.

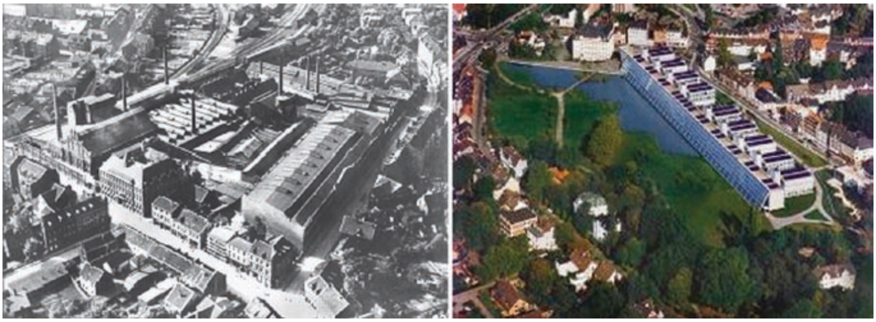

Fig. 6.2.1.3 Old and new – (*left*) Gelsenkirchener Gußstahl- und Eisenwerke AG in 1929 and (*right*) Wissenschaftspark Gelsenkirchen with its 210 kW PV plant (1996) (see *Color Plates*)

The inauguration of Science Park Gelsenkirchen, together with the large scale application of locally produced solar technology, defined the common starting point for two major pathways for implementing the solar city strategy, namely:

– Joint efforts of the local and state government to support the growth of a clean energy industry cluster
– A series of spectacular demonstration projects in order to substantiate the cluster strategy and to create local identity and support for the strategy

6.2.1.4.2 PV-Industry: Nucleus of a Clean Energy Cluster

An obvious step to strengthen the city's nascent PV industry was to use the PV value-chain and attract investment for a solar cell factory. This goal was achieved in 1999, when Shell Solar opened a facility with advanced production technology and an annual capacity of 25 MW solar cells near the existing solar module factory. The investment of €30 million was supported with funds from the state government and the EU. Today both factories (cell and module production) are owned by Scheuten Solar and projected for growth in line with the upward trend of global PV markets: in 2008 the cell factory has grown to 50 MW production capacity and has 100 employees, and the module factory relocated to the city. Production capacity in the new plant is expected to grow to 100 MW, with a growing number of employees projected to be at 420 by 2010. To support innovation and optimisation in solar cell production technologies, the FhG ISE opened up a PV laboratory and service centre in Gelsenkirchen close to the solar cell factory in 2000.

The combination of modern production facilities and spectacular demonstration projects began to raise interest in the Gelsenkirchen example. Science Park Gelsenkirchen, Shell's solar cell factory and Academy Mt. Cenis in the neighbouring city of Herne, formed the so-called Solar Triangle Emscher-Park, a project presented at the World Expo 2000 in Hannover. Spurred on by the emergence of a local PV industry and improved support schemes for PV from the state and federal levels in the late 1990s, a growing number of companies in the region engaged in the planning, installation, maintenance and marketing of solar technologies, assisting the development of a ´solar service sector´. To support this, regular training programmes were set up for architects, project developers, workmen and unemployed people – many initiated and hosted by the Science Park (Schmitz-Borchert and Jung 2002). Today, the portfolio of companies in the clean energy cluster goes far beyond the PV sector and includes production facilities for solar thermal collectors, ground-based heat pumps and components of wind power stations, as well as engineering companies focusing on biogas and wind parks.[4]

6.2.1.4.3 Getting Citizens Involved: Solar Housing Estates

Parallel to these cluster management activities, the city administration worked on the second pathway of the solar city strategy, namely through the development of further demonstration projects. The above mentioned projects (Science Park, etc.) highlight the economic potential of solar technology and its suitability for modern industry architecture. This message was easily spread to politicians, entrepreneurs and architects – but was not exactly suitable for involving the general public.

6.2.1.4.3.1 Gelsenkirchen-Bismarck Solar Housing Estate

Public involvement was achieved through the Gelsenkirchen-Bismarck solar housing estate, a project demonstrating that clean energy technologies – as part of integrated housing concepts – have great potential to improve the urban living environment. This project was the first of its kind in the Ruhr region and part of the state programme 50 Solarsiedlungen NRW (50 solar housing estates NRW[5]), launched in 1997 as a unique effort to stimulate innovation in solar and low energy architecture. The projects included are not only characterised by innovative concepts for energy use, but also by excellent social, environmental and urban parameters. A follow-up programme with a broader technology focus is currently under preparation by the state Ministry for Economic Affairs and Energy (working title: 100 climate protection estates).

The solar housing estate was developed at the edge of the former mining site, at the heart of the Gelsenkirchen-Bismarck district, 2 km from the city centre. Planning for the greater area commenced in 1993 with an urban planning competition leading to two projects – an integrated school with eco-friendly architecture

[4]For a comprehensive overview see www.solarstadt-gelsenkirchen.de > Company Guide

[5]www.50-solarsiedlungen.de

and progressive teaching methods; and a housing estate partly comprised of self-constructed houses with intentionally simple architecture. The construction of the solar housing began in 1999 and was completed in 2001. On an area covering about four hectares, two property developers constructed 72 terraced houses, which sold in a short period mostly to young middle-class families (costs ranging between €170,000 and €240,000). With its central location, distances to key service and supply facilities, including the above mentioned school and a subway station connecting the area to the city centre, are short (Table 6.2.1.2).

The buildings' average space heat requirement of 20 to 8 kilowatt hour (kWh) per square meter (m^2) was 40–60% lower than the German standard at that time. For urban planning purposes (west-east-facing facades) the use of passive solar energy in the northern part of the estate was limited. Solar energy is utilised primarily through active solar thermal and photovoltaic systems installed on the roofs. These systems operate in a decentralized stand-alone mode, i.e. separately for each house, and are supported by separate gas-fired condensing boilers. In the southern part of the estate buildings face southwards, which, in conjunction with good zoning and internal layout of the buildings, allows the use of both active and passive solar energy. The active systems also serve as shading elements to prevent summer time overheating. Houses in the southern part are supplied with heat from central energy units, used for each group of buildings to save costs. The solar thermal systems are linked and feed their output into a joint storage system supported by an efficient gas-fired burner with condensing technology.

As part of the project evaluation, a life-cycle assessment was conducted to calculate the total energy required to construct the entire housing estate. In this a remarkably high proportion of energy for infrastructure – 15% – was identified, mainly due to complicated preparation of the site involving clean-up of contaminated land and buildings. For individual houses, overall energy requirement is dominated by the building envelope (i.e. the walls, foundations, roofs, ceilings and floors). Technical systems were found to play a subordinate role. The energy input required to produce the buildings totals around 1,400 kWh/m^2, which is in the order of the total space heat requirement over 35 years (Energie-Cités 2002; Petersdorff et al. 2000; NRW 2008).

Table 6.2.1.2 Details on the 72 single-family terraced houses (solid and timber-framed)

72 Single-family terraced houses (solid and timber-framed)		
Living space per house	110–140	m^2
Calculated annual heat requirement	20–38	kWh/m^2
Collector area	440	m^2
Solar contribution to hot water requirement	65	%
Installed photovoltaic (PV) capacity	88	kW_p
PV contribution to electricity requirement	40	%
Some houses have green roofs		
Rainwater infiltration through open depressions in the soil		

Awareness about the project goals among the residents of the estate was achieved through information meetings and brochures. The residents of the estate founded a local environmental advocacy group SOL – Förderverein für solare Energie und Lebensqualität der Sonnensieldung Gelsenkirchen-Bismarck e. V. (Association for solar energy and quality of life). The group offers information events and guided tours through the estate.

The positive ramifications of the project were many and went far beyond environmental issues. Most importantly, the project offered an attractive living environment for many young families who otherwise might have chosen to move out of the city. Furthermore, it helped to stabilise the social mix and raise the profile of a city district in urgent need of regeneration. It set the stage for the systematic integration of clean energy solutions in housing projects in the city and beyond. Last but not least, it helped to engage the public in the implementation of a solar city strategy, which was initially conceived in top-down direction.

The positive social effects of solar housing projects were underlined in a second project within the state programme 50 Solar Housing Estates. The Gelsenkirchen-Lindenhof solar housing estate of the housing company LEG NRW, is an example of a successful integration of solar technology in the modernisation of old buildings. The Lindenhof housing estate was originally built for miners and their families in 1952. The renovation measures aimed to significantly raise environmental standards and at the same time keep rental costs at a socially acceptable level. Planning of the project started in 2000, with modernisation measures commencing in 2002 and completed in 2003.

Improved heat insulation of the building envelope and a ventilation system with heat recovery reduced the heating energy demand of the 224 apartments by 80% (from more than 300 kWh/m^2 to 60–65 kWh/m^2/year). Energy for space heating and warm water is supplied through a local heating system with five heat stations fed by 600 m^2 of solar collectors and very efficient gas-fired burners with condensing technology. Through these measures, overall CO_2 emissions were reduced by more than 85% and energy costs per square metre were reduced by almost 60% (EnergieAgentur NRW 2008). More importantly, the solar modernisation helped to raise the lease possibility of the apartments. Almost all of the former inhabitants moved back to the estate and vacancies existing before the renovation were easily filled. Overall demand for the new apartments soared during the construction phase and could not be met.

To facilitate the replication of such solar housing projects, the city administration launched a programme in 2003 to support smaller housing companies and cooperatives to analyse their building stock and set investment priorities. This initiative resulted in solar renovation projects of the city-owned housing company (block of houses, renovation completed in 2006) and a housing cooperative (solar housing estate, currently in the planning stage).

6.2.1.4.3.2 Social Activities

Public participation in the implementation of the solar city strategy was further increased by numerous activities conceived and organised within the Local Agenda

21 network with core funding coming from the City of Gelsenkirchen and the Protestant church. The most prominent project example is the charity race SOLIDAR 21, annually organised since 2000. In these races, between 3,000 and 5,000 school pupils, run some 10,000 km altogether, and are sponsored by approximately 10,000 individuals. The budget raised (between €30,000 and €45,000 per year) is partly spent on photovoltaic installations on public buildings and for solar energy projects in developing countries.[6]

6.2.1.5 Second Wave: Strategy Development and Institutionalisation

The successful implementation of the above mentioned large-scale projects had positive repercussions on the strategy level. Within the city administration, processes and budgets were optimised to facilitate further investment and application of solar energy, and also to live up to rising expectations generated by the solar city strategy. In 1999, the City Council set up an annual budget of €50,000 for the general ‘promotion of solar energy’, which was renewed every year since then, although the volume amount was reduced to €45,000 in 2004, but has since 2008 again raised to €65,000. The budget is managed by the city’s Environment Office and used on projects to raise awareness, offer consultancy for private investors and studies to support the development of additional policies and instruments. As one of the first projects funded through this budget, the website[7] was launched in 2000 to disseminate information about clean energy activities within the city.

6.2.1.5.1 Resolutions and Studies

In a resolution passed in 2000, the Council charged the administration to set up an inventory of public buildings suitable for installation of PV or solar thermal systems, and to install such systems ‘whenever it makes sense’. In the same year, the Council’s construction board set up a €100,000 budget to equip five schools with PV systems. This budget was renewed annually and led to the installation of 17 PV systems and more than 29 solar thermal systems – the latter mainly on school gyms.

Between 2001 and 2006, several studies were conducted to support both the development and implementation of the city’s clean energy strategy. The study Solar City Gelsenkirchen, commissioned by the State Ministry for Urban Planning tried to set targets and major fields of action. Through public hearings and workshops, major stakeholders participated in defining the solar city paradigm and implementation scenarios

[6] http://agenda21.gelsenkirchen.de

[7] http://www.solarstadt-gelsenkirchen.de

(Everding 2006). Solar urban planning was identified as a particularly attractive field of action (Wachten et al. 2002). A CO_2 inventory for the city and detailed sectoral climate action plans were developed within a follow up-study commissioned by the City of Gelsenkirchen, compiled with support of the three local energy utilities (masterplan on energy) (Gajewski et al. 2005). The third study focused on the potential of the building stock and new development areas for application of solar technologies. The first of these studies clearly identified that moving from single projects to sectoral action plans would afford new institutional structures: firstly within the city administration, because energy issues cut across traditional lines of responsibility and secondly to get other stakeholders systematically involved.

Regarding, internal structures, an energy team with members from various departments of the city administration was formed in the aftermath of the masterplan study in 2003. The energy team developed a set of measures for more ambitious energy efficiency measures in public buildings and steered the implementation thereof. This procedure was managed by a consulting firm and the results were certified within the European Energy Award project in 2008.[8] Coordination within the administration will further benefit from the appointment of a climate protection and solar officer, mandated by a city council resolution in 2008. Through the same resolution, the City joined Climate Alliance[9] and ICLEI's Cities for Climate Protection™ (CCP) Campaign[10].

6.2.1.5.2 Solar City Gelsenkirchen

In 2004, to improve participation of major stakeholders, the city administration and Science Park Gelsenkirchen initiated the foundation of Solarstadt Gelsenkirchen e.V. (Solar City Gelsenkirchen), a non-profit registered association.[11] Among the founding members were the (privatised) local utility, the University of Applied Sciences, the Chamber of Crafts, a large housing company and the solar industry. Together with the two local financing institutions joining the association in 2007, the member portfolio covers all major players along the chain from research, development and production to installation and maintenance of clean energy technologies. From the beginning, the association served as a forum for communication and the development of Public-Private Partnership (PPP) project qualities.

As one of its first activities the association helped to raise funding for an innovative project at a Gelsenkirchen school completed in 2005. The Solar&Spar Projekt (Solar & Save Project) introduces a new approach in energy performance contracting. The construction of a 30 kW PV power plant was combined with measures to

[8] http://www.european-energy-award.org/

[9] http://www.klimabuendnis.org/

[10] http://www.iclei.org/ccp

[11] http://www.solarstadt-gelsenkirchen.de

modernise lighting and the heat supply system, leading to a total emissions reduction of 750 t CO_2/year. Due to saved energy costs, the overall investment of €600,000 is highly profitable, allowing the capital to be increased by selling shares to citizens and other private investors. During this process, the solar city association served as a trustee and managed the fund up to its closure (The project was initiated by the Wuppertal Institute for Climate, Environment & Energy and co-funded through the state programme ‘Energy School 2000+’).[12]

Support for the clean energy movement was substantially broadened in 2008, when some of the biggest companies in the city joined and provided financial support for a 3-year campaign aimed at further raising the profile of Gelsenkirchen as a clean energy city. The solar city association was asked to conduct the campaign. By broadly joining this ‘Future Initiative Gelsenkirchen 2020’, the private sector acknowledged the potential of the solar city and the clean energy paradigm to improve the overall image of the Gelsenkirchen.

6.2.1.6 Second Wave of Large-Scale Projects

The recognition of clean energy as a marketable paradigm for Gelsenkirchen was helpful for the launch of other large scale projects. In 2007/2008, four remarkable projects have been completed, partly initiated by actors new to the local solar scene.

6.2.1.6.1 Roof Space for Large PV Project

Gelsendienste, a city-owned company responsible for the management of waste and green spaces, made available one of its depot roofs for an investor to install a 185 kW photovoltaic plant. The roof space is rented out to the investor, thereby also generating an income for the roof-space owner. The project is the first of its kind in the city. Earlier attempts often failed because potential roof providers perceived the risks involved with long-term leasing contracts as too high.

6.2.1.6.2 Private Sector Investment

The 360 kWp PV installation on the depot of logistic company LOXX showed that large-scale PV projects can be attractive to private sector companies in many respects, as an economically viable investment and as a credible “green statement”. One of the most spectacular projects so far is the 355 kWp PV system on a leftover concrete colossus of the steel era. The PV-engineering company Abakus Solar

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[12] http://www.wupperinst.org/solarundspar/PDF/project_description.pdf

together with other private investors installed the plant on the ore- and coal bunker of the former steel works Schalker Verein, creating another landmark and strong symbol for the city's transition from coal to solar energy.

6.2.1.6.3 Housing Company Using PV

The solar housing estate Gelsenkirchen-Schaffrath provides another superlative action for the solar city project portfolio. By the end of 2008, the housing company THS installed almost 800 kWp of solar modules on south-oriented roofs of the modernised former miners' estate, creating the largest PV community in Germany and the second-largest in the world.[13] The project is the city's third contribution to the state programme 50 solar housing estates. As part of the modernisation, the heat requirement of the buildings was reduced to an average of 60 kWh/m^2 annually, and heat supply was switched to district heating.

6.2.1.6.4 From Solar Housing Estates to Solar City Districts

The positive experience with solar housing projects encouraged the city administration to further develop and upscale the concept by applying solar urban planning methods on the level of a city district.

The Stadtquartier Graf Bismarck[14] (City Quarter Graf Bismarck) has been developed on the largest industrial brownfield of the city, which was the power plant location of the former coal mine Graf Bismarck. It is planned that the 80 ha quarter would include 5,000 working places and 700 dwellings, also with office buildings, trade, commerce and recreation all with high energy efficiency requirements, solar urban planning and applications of solar systems. The development of infrastructure commenced in 2008, with completion of the whole project expected after 2012. The energy concept for the site does not prescribe the implementation of certain technologies but ensures a high standard for overall energy efficiency. The tender for the heat energy supply stipulates a maximum value of 0.7 for the primary energy factor – a measure for total primary energy requirement of buildings set under new federal legislation. This requirement can only be met with a heat energy supply system based on cogeneration and/or a significant share of renewable energies.

In an innovative approach, the city is imposing solar requirements in the contracts of land purchases. This approach is possible because the State Development Corporation (LEG) is the owner of the land. An investor manual has been prepared with commitments to the energy concept. Residential buildings must include a

[13] http://www.pvdatabase.org/

[14] http://grafbismarck.gelsenkirchen.de/Projekt/default.asp

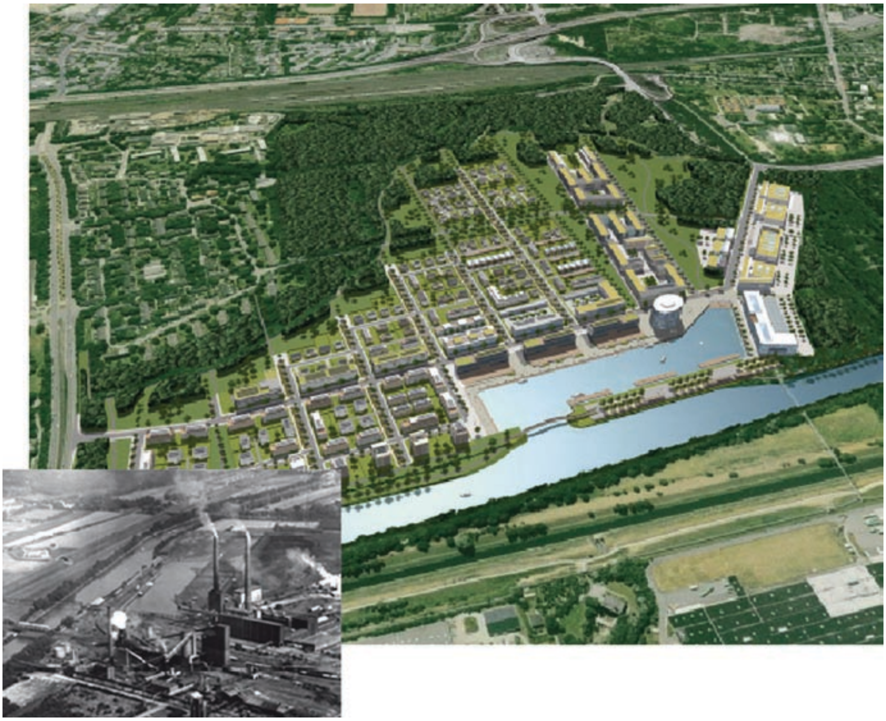

Fig. 6.2.1.4 (*Bottom left*) The former coal mine, cokery and power plant Graf Bismarck in the 1950s, and (*right*) the same area with an urban design concept for the new city quarter Graf Bismarck (From City of Gelsenkirchen) (see *Color Plates*)

minimum of 1 kWp/unit and non-residential buildings must include PV on surfaces visible to the public.

An overall urban plan has also been developed, which includes a simulation of shading and solar irradiation on building surfaces. To avoid major shading of building surfaces (solar access) an advisory committee will assist individual investors (Fig. 6.2.1.4).

6.2.1.7 Conclusions

To be successful, local strategies for climate protection and renewable energies have to be linked to major development trends of the respective city or community. In cities impacted by industrial decline, high unemployment rates and loss of population – clean energy strategies can offer solutions that also address these socio-economic problems. In the case of Gelsenkirchen this was achieved by implementing innovative clean energy concepts for the redevelopment of industrial brownfields and the renovation of old building stock. Creating new jobs through the development of a clean energy industry cluster and improving the urban living environment through solar housing projects have become core elements of a comprehensive strategy paving the way towards a new energy future.

Many elements of the Gelsenkirchen case – ranging from agenda setting, strategy development and institutional design to the implementation of individual projects – should be relevant particular to cities in economic transition like such as those in former European coalfield regions.

Key replication aspects

- Communities that are losing their population can use the planning, implementation and maintenance of sustainable energy to provide jobs and stimulate the economy, in particular relevant to the Small and Medium-sized Enterprise sector, and advanced sectors such as R&D.
- Should this be possible, imposing RE and EE requirements in contracts of land or building purchases.
- Provide opportunities or establish structures to allow the participation of major stakeholders, the city administration and any relevant groups that have a vested interest in economic development of the city.

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Chapter 6.2.2
The Varvarin Energy Clock: Displaying Energy Savings to Mobilise Environmental Initiatives (Varvarin, Republic of Serbia)

Siegfried Brenke and Maja Matejic

Abstract The modernisation of street lighting is a relatively simple energy efficiency (EE) measure, and has been applied in many municipalities worldwide. Although any improved quality of street lighting is immediately visible for citizens, related benefits such as energy savings, advantages to the environment, and budget impacts often remain unnoticed by the public. Yet these are important elements that, combined, can send a strong message about the advantages of changing and even lead to behavioural change. On the main square of the Town of Varvarin, the 'Energy Clock' – a light-emitting diode (LED) screen – displays the energy consumption of a section of Varvarin's street lighting system. In addition, it also displays related reductions in greenhouse gas (GHG) emissions and municipal financial savings made. The Varvarin Energy Clock is the first system of its kind designed and installed in South-Eastern Europe, and this case illustrates the vast replication potential in other municipalities.

Keywords Energy efficient street lighting • flat rate billing • high cost-saving potential • light-emitting diode (LED) • municipal services • on-line monitoring system • public awareness-raising • public display of energy and budgetary savings

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6.2.2.1 Varvarin in Context

The Municipality of Varvarin is situated in the Rasina District, the centre of Serbia and in the south of the Šumadija region (Table 6.2.2.1). It lies between the Zapadna Morava-, West Morava- and Velika Morava/Great Morava rivers. Varvarin is at the junction of regional roads connecting Southern and Northern Serbia, as well as the larger cities Kruševac and Kraljevo. Three regional roads pass through the centre of the municipality. The Municipality of Varvarin is comprised of 21 local communities, with the town of Varvarin the administrative, industrial, educational, cultural and medical centre of the municipality.

The Municipality manages two public companies, namely the Directorate for Urban Planning and Construction (managed as a public company), and the Public Company 'Morava' (the regional water supply), as well as several public institutions – the Culture Centre, Sports Centre and the Kindergarten 'Naša radost'. There are also two secondary (high) schools and 18 primary schools.

The main economic activity is based on agriculture, employing some 30% of the municipal work force as well – specifically in crop farming, fruit growing (strawberries and raspberries) and animal husbandry. Before the collapse of Yugoslavia, the municipality had a significant textile and machine-building industry. Presently, only one food industry facility operates in Varvarin. The municipality has the potential to further develop the local food industry and mineral water production.

In Serbia the provision of municipal services is being hampered by problems inherited from the past, such as poor management, obsolete equipment and a lack of maintenance. Also, flat rate billing combined with low energy prices have kept the interest in energy efficiency (EE) at a low level, be it in district heating and water provision, the management of public building stock or municipal street lighting. However, seen from another perspective, this means there is high energy savings potential, and cost-saving potential in municipal services.

Serbian public utility companies are facing transition problems, which significantly decrease their capability to mobilise resources for investing in EE measures. Thus, identifying investment opportunities with high energy saving potentials and low implementation complexity combined with visible improvements of services may serve to kick-off for more comprehensive municipal EE strategies to follow. Street lighting is one of the municipal services provided by Serbian municipalities and usually maintained by the local electricity distribution companies. The main features of the current system are:

- Rather low tariffs for street lighting in Serbia – currently at some 6 Euro cents, even though the tariff has increased substantially in real terms since 2005.

Table 6.2.2.1 Varvarin municipal profile

Population	22,000 inhabitants (2002)
Land area	249 km^2
Municipal budget	€2,306,000 (2007)
Targets	No specific CO_2 reduction target

- Unsatisfactory quality of lighting. High percentage of lamps is frequently out of operation due to lack of maintenance. Photometric parameters of the street lighting often do not correspond to the road category.
- Relatively high electric power consumption since ~85% of light sources are mercury bulbs and ~5% are incandescent bulbs.
- Illegal connections to the street lighting grid in some municipalities.
- High electricity and maintenance costs for the municipal budget.
- Pronounced negative effect on the environment due to the massive use of mercury bulbs, which are mainly improperly disposed off after their use, “light pollution” is prominent.

6.2.2.2 Goals

The Vavarin Energy Clock activity is part of a project ‘Modernisation of Municipal Services in Serbia’, funded by the GTZ (Deutsche Gesellschaft für Technische Zusammenarbeit[1]), within the GTZ Small Scale Investment Scheme. It has the following goals:

- Improving part of the municipal street lighting system in Varvarin, while lowering energy consumption, reducing GHG emissions and realising savings in the municipal budget.
- Visualising through a public display – in a real time mode – all key project parameters and actual project performance in order to raise awareness and stimulate follow up initiatives.

For many years the improvement of street lighting, mainly by switching to more energy efficient light bulbs, has become a standard routine for many environmental - and/or budget - conscious municipalities. However, many more cities and towns are continuing to use an outdated, costly and environmentally damaging system to provide this basic municipal service – obviously not aware of proven solutions available for immediate improvement. Thus, the main focus of the ‘Varvarin Case’ is not changing the light bulbs. Rather the focus is on how the results of EE projects in municipal street lighting can be made as transparent and as visible as possible, through an on-line monitoring system with a public display of energy savings, GHG reduction and cost savings.

6.2.2.3 Starting the Initiative

The initiative to modernise the street lighting system came from municipal technicians who, at the time, were often annoyed by the poor operation of the street lighting system and constant complaints by citizens. A group of municipal technicians formed the project team which technically and financially elaborated the proposal

[1] www.gtz.de

to modernise the street lighting system. From the beginning the project team was convinced that improvements in quality of operations and savings in energy, as well as maintenance, could be achieved. The Mayor of Varvarin turned to the GTZ requesting co-financing for the project, which was accepted and formed part of the 'Small Scale Investment Program' of the GTZ project 'Modernisation of Municipal Services' conducting a small street lighting project in Varvarin.

6.2.2.3.1 Replacement of Light Bulbs

In 2007, obsolete lamps with mercury bulbs were replaced by 439 high pressure sodium light sources. Combined with the 66 similar lamps already installed by the Serbian Energy Efficiency Agency, a total of 505 lamps were replaced in the municipality – representing some 12% of the total stock.[2] The estimated payback time for the overall investment amounts to between 7 and 8 years, based on energy savings of about 35% and reduced maintenance costs of about 20%, also assuming a 3% nominal increase of electricity tariffs and annual maintenance. The implementation of the project had an immediate impact, in particular with interest among the citizens, as the improved quality of the service was obvious. However, at this stage it was still only a 'routine street lighting project' (Fig. 6.2.2.1).

Fig. 6.2.2.1 Light bulb replacement in progress (see *Color Plates*)

[2] Additional technical information available from Sladjana Jevremovic, Director, Urban Planning and Construction, jovanavanja@ptt.rs, Ulica Slobode bb, 37260 Varvarin, or by Maja Matejic (s.a)

6.2.2.3.2 Visibility of Results

The dedication of the municipal leadership to increase EE and improve the environment, as well as the commitment towards an initiative for raising citizens' awareness in the municipality were the main reasons to go even further. Varvarin was selected as a demonstration case for a transparent on-line monitoring system for electricity consumption, energy savings, pollution reduction and budget savings. The idea of the Varvarin Energy Clock was born, to function as a monitoring system for street lighting operations and performance. The idea behind it was that all relevant information on economic and environmental benefits achieved should be visible in real time, and presented on-line, for the following people or groups:

- The municipal operations manager on the monitor in his/her office
- The electricity distribution company in Krusevac on its own monitoring system
- The citizens of Varvarin on a one by two meter LED screen placed in the centre of town
- Anyone interested visiting the GTZ project website – www.mku.co.yu

The Mayor of the Municipality of Varvarin, as well as the municipal project team, accepted this idea with great enthusiasm, recognising the chance for further improvement of the street lighting system, for campaigning, awareness raising and education of the local population. The municipality provided all necessary technical documentation and licenses to place the system on the main municipal square. Technicians from the municipal public utility company were in charge of construction. The regional Electricity Distribution Company Kruševac (ED) recognised the significance of this project and joined it by providing GPRS (General Packet Radio Service) communication through its own communication line. Technicians of ED completed all necessary installations of new meters at the transformer units. Significant support also came from the Serbian Energy Efficiency Agency and the local producer of efficient lighting equipment, Minel Schreder.

6.2.2.3.3 Monitoring System

The monitoring system covers a section of 1,308 street lights, of which 505 have new and 803 old lamps. The implementation of the street lighting monitoring system, or 'Energy Clock', included the following activities:

- Installation of new electrical meters and communication systems in transformer units. Two types of meters were used: meters for active energy 3 × 230/400 V, 60 A, and accuracy class 2; and meters with accuracy class for active energy 1, reactive energy 3 and maximum demand 1, 3 × 230/400 V, 5 A. The meters are multi-functional, equipped with the tariff registers necessary to keep all information relevant for billing as long as needed.

- Providing a wireless connection between the meters and central communication unit based on GPRS technology.
- Installation and setting up of the central monitoring unit in Varvarin.
- Installation and setting up of the software and user data acquisition interface.
- Creation and organisation of the database on measured values and other relevant calculated values in the appropriate format.
- Creation of user templates for on-line tabular and graphical display of the measured values, as well as user templates for various analyses of the measured values.
- Installation of a 1 × 2 m LED display at the public place close to the city hall, for the on-line public display of measured and calculated parameters.
- Installation of software for the communication between the central computer and LED display as well as execution of wireless communication between the central computer and LED display.
- Setting up of the municipal monitoring unit and training of the municipal staff to operate the monitoring system.

Data reading and processing is managed by municipal staff. The sampling rate is 12 readings per minute and accuracy is ±1%.

Some relevant technical data captured include the following:

On-line measured and monitored values:

- Current line voltage (V) – per each line per each transformer unit
- Current (A) – per each line per each transformer unit
- Current active power (kW) – per each line and total per each transformer unit
- Current reactive power (kVAr) – per each line per each transformer unit
- Increment of electricity consumption (kWh) – per each line and total per each transformer unit
- Frequency in the system (Hz) – per each transformer unit
- Number, time and duration of power cut offs, if occurred

Calculated data based on the on-line measurement:

- Percentage and number of operating bulbs for each line per each transformer line (error rate ±1% i.e. two bulbs per line)
- Cumulative active energy consumption over a time period for whole system
- Cumulative reactive energy consumption over a time period for whole system
- Cumulative CO_2 emissions over a time period for whole system
- Cumulative cost for electricity over a time period for whole system

Text publicly displayed on the screen and sent to the GTZ project website:

- Project description (participants, investment costs, scope, etc.)
- Current status of the system:

  - Percentage of lamps currently operating
  - Electricity consumed for the street lighting during the preceding night
  - Savings in electricity, CO_2 and municipal budget achieved last night in comparison to the same day previous year

- Cumulative savings in electricity and CO_2 from the moment of installation of the new lamps
- Cumulative savings in coal consumed by thermal power plants from the moment of installation of the new lamps
- Current electricity consumption and budget effects by street lighting operating

After dusk, when street lights are working, the screen shows energy consumption in real time and as actually measured at the 17 related transformer units. During daylight the screen shows the energy consumption of the preceding night, compared to the energy consumption 1 year ago (before the energy-efficient bulbs had been installed).

6.2.2.3.4 Budget and Financing

For the first project phase of 'Modernisation of the Varvarin Street Lighting System', the installation of 439 new bulbs, lamps and repair work on the system came to a total budget of €54,200. Of this amount the GTZ project covered €27,100, and the Municipality of Varvarin contributed €27,100.

The second project phase 'Varavarin Energy Clock – Installation of the Street Lighting Monitoring System' included the installation of 17 m in transformer units for wireless communication and related software, Poles and power supply for display, LED screen and related communication devices, PC for Municipal Office, with a total budget of €14,300. The GTZ project 'Modernisation of the Municipal Services' covered €9,300, and the Minel Schreder Company contributed €5,000 (Fig. 6.2.2.2).

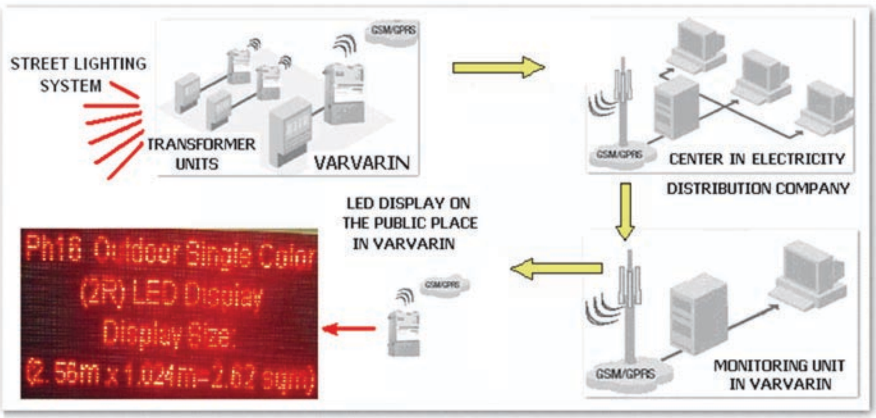

Fig. 6.2.2.2 Structure of the monitoring system (additional display on www.mku.rs) (see *Color Plates*)

Additional support included contributions from the Electricity Distribution Company Krusevac: 19 modem cards for GPRS communication and the GPRS communication costs, and from the Municipality Varvarin the preparation of the technical documentation, fees, installation of the screen supports etc.).

6.2.2.4 Results

The installed monitoring system enables on-line graphical visualisation of the measured values, i.e. a constant insight into the system operation and allowing for prompt reaction on any disturbance or interruption including the detection of any illegal connections. This function is permanently used by municipal technicians in charge for the street lighting system maintenance. Consequently, the quality of the street lighting system maintenance is significantly improved.

Such monitoring system also provides the basis for further implementation of advanced EE measures, such as the optimisation of system operation by regulating light intensity or by reducing the number of operating lamps during the night. The constant recording of measured and calculated values enables municipal staff to perform all kinds of technical and financial analyses. Furthermore, the installation of the electrical meters with wireless communication based on GPRS technology, which is the core of the monitoring system, is very much in line with the ongoing programme of the Electric Power Industry of Serbia, on mass introduction of remote metering for a wide range of consumers.

The project has also enabled the local electricity distribution company to gain new experiences and knowledge in the use of smart metering in municipal services, as well as to understand the impact of smart metering on EE in public use of electricity. In addition to this, the monitoring system can also be used as training equipment for technicians and engineers specialised in lighting.

Besides the above, there were several social benefits of the Varvarin Energy Clock, namely:

- The energy, CO_2, and budgetary savings made are visible for all citizens.
- Citizens consider that they can control municipal services better.
- Citizens are encouraged to more actively participate and influence municipal life.
- Placed at the central city square, the LED screen is a great location for education and awareness-raising.
- Municipal decision-makers and technicians are encouraged to initiate similar EE projects, due to the success of this project.
- The location of the Energy Clock enables many other actions (open school classes, promotions, visits by schoolchildren, technicians, politicians etc. from other municipalities, central government and international institutions) (Fig. 6.2.2.3).

Fig. 6.2.2.3 School children watching the Energy Clock

The most significant results achieved by the installation of the monitoring system are seen in public campaigning and promotion on the importance of EE for developing sustainable municipal service systems.

Since Serbia ratified the Kyoto Protocol in October 2007, GHG emissions came into the focus of public interest. So publicly displayed reduction of GHGs achieved due to these particular measures very effectively draws public attention, and increases the replicability potential of this project.

The pay-back time of the initial investment can be made visible and will be reduced with rising energy costs, which in turn should interest potential investors for new projects. Transparency of energy performance is a key incentive for stimulating the market to move on with further EE innovations. Furthermore families and private companies are continuously reminded that energy and budget savings are possible – and often more feasible than assumed. The interest generated among neighbouring municipalities shows that the project has excellent replication potential.

6.2.2.5 Lessons Learnt

Addressing the project coordination aspects were of particular interest. The project connected local self-government bodies, public utility staff, the national association of cities and municipalities, the electricity distribution company, government institutions, the equipment producer, as well as expertise from the university and the donor organization. All of these actors, for the first time, worked on such a coordinated project objective, and all now have an example of doing the same or start similar efforts. Based on experiences made, the time factor can be more easily assessed and planned for similar future projects. An experience which is likely to continue being valuable is the data acquisition and communication chain which looks as the most probable area of failures, so that further technical efforts can focus on improving system reliability.

Key replication aspects

- Modernising municipal street lighting is a relatively simple EE measure, and can only contribute – albeit usually only in a limited way – to overall energy savings. Yet the real value is the visibility of real results achieved. In this regard, and considering that many other sectors also have projects, this is an element that should be included to raise awareness and inform people. The current European Union approach towards a mandatory classification of buildings through an 'energy passport' supports this. Municipalities can take the lead in making the energy consumption of their office buildings, schools and other administration and service areas fully transparent. By using the concept of the 'municipal energy clock' in visible places on public buildings (particularly at schools), it is also an instrument to display the relevance of user behaviour on energy consumption.
- Through improved services, in line with energy savings and reduction of GHG emissions, made visible to the public, but also to local leaders, municipal energy managers and environmental non-governmental organizations (NGOs), it may be possible to campaign more successfully for a broader and more systematic approach towards municipal EE.
- Better transparency and benchmarking on EE aspects related to all kinds of municipal services could also facilitate the financing of EE investments through loans or through contracting models. One of the most effective ways for making the linkages between EE investments and related economic and environmental benefits transparent is to establish a system, which reveals this context through a constant and consistent performance monitoring in all relevant categories. By doing this publicly, visible in REAL TIME on the market place and on the internet, the project provides a basis for permanent public review. It stimulates discussion on further improvements and motivates youth groups, citizen initiatives and NGOs to think about 'what to do next'.

Acknowledgements The Varvarin Energy Clock is the result of cooperation between the Varvarin Municipality, the GTZ project 'Modernisation of Municipal Services', the Association of Serbian Towns and Municipalities (SCTM), the Regional Electricity Distribution Company and the Minel Schreder Company as provider of the installed equipment. Without the enthusiasm and whole-hearted support of the municipal leadership and professional staff, and without the genuine persistence of all individuals involved in the implementation of the project, it might have taken a longer and more uncertain path.

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Siegfried Brenke *holds a Doctorate in economics. After 7 years of Research in Housing, Urban Affairs and Environmental Economics (1972–1978) at the University of Münster, Germany, he joined the Federal Ministry for Regional Development, Building and Urban Affairs in Bonn, Germany. The work at the Ministry focused on housing policy, urban renewal, environment and international cooperation from 1978 to 1996. It was interrupted by a leave period from 1987 to 1992, when he served as Director of the Urban Affairs Division in the Environment Directorate of the Organisation for Economic Co-operation and Development (OECD) in Paris. During this period Siegfried was actively involved in the establishment of ICLEI, as a Founding Board Member. From 1996 he worked as Director of the Housing Department, State Ministry for Housing, Urban Development and Transport in Saxony Anhalt, Magdeburg, before joining the United Nations Interim Mission for Kosovo (UNMIK) in October 1999. He served as UNMIK Administrator for the City of Pristina and as Principal International Officer for the Ministry for Spatial Planning and Environment, provisional government of Kosovo. Since October 2003 Siegfried Brenke has been working with the GTZ (German Technical Cooperation) on Municipal Waste-, Water- and Energy Efficiency issues. (www.mku.rs, www.sls.rs).*

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Chapter 6.2.3
Ecological Waste Management: A Modern Waste Management Approach (Freiburg, Germany)

Edith Wild and Klaus Hoppe

Abstract Modern waste management is subject to continuous change. Legislation and regulations on national as well as European level, new technologies and constantly growing requirements for environmentally sound recovery and disposal of waste set high standards for the implementation of municipal waste management. In addition to ecological aspects, economic aspects have to be considered – the services of modern waste management should be affordable for citizens in the long term. The City of Freiburg chose the path of ecological waste management in 1991. With this aim, a highly differentiated citizen-friendly waste separation system was implemented. This waste separation system is based on hierarchical principles: the best waste management always is waste prevention (resource efficiency), followed by the recovery of as much of the waste as possible and at last its disposal according to ecological principles. Following this hierarchical model the City of Freiburg has devised concepts for waste prevention, recovery and disposal, as well as waste-to-energy – in an integrated concept.

Keywords Citizen-friendly-waste separation system • combined heat and power (CHP) • fees and financial incentives • methane • modern waste management • organic waste • Public–Private Partnership (PPP) • recovery and re-use • resource efficiency • sustainability • waste-to-energy

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Table 6.2.3.1 Freiburg municipal profile

Municipal profile	
Population	220,000 (2008)
Area	±153 km^2
Municipal budget	€710 million (2008)
eCO_2 targets	40% CO_2 reduction by 2030

6.2.3.1 Context of City

The City of Freiburg (Freiburg im Breisgau) is a medium-sized city situated in the South-west of Germany, close to the Swiss and French borders, in the Federal State of Baden-Württemberg. Geographically, Freiburg includes some surrounding villages: Ebnet, Hochdorf, Kappel, Lehen, Munzingen, Opfingen, Tiengen, and Waltershofen. This well-known city in the Black Forest region is known as a 'Solar Region", and since 2008 also profiles itself as a 'Green City' – moving beyond the concept of a solar city to also reflect other issues impacting on sustainability and high quality of life.

Some relevant issues impacting on its climate protection approach: the city has the highest level of solar radiation in Germany; about 70% of the city's building stock is old and provides a challenge in energy efficient renovation – this is also relevant to the use of energy for space heating, with district heating running of fuel from waste a topic for future expansion. The city's economic activity is mainly represented by the service sector. Freiburg draws visitors from around the globe to learn from its numerous excellent examples in various fields – from energy to transport, from buildings to waste management. Well-known for its solar energy approach and integrated transport system, the city also has a very effective waste management system.

6.2.3.2 Goals

The waste management responsibility of municipalities in Germany and across Europe is very differentiated. In recent years, well-planned waste management with an increasingly ecological focus has become more important. Legislation on European and the local level set the framework that guides implementation of modern, sustainable waste management on the community level. Environmentally-oriented municipalities tend to exceed legal regulations and offer a wide ranging waste management system to their inhabitants, particularly addressing the reduction of waste, recycling and re-using as well as waste-to-energy solutions. Many of these local activities have been pioneering, and used by legislating bodies to conceive improved legally binding framework conditions.

Freiburg's waste management shows how ecological and economic waste management can be effectively implemented, and also be citizen-friendly. Without the acceptance of its citizens, a community waste management concept that includes the reduction of waste as well as increasing the amount of recyclable waste, can not be successful. To achieve broad acceptance amongst citizens, steady public relations work and a broad choice of waste prevention and waste recovery facilities, as well as transparent waste fees, are essential. Further, waste management is subject to continuous external changes. Municipalities have to react to changes in the legal framework as well as market conditions, so concepts need to be flexible. The example of Freiburg will illustrate how these goals were achieved, focusing on energy efficiency and renewable energy solutions.

6.2.3.3 First Aim: Waste Prevention

As is the case with energy, waste prevention is the highest aim in an ecologically oriented concept of waste management. Freiburg has an integrated concept of waste prevention, which has proven to be very effective.

However, it should be clear that the commitment to waste prevention can not be ordered by the municipality but is rather a decision made by each individual – in other words a choice they make regarding their behaviour.

The city as public waste disposal authority can aim to influence citizens' awareness, by encouraging them to move away from the 'throw-away society' we have become, to responsible consumer behaviour that is focused on sustainability. For this reason the City of Freiburg strongly focuses on public relations as a tool and method for spreading information and outreach. The city's inhabitants regularly receive details about new regulations and measures, as well as general background information concerning waste management. There are annual waste disposal calendars (indicating on which day what type of waste is collected – waste separation approach), information leaflets, press releases and events. Specific questions can also be posed through a waste hotline (telephone/email), and answers to frequent questions can be found online.

An important starting point concerning a responsible attitude towards waste lies in working with children – from toddlers to teenagers. By means of appropriate programmes, a positive attitude towards the responsible handling of waste can be developed. A number of successful educational measures and projects were implemented, of which three exemplary projects are briefly outlined below:

- In 2001/2002 the project 'Kids and Agenda 21' – a competition for primary schools – was launched. The aim was to renew and intensify thinking about climate protection in a fun way by means of creating a special agenda. In this way environmentally conscious behaviour and social interaction are both encouraged, ideally also with a ripple effect to the home, leading to the questioning of consumer buying habits. The competition 'Kids and Agenda 21' was conducted in 30 primary and secondary schools and in seven schools for handicapped children.
- In 2003 a cooperation action with neighbouring communities was started with the project 'garbage is not necessarily waste', meaning that garbage is too

valuable to simply dispose of it. The aim is to recover any valuable elements to the maximum level. The outcome was an educational waste guideline that all schools in the Freiburg region now have in their reference library. In 2004 an additional focus was added, namely using recycling paper and environmentally friendly material in schools. Through direct information provided by waste consultants of the city cleaning company ASF GmbH (see below) during lessons, the pupils, teachers and indirectly the parents learn about the benefits of using recycled material. As a result, 52 classes in 12 municipal schools have changed to using recycling paper. The change was conducted in a cost neutral way for both pupils and schools.

6.2.3.4 Municipal Approach

In addition to this educational approach, further measures towards waste prevention have been implemented.

A directive was approved by the municipal Council in 1991, banning the use of throw-away crockery and beverage packaging at events organised by the city or taking place on municipal grounds. Hence reusable crockery is used for example at the annual Christmas Market and all events at the city's trade fair. Even football events of the local football team are nearly waste-free.

Furthermore, the waste management concept[1] encourages waste prevention by imposing fees on waste. Private composting and the use of non-disposable nappies are financially supported. In this way, citizens can directly profit from their activities in waste prevention. An additional measure in waste prevention is the commodity exchange. Through the collection of bulky waste (from homes) and the possibility to take this to the recycling centres, citizens can get rid of unwanted used articles. Well-preserved furniture, domestic appliances, books, etc. are then passed on to interested individuals against a small compensation fee. In this way the lifecycle of 'waste' is extended (Fig. 6.2.3.1).

6.2.3.4.1 Increasingly Important: Recovering Waste as a Resource and an Energy Source

The importance of waste recovery is rising in times where resources are getting scarcer. Garbage is not only seen as waste for disposal, but is gaining in importance as an energy source and secondary resource.

Non-avoidable waste is collected separately in Freiburg and subject to ecological recovery. Technical progress in recording, sorting and recycling has led to the increas-

[1] According to the laws for recycling management, and waste disposal and the state law for waste disposal, governing bodies have to develop a waste management concept for recovery and disposal of waste being generated in their area. The waste management concept for the city of Freiburg has been revised in 2008, and 2000 copies were published. It can be viewed on www.stadt.freiburg.de.

Fig. 6.2.3.1 Bulky waste, commodity exchange (Archive ASF GmbH)

ing importance of waste recovery. Today, organic waste, glass, paper, packaging, metal and electronic scrap, wood and cork are, among other materials, collected for recovery and re-entered into the economic cycle – according to resource-saving principles. For this recovery appropriate logistics for the separate recording of waste and recyclable materials are necessary.

In Freiburg, organic waste has been collected separately for over 10 years and is converted to compost in a fermentation plant of BKF GmbH (Biogas- und Kompostbetrieb Freiburg GmbH). The energetic recovery of organic waste is linked to the generation of energy in a combined heat and power (CHP) plant delivering electricity to more than 2,800 households. The electricity produced (in 2008 this was 8,450,000 kWh) is fed into the regional power net belonging to the utility company Badenova.

6.2.3.4.2 An Increasing Recycling Rate

Between 1992 and 2007 the amount of waste to be recycled rose from approximately 17,000 t to nearly 60,000 t. The introduction of an organic waste bin in particular led to a considerable increase in separate waste collection. In the same period, the total amount of waste for disposal (e.g. domestic waste, bulky waste and sorting residues) decreased noticeably from 52,000 to 28,000 t. When only considering the amount of residual and organic waste in 2007, the allocation was around 22,000 t of residual waste compared to 14,000 t of organic waste. This corresponds to approximately 100 kg of residual waste and 63 kg of organic waste per citizen in

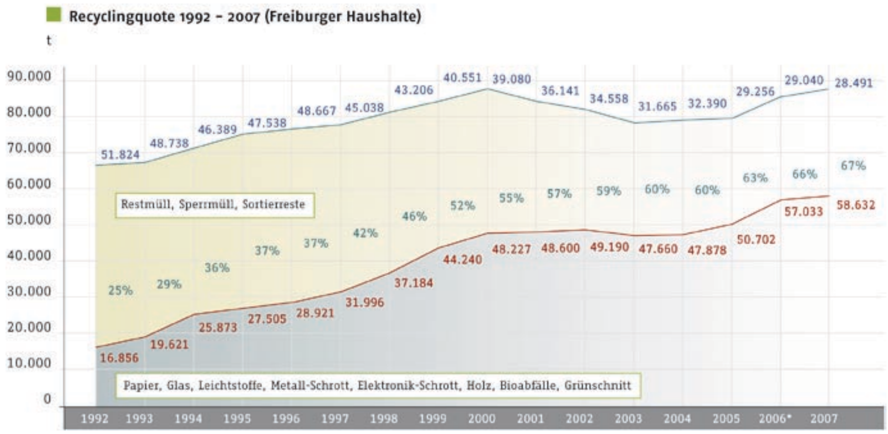

Fig. 6.2.3.2 Amount and proportion of recycled waste (red line) compared to total amount of waste (green line) between 1992 and 2007. It shows the increase of recycling, while the amount of non-recyclable material is constantly decreasing (see *Color Plates*)

Freiburg. The high percentage of recycled waste of 63.3% (2007) reflects a high acceptance for waste separation amongst the Freiburg population (Fig. 6.2.3.2).

In addition to waste collection, there are three recycling sites in the city where citizens can get rid of potentially recyclable waste free of charge: from bottle corks to paint, to electronic scrap and bulky wood. These sites are an integral part of the waste management concept.

6.2.3.4.3 Waste as a Resource

The local production of energy and using waste as a resource makes sense when seen against diminishing natural resources and rising energy prices due to imported fuels. Therefore, in addition to material recovery, the energetic recovery of waste is of increasing importance, focusing on reducing CO_2 emissions as an active contribution to climate protection and the climate-political goals of the City of Freiburg.

In Freiburg, by means of disposal and recovery of waste, the energetic potential is exploited to a maximum level. This is accomplished by:

- Using the heat of residual waste incineration for electricity and (in planning) heat generation (2007: 95,000,000 kWh)
- Making use of digestion heat for electricity generation (2008: 8,450,000 kWh)
- Making use of landfill gas (methane) for electricity generation (2007: 7,936,000 kWh/a) and the heat supply for a city district (2007: 4.599.000 kWh/a), and a recovery site of food leftovers. Further measures are under preparation, including a biogas site for the further recovery of food waste as

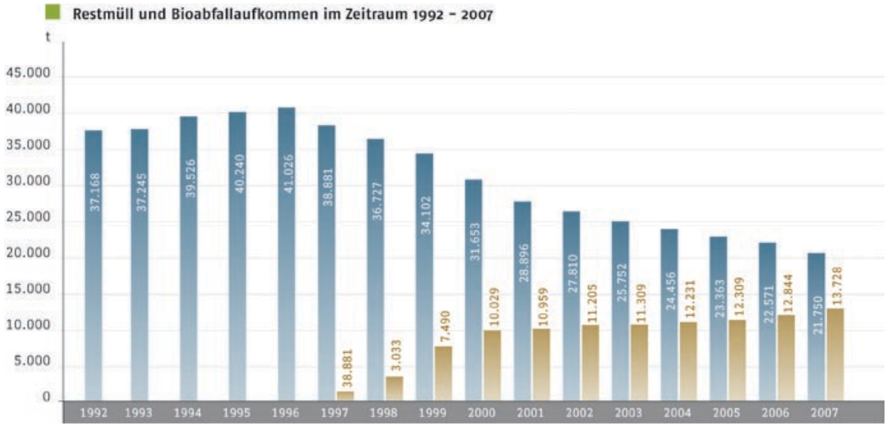

Fig. 6.2.3.3 The amount of solid waste (in blue) compared to organic waste (in brown) between 1992 and 2007, clearly shows a reduction in solid waste and higher separation leading to the collection of more organic waste (see *Color Plates*)

well as using the flammable proportion of wood cuttings for combined heat and power generation. According to the German Federal Association of the Power Supply Industries (Bundesverband der deutschen Energiewirtschaft), CO_2 emissions in Germany in the area of waste have decreased by 46 Mio tons in between 1990 and 2005. The closure of nearly all landfill sites for untreated waste in Germany (including Freiburg) in 2005 was done in accordance with the federal administrative regulation that provides technical instructions for recovery, treatment and disposal of residential waste', in particular to contribute to a reduction of greenhouse gases (especially methane) into the atmosphere (Fig. 6.2.3.3).

6.2.3.5 Use of Landfill Gas and Treatment of Waste Water

Since 1991, landfill gas has been recovered, with the mixture of gases (mainly methane) collected via a field /system of 50 gas wells from Landfill Eichelbuck, set up in 1972 and closed for dumping waste in 2005. In 2004 approximately 80,000 t of waste was dumped here. With the legislation to close the site, a number of other measures for the shutdown, recultivation and after-treatment were implemented to minimise environmental hazardous influences. The recovery of gas continues, and the extracted gas is fed into a gas cogeneration plant in a nearby city district. The aim of this de-gasification is to:

- Avoid uncontrolled gas discharge into the atmosphere – an important contribution to climate protection.
- Save fossil fuels by using landfill gas.

- Reduce greenhouse gas emissions.
- Improve the energy yield by combined heat and power generation.

The emerging gas can be recovered to 90%, and 3,400 households are heated and 5,800 households are provided with electricity. To avoid pollution of the groundwater the wastewater is filtered by means of a bioreactor, with organic parts used for composting.

Over a period of approximately 14 years, closing down measures will be implemented on the landfill site. This includes sealing the surface, recultivation and greening of the site. After-treatment will start in 2020 to ensure the safety of the landfill. This includes supervision and inspection of the site and all its facilities. With organic decomposition decreasing over time and sealing the landfill site surface by 2020, the release and capture of methane will keep on reducing.

6.2.3.6 High-Tech Incineration

In agreement with the legal ordinance that waste must not be disposed of in landfills without having been treated beforehand, since November 2004 Freiburg's household and industry waste is thermally treated and disposed of in a thermal treatment and energy recovery plant, TREA Breisgau (Thermische Restabfallbehandlungs- und Energieverwertungsanlage), based outside Freiburg. This site was established in close cooperation with surrounding rural areas to achieve a joint ecologically friendly and economically viable regional waste disposal. To this aim, a joint association for waste management was founded – Abfallwirtschaft Breisgau – to find appropriate technology and an operator through a European-wide call for tender.

The waste incineration technology of TREA Breisgau satisfies recent environmental standards (Verordnung über Verbrennungsanlagen für Abfälle und ähnliche brennbare Stoffe – BimSchV 17 vom 20.08.2003 – regulation on incineration sites for waste and combustible drapery) and combines safety, cost effectiveness and environmental friendliness in a technically modern way. 1.3 Million people live within reach of this disposal plant, meaning residual waste from these households, local businesses and industry can be handled. In TREA Breisgau approximately 150,000 t of household and industry waste can be treated thermally. In this way TREA Breisgau is the backbone of disposal security of urban waste. The City of Freiburg has by contract secured 29,000–52,000 t for a fixed price until 2030.

Energy that is produced through incineration can be recovered for district heating and electricity. Currently the amount of electricity fed into the public network is sufficient to provide 25,000 households with electricity (95,000,000 kWh/a). It is planned to also use the generated heat thermally (CHP) in order to increase efficiency. A four-step waste gas purification ensures that external environmental standards are met. Currently, the emissions released are below these national standards by a factor of 50%. For TREA Breisgau, a logistical concept was developed to transfer large amounts of waste using the railway system and to relieve surrounding communities of waste transport on trucks.

Today, not even the most modern waste incineration plant is free of residual waste. Ash generated corresponds to approximately a quarter of the original amount of waste by weight, and about 1/10th of the original amount by volume. To use this ash a non-profit organisation for ash recovery was established in 2003. Its aim is to reuse the ash to cover regional landfill sites, which are being closed.

6.2.3.7 Public–Private Partnership: Organisation of Waste Management Since 2000

In 2000 the city decided to partly privatise municipal waste management, and created the city waste management and cleaning company Abfallwirtschaft und Stadtreinigung Freiburg GmbH (ASF).

This Public–Private Partnership (PPP) was decided on for several reasons, namely economic optimisation while maintaining environmental standards and retaining political control to ensure the proper strategic direction. It helped to reduce the financial burden on the municipal household, with further benefits including stable prices and the security of jobs. Additionally, a new company in the region was established, with the potential to expand activities further.

The most important political coordination instrument is a framework agreement between the city and the company valid over a period of 20 years. The regulation of tasks transferred to the private company is arranged in accordance to individual contracts in combination with a catalogue of services being updated every 5 years. The City of Freiburg still takes full responsibility for waste management, the calculation of waste fees, control of the compliance of contracts with ASF and regional cooperation.

In 2002 some of the municipal shares 47% of municipal shares of ASF were sold to private investors. Since February 2008, Remondis, a large German waste disposal company, is sole owner of these shares. The municipal majority ownership of ASF by 53% is conserved and guarantees continuation of the direction and quality of waste management in Freiburg.

6.2.3.8 Fees on Waste Disposal: Reimbursement for an Extensive Service

Freiburg has been debating the idea for a household-specific waste fee system for quite a while. Such a fee would imply that every household is entitled to an own container for residual waste. Citizens can choose the size of their disposal containers and the frequency of the waste collection (weekly, fortnightly) according to their needs. Through waste prevention and accurate waste separation, the amount of waste fees can be influenced. Those, who ‘produce less’ pay lower waste fees. A minimal volume per person is the only limit to this, namely at least 5 l of waste have to be disposed of per person per week to cover fixed expenses. In addition, it is possible for several households to build a 'disposal society' and share fees for a container.

In addition to the disposal of residual waste, these fees also cover a number of other services. Freiburg's waste management offers its citizens an above-average and very comfortable offer: organic waste containers are emptied once a week all the year around and cleaned twice a year. This measure ensures hygienic standards and leads to broad acceptance as a solution amongst Freiburg's citizens. However, due to the need for waste incineration and transport, costs are higher when compared to previous disposal in landfills. Freiburg's waste fees are average compared to other German cities, while its offer is very wide-ranging and conducted at a high technological and ecological level. The annual costs of waste management in Freiburg amount to €21 million.

6.2.3.9 Results

The City of Freiburg started its environmentally friendly waste management in 1991 and recognised waste prevention as a priority. The continued reduction in the amount of residual waste collected is an indicator of success. This development, which can be attributed to acceptance and action of Freiburg's population, has led to an increase of the quota of recycled material from 25% (1992) to 67.3% (2007).

Freiburg's waste management approach has thus proven to be both ecologically and economically worthwhile. In the future, waste prevention will also be preferred to waste recovery, which in term will be preferred to waste disposal – the hierarchy approach. The increased importance of waste as a resource and energy source has a decisive influence on Freiburg's waste management and energy approach. It is an integral part of sustainable city development and locally contributes to resource conservation and climate protection.

6.2.3.10 Lessons Learned

Freiburg's waste management concept went through many phases of development during the last 15 years in which waste prevention and waste recovery became priority. Here it is very important to acknowledge the needs and habits of citizens, for example:

- How far are people prepared to walk to dispose their glass waste? This is a question concerning their acceptance of delivering waste themselves.

- What size should the residual waste container be to ensure it does not indirectly provoke illegal dumping (i.e. small enough to make it useful, large enough not to be inefficient)?
- How many recycling sites are reasonably needed, what can be disposed here and what kind of control is advisable to prevent misuse?
- How can organic waste be collected separately within a city and how can sanitary problems during summer be avoided?

Many of these aspects of Freiburg's waste disposal management developed over the years and were optimised step by step. When starting some new collection systems, for example organic waste, these were first tested in pilot areas before being introduced throughout the city. For other new approached, experiences of other cities were studied. The result today is a widely differentiated, citizen-friendly waste separation, -collection, and -use system. To retain this high level, waste as resource and source of energy will increasingly become important.

Key replication aspects

In addition to legislation and regulations locally specific aspects play a major role when developing and optimising a waste management concept. The first and most important step is to conduct an inventory, which should be supported by research, addressing:

- Which systems of waste management already exist and might be integrated?
- What amount of waste is produced (e.g. per capita?)
- Which climate related and habit related aspects of the population need to be considered?

Following this, a concept, possibly within a political or theme-specific target, can be developed integrating questions such as:

- How can different municipal areas best be served?
- Where does it make sense to have collecting posts and for which types of waste?
- How differentiated should collection be handled?
- What kind of organisational structure should be chosen for waste management?

It is also advisable to follow the development and refinement of the strategy by employing professional guidance, develop practice-oriented models and integrate these early and transparently into administrative, political and civil decision processes.

Change in waste management following legal amendments or economic developments, was mentioned at the start of this article. This does not always have a positive impact on municipal waste management. The liberalisation of industrial waste has led to higher fixed prices of waste management, which in general have to be paid for by citizens. Therefore, municipalities have to keep in mind the boundaries of financial capacity, and try to find solutions that have a wider impact.

Due to constantly advancing technologies in the area of sorting but also in less wasteful packaging, public collecting systems have to be re-checked regularly for ecological and economic impacts and feasibility.

Reference

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Edith Wild *studied public management 1990–1994 at the Kehl University (Verwaltungsfachhochschule). On finalising her studies she has been working for different departments within Freiburg's city administration. In 2006 she joined the municipal waste management department. Her focus is the waste management concept of the city of Freiburg and its presentation to the public.*

Klaus Hoppe *is a geographer. He obtained his degree from the University of Saarbrücken, Germany, with main focus on city planning and development as well as climate geography. He has been the Head of the Energy Department in Freiburg since 2001, and in this context is responsible for the implementation of city's climate protection goals. In particular, he addresses the development of instruments and projects towards energy efficient city development, which includes the coordination within administration itself as well as all important stakeholders. Concurrently, as one of the Directors of the Waste Management Unit, he is responsible for the development and implementation waste management strategies and conception including business plan and regional cooperation. Before this, working for a rural district, he initiated the Local Agenda 21 process and directed the waste management unit. Furthermore he cooperates with several city networks concerning energy supply and climate protection and works as a consultant for municipalities implementing concepts in the fields mentioned.*

Chapter 6.2.4
The Minewater Project Heerlen: Low Exergy Heating and Cooling in Practice (City of Heerlen, The Netherlands)

Peter Op't Veld and Erwin Roijen

Abstract In Heerlen, the Netherlands, warm and cold water volumes from abandoned mines will be used for heating and cooling of buildings, based on a low exergy energy infrastructure. The combination of low temperature heating and cooling emission systems, advanced ventilation technologies and integrated design of buildings and building services provide an excellent thermal comfort and improved indoor air quality during 365 days/year, combined with a CO_2 reduction of 50% in comparison with a traditional solution. In the Remining-lowex project[1] four ambitious local communities, namely Heerlen (The Netherlands), Zagorje (Slovenia), Czeladz (Poland) and Burgas (Bulgaria), intend to demonstrate the use of locally available low valued renewable energy sources (RES), specifically water from abandoned mines for the heating and cooling of buildings. The system is based on low energy principles, and is facilitated by an integrated design of buildings and energy concepts. They will realise two sustainable mining communities (Heerlen and Zagorje) with between 50% and 100% carbon dioxide (CO_2) reduction and a 60% increase in energy supply from renewable energy sources (RES) compared with standard national practices. The two demonstration sites have 440 new houses, 57,000 m^2 (square metres) of non residential new buildings, 84,500 m^2 of existing non-residential buildings, and three existing prepared buildings that will connect with the minewater grid in Heerlen, and 6,000 m^2 of new and 2,000 m^2 existing buildings connected to minewater and 1,154 existing houses connected to biomass in Zagorje. Feasibility studies leading to concrete local sustainable energy

[1] http://www.remining-lowex.org/

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plans and implementation will be conducted in Czeladz, Burgas (Cherno More), Zagorje and the former mining communities in Heerlen.

Keywords Abandoned mines • advanced ventilation technologies • feasibility studies • heat and cold storage • heat pumps • heating and cooling of buildings • intelligent energy management system • improved indoor air quality • integrated design of buildings and energy concepts • local energy stations • low valued energy (low exergy)

6.2.4.1 Heerlen in Context

Nestled in the foothills of the Limburg Downs and the German Eifel region, Heerlen expanded outwards from the mining communities that surrounded the various coal pits dotted throughout the area. The mining industry spurred Heerlen's growth. Within just a 100 years it had transformed itself from a small collection of hamlets with about 6,000 inhabitants into a city of 90,000. This unusual history and its situation in two stream valleys have turned Heerlen into a city in which modern architecture and facilities are intertwined with green landscape features (Table 6.2.4.1).

Table 6.2.4.1 Heerlen municipal profile

Population	90,125 (2007)
Area	45.50 km^2
Municipal budget	Circa €300 million (2007)
eCO_2 targets	20% reduction in 2020 (baseline 1990)

6.2.4.2 From Abandoned Mines to Energy Resource and Storage

Abandoned and flooded mines have a high potential for geothermal utilisation as well as heat and cold storage of water volumes in remaining underground spaces. The use of heat and cold from minewater is one of the important aspects of rational and sustainable utilisation of post-mining infrastructure and may bring positive socio-economic results, social rehabilitation and improved health for communities living in European areas with (former) mining activity. In Heerlen, the Netherlands, the redevelopment of a former mining area, including a large scale new building plan, is being realised with a low exergy infrastructure for heating and cooling of buildings, using minewater of different temperature levels as a sustainable source. Mines have large water volumes with different temperature levels. In Heerlen the deeper layers, about 700–800 metres (m) have temperatures of ~30 degrees Celsius (°C);

shallow layers (200 m) of 15–20°C. These water volumes can be considered as heat/cold storage as well as geothermal sources. Most crucial however is that these sources provide low valued energy. As on the demand side, heating and cooling for buildings also require low valued energy and the intended design strategy is to realise the climatisation of the buildings in this pilot preferably directly by minewater. The combination of low temperature emission systems with advanced ventilation technologies and integrated design of buildings and building services provide an excellent thermal comfort for 365 days a year, including sustainable heating and cooling and improved indoor air quality. This sustainable energy concept gives a reduction of primary energy and CO_2 of 50% in comparison with a traditional concept (level 2005). The Heerlen minewater project[2] is funded by the European Commission (EC) Interreg IIIb, the 'Unieke Kansen Regeling' (UKR) programme of the Dutch Ministry of Economic Affairs and the EC 6th Framework programme (FP6).

6.2.4.2.1 The Energy Concept

The minewater energy concept in Heerlen is basically as follows. Minewater is extracted from four different wells with different temperature levels. In the concession of the former ON III mine (location 1 Heerlerheide) mining took place to a level of 800 m, where warm wells (~30°C) can be found. In the former ON I mine (location 2 Heerlen SON) mining took place to a level of 400 m and here the relatively cold wells are situated. The extracted mine water is transported by a so called primary energy grid to local energy stations. In these energy stations heat exchange takes place between the primary grid (wells to energy station) and the secondary grid (energy station to buildings). The secondary energy grid provides low temperature heating (35–45°C) and high temperature cooling (16–18°C) supply and one combined return of minewater (20–25°C) to an intermediate well (Fig. 6.2.4.1).

The five well locations and energy stations will be connected by a system of three pipelines of 7 kilometres (km) each. Warm water is transported from the warm wells at the north and cold water is transported from the shallow wells at the southern region to the energy stations. Return water of 20–25°C is transported to an intermediate well (depth 450 m) and re-injected into the former mines. The temperature levels of the heating and cooling supply are 'guarded' in the local energy stations by a polygeneration concept, consisting of electric heat pumps in combination with gas fired high-efficiency boilers. The surplus of heat in buildings (e.g., in summer, cooling, process heat) which can not be used directly in the

[2] http://www.heerlen.nl/smartsite.dws?id=39949

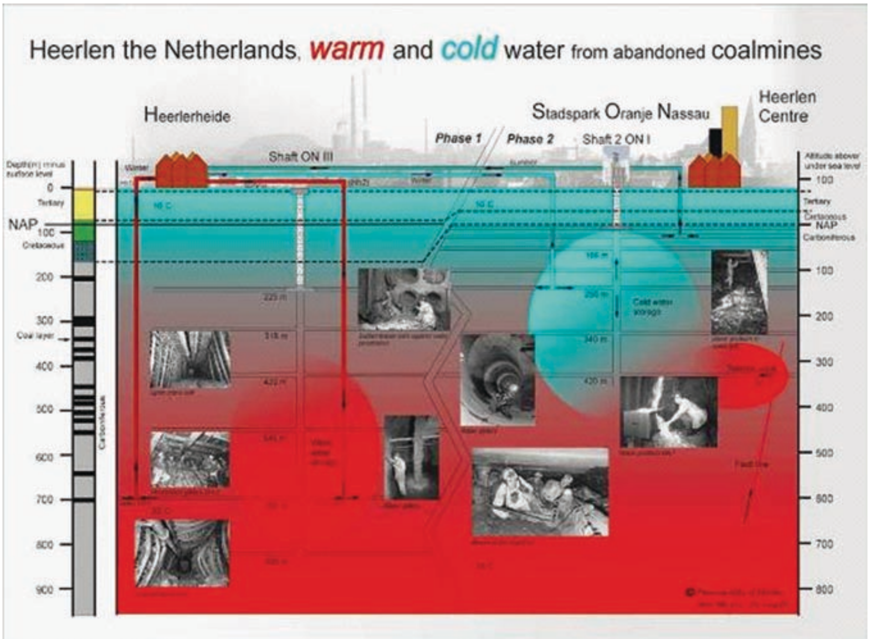

Fig. 6.2.4.1 Schematic cross section of the underground conditions of the ON I and ON III mines (From Municipality of Heerlen) (see *Color Plates*)

local energy stations can be led back to the minewater volumes for storage. Domestic hot water (DHW) is prepared in local sub-energy stations in the buildings by heat pumps, small scale Combined Heat and Power (CHP) or condensing gas boiler, depending on type of building and specific energy profile. The total system is controlled by an intelligent energy management system, including telemetering of the energy uses/flows at the end-users. A scheme of the total concept is given below (Fig. 6.2.4.2).

6.2.4.2.2 Integrated Design Approach Versus Traditional Approach

The present development of energy efficient buildings increasingly requires an integral design approach. A few decades ago energy efficient design and building mostly focussed on improving a certain technique or technologies. Today an energy efficient building, supported by an energy efficient installation, has to be combined into a single integrated energy efficiency concept with optimal performance in terms of indoor climate, thermal comfort, the user's satisfaction, etc. This requires

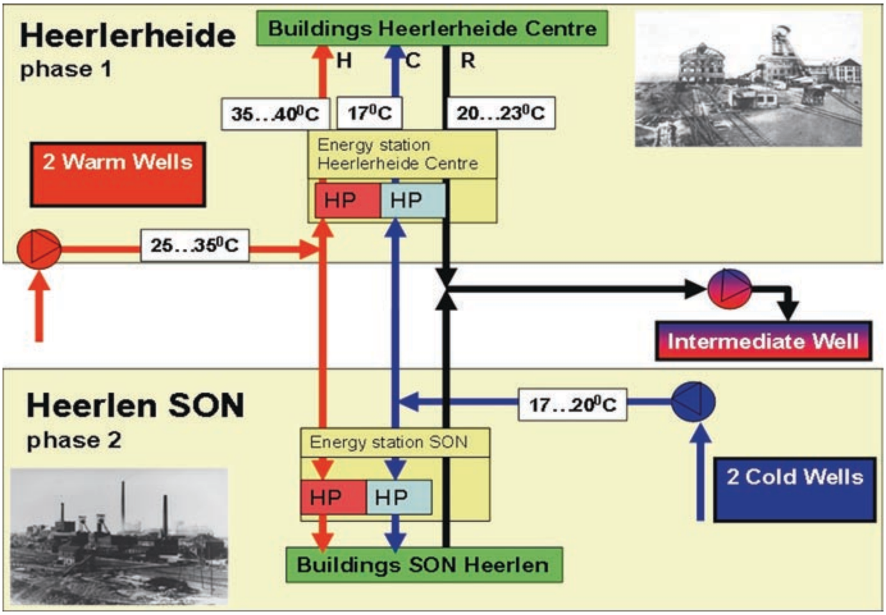

Fig. 6.2.4.2 Schematic view of the energy concept in Heerlen, connection of the wells and energy stations (see *Color Plates*)

an integral design approach where well balanced choices are made. It means that, in sustainable building projects, it is crucial to consider the design, the realisation of energy sources, heat generation (especially with non-traditional solutions such as heat pumps, cogeneration, heat/cold storage) and distribution, as well as emissions – all together, including all possible interactions with the building, building property and building users. Only with such an approach can a set of well defined performance criteria be developed concerning energy performance, sustainability, indoor air quality, thermal comfort (365 days/year, winter and summer conditions) and health. Furthermore it is necessary to place a specific emphasis on investments and energy exploitation, as well as communication to the end-users. A traditional approach is often based on the partial optimisation of different disciplines. An integrated approach will achieve total optimisation, taking into account all disciplines and their interaction.

The basis for design is a set of unambiguous well-defined performance criteria. The design strategy applied in this approach is the so called 'Trias Energetica'. It is a three-step approach that gives a strategy to establish priorities for realising an optimal sustainable energy solution, containing the following steps:

- Step 1: Limitation of energy demand
- Step 2: Maximizing share of renewables
- Step 3: Maximizing efficiency of using fossil fuels for remaining energy demand

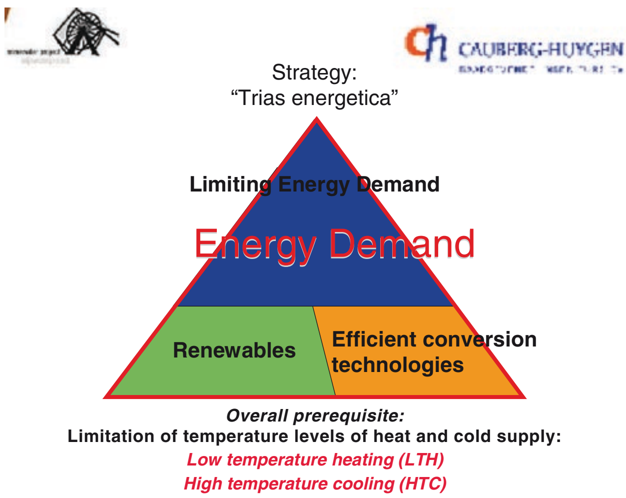

Fig. 6.2.4.3 Design strategy 'Trias energetica' (see *Color Plates*)

With the overall prerequisite to be considered - limit temperature levels of heat and cold supply (conform to the 2nd law of thermo dynamics) (Fig. 6.2.4.3).

In general the heating and cooling of buildings can be realised with very low valued energy, with medium temperatures close to required room temperatures. The better the building properties (extreme high thermal insulation, high air tightness, and a suitable emission systems) the closer the temperatures of heat and cold supply can be to room temperatures. In order to utilise these moderate temperatures for heating and cooling the buildings must comply to a number of boundary conditions such as:

- Limitation of heat losses ($U_{envelope} < 0.25$ W/m^2.K, $U_{windows} < 1.5$ W/m^2.K)
- Limitation of ventilation losses and peaks by air tight building (n50 < 1.0), mechanical ventilation with high efficiency heat recovery or state of the art demand controlled hybrid ventilation systems
- Limitation of solar and internal gains to limit cooling loads, integrating shading and sun blinds in architectural design
- Application of combined low temperature heating and high temperature cooling emission systems (thermally activated building components, floor and wall heating).

For some functions higher temperatures will be necessary, such as domestic hot water (DHW). Also lower temperatures can be required for certain functions (e.g. high cooling loads for some types of buildings or dehumidification of supply air). Another aspect to be taken into account is that the use of geothermal energy and heat/cold storage as such does not cover electricity use/sustainable electricity generation. Therefore additional sustainable solutions have to be taken into account. Sustainable electricity generation can be realized by cogeneration such as biomass CHP. This combination can also deliver higher temperatures for DHW (Fig. 6.2.4.4).

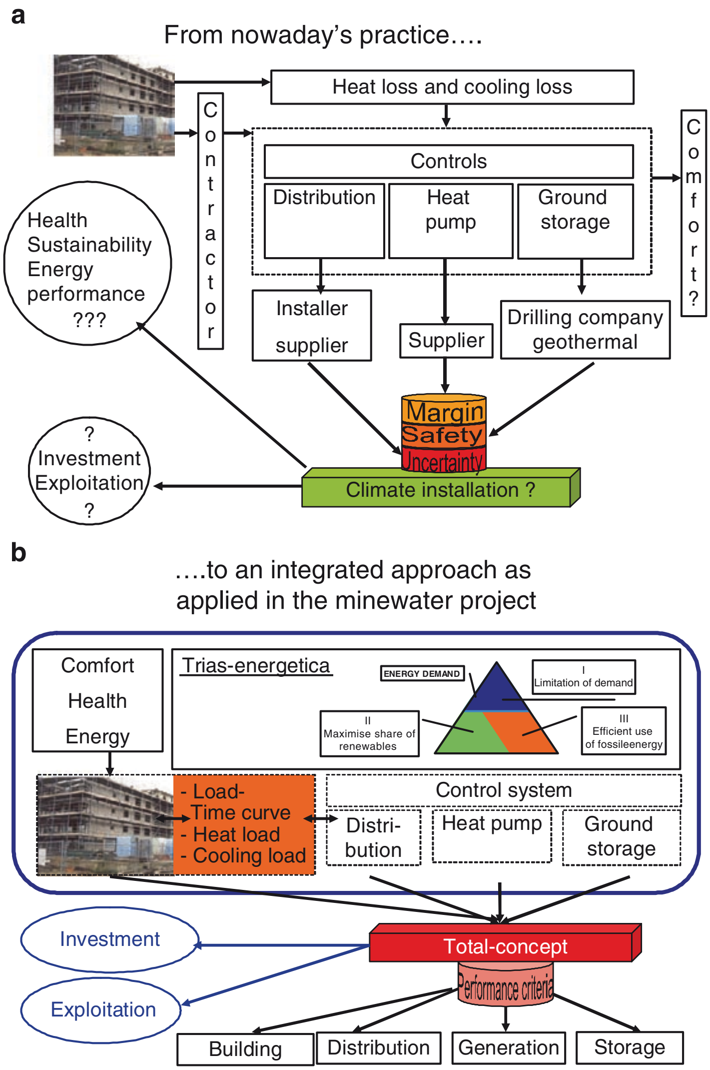

Fig. 6.2.4.4 From a traditional to an integrated design approach (see *Color Plates*)

6.2.4.3 The Demonstration Locations

There are three main demonstration locations in Heerlen:

- Heerlen Heerlerheide Centre
- Heerlen centre SON (Stadspark Oranje Nassau)
- Heerlen centre head office of ABP (Dutch state pension funds)

The locations at the centre of Heerlen will participate in the Minewater project, while Heerlerheide Centre is completely 'minewaterproof' at the moment.

6.2.4.3.1 Location SON

The development of Stadspark Oranje Nassau (SON) has a strategic significance for the social and economical rehabilitation of Heerlen. This plan will be realised in combination with sustainable mobility and accessibility. The total programme contains the realisation of approximately 100,000 m^2 of new buildings (offices, shops, residential, school and a hotel) and the renovation of a large existing office building (43,500 m^2) of the Dutch Central Office of Statistics.

6.2.4.3.2 Location ABP Head Office

This location concerns the retrofitting of the ABP head office of 41,000 m^2. The total building envelope is retrofitted to a level better then the current values for new buildings of the Dutch Building Decree. The minewater will be used for comfort heating and cooling, i.e. low temperature heating and high temperature cooling in all offices. The ABP building will have a direct connection to the minewater wells and will have its own energy station to provide the required temperature levels for the distribution net. The energy station will have heat pumps. The emission systems in the offices are climate ceilings. Special glazing will be used to limit solar radiation in summer; this makes it possible to use high temperature cooling.

6.2.4.3.3 Location Heerlerheide Centre

This plan is situated on the concession of the ON III pit in a relatively deep mined area with warm wells of about 30°C. The plans include the following activities for *new buildings:*

- 33.000 m^2 (330) dwellings (single family dwellings and residential buildings)
- 3.800 m^2 commercial buildings
- 2.500 m^2 public and cultural buildings
- 11.500 m^2 health care buildings
- 2.200 m^2 educational buildings

The first new building and construction activities in Heerlerheide Centre started in 2006. The complete plan will be realised between 2006 and 2011. All planned buildings will be connected to the energy supply (heating and cooling) from minewater.

All these buildings are planned in a very compact area which is very favourable for energy distribution. The building location is situated between two warm wells. In addition to this, the planned building functions require heating as well as cooling. The location of the wells has been determined as a result of geological research. The drilling of the warm wells took place from February to June 2006. The two warm wells and the first primary grid (i.e. the connection between the two warm wells) was completed in June 2006, followed by a successful testing in July (Laenen et al. 2007; Swart 2006). The cold wells in the southern region are drilled from August to October 2007 (Van Tongeren et al. 2007). The energy supply includes the construction of an energy station and a small scale distribution grid from this station to the buildings. In the energy station the minewater is brought to the necessary heating and cooling temperature levels by heat pumps. In order to facilitate the process and to guarantee all real estate developers, involved in this building plan, the delivery of energy to the buildings the main investor, housing corporation Weller, is realising the exploitation of the energy supply, including the building and construction of the energy station and distribution grid. It is important to realise, that with minor modifications this energy supply can also be functional and operational without the application of minewater (Fig. 6.2.4.5).

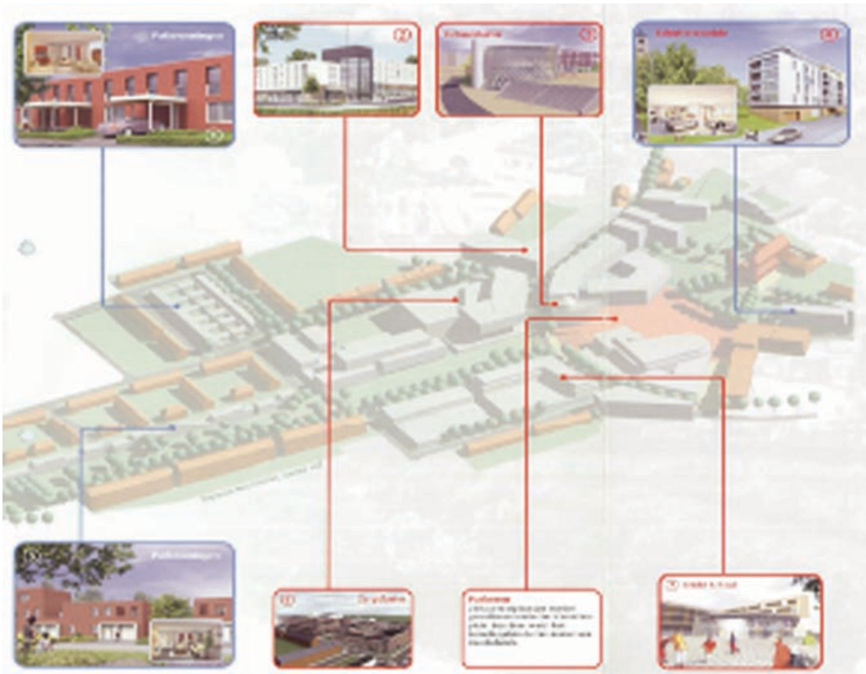

Fig. 6.2.4.5 Impression of location Heerlerheide (From Weller) (see *Color Plates*)

6.2.4.4 Balancing Supply and Demand Side

For the elaboration of the final energy concepts the following questions had to be answered:

- What is the total heating and cooling demand, how to control and limit this demand?
- What are the target values for percentage of renewables in total energy demand?
- What is the available amount of renewable energy from minewater (i.e. how much water can be extracted) and other renewables?
- What is the most efficient conversion technology for the (not sustainable) back-up system?

This input is necessary for the integrated design process, including buildings, sources and energy systems, distribution and emission systems. An important tool for the assessment of this process and balancing demand and supply side is the so-called 'energy profile' of a building, expressed in a load-duration curve, based on dynamic software calculations (using the transient systems simulation programme called TRNSYS) of the energy demands of the buildings. This curve is a profile representing the energy demand over a whole year, including heating and cooling demand. This curve provides a good indication of the maximum capacities for heating and cooling, as well as the balance between heating and cooling demand. Important for balancing the supply and the demand side is the tuning and balancing between the cold and heat sources, in this case, the deep (warm) and shallow (cold) wells. This assessment takes place in relation to the required temperature levels, the yearly extracted volumes and the energy demands of buildings; this in relation to the available water volumes in the reservoirs. The load duration curves give important information about:

- The balance between cold and heat demands
- The effect of optimisation (e.g., limiting heat losses by thermal insulation or heat recovery, etc.)
- The way how to limit the installed capacity of heat pumps, CHP and other heat generation, and, on the other hand, how to increase the number of operation hours, in combination with storage, to increase the efficiency and to decrease investment costs.

In order to establish a balance between the rational use of energy needs on the building side and the renewable energy supply a total annual heat-load duration curve of the total building plans in Heerlerheide Centre and SON is calculated by dynamic simulations with TRNSYS. In Figure 6.2.4.6 the combined heat-load duration curve for Heerlerheide is shown.

Peak heating power is about 2.2 megawatt (MW); this is about 20% lower than calculated with traditional heat loss calculations, and can be explained by the internal gains and heat accumulation as taken into account only in the

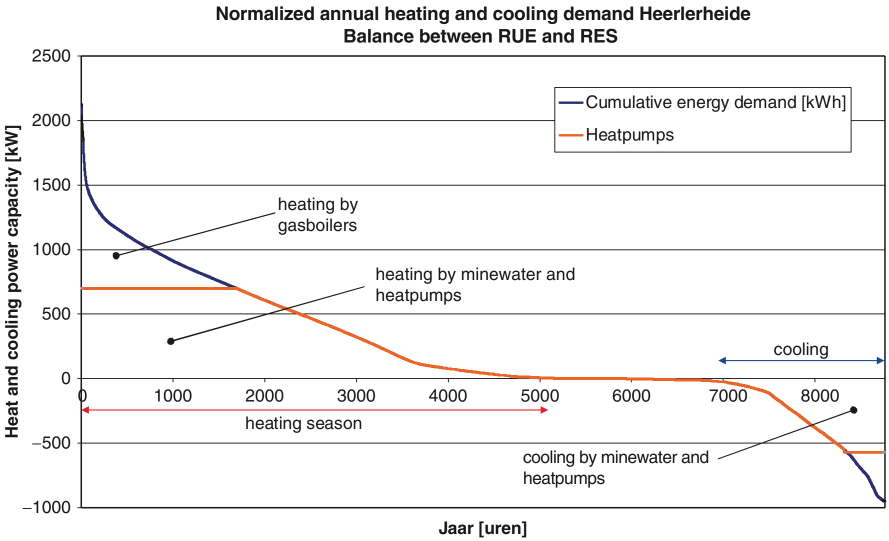

Fig. 6.2.4.6 Annual load-duration curve Heerlerheide (see *Color Plates*)

TRNSYS calculations. The four heat pumps in the Heerlerheide energy station will have a combined peak capacity of 700 kW_{th} and thus covering up to 80% of the annual heat demand. Due to the small temperature step, the average coefficient of performance (COP) of the heat pumps is ~5.6, but can rise up to eight under favourable circumstances. A total heating capacity of 2.7 MW gas-fired condensing boilers will be installed as back-up and for peak moments (20% annual). The heat-load curve also shows a period of ~2,000 h/year without any heating or cooling demand. The maximum cooling demand is ~1 MW and can be mainly covered by the minewater and inversed heat pumps. The heat and cold of the energy station are supplied to the individual buildings by district heating. The supply temperature for floor heating depends on the outdoor temperature and will be maximum 45°C to −10°C outside. The calculated seasonal average supply temperature will be 35°C, and thus fits perfectly into the principle of 'very low heating'. DHW is prepared by preheating the cold tap water with the supply for central heating and after-heated to 70°C with condensing high-efficiency boilers. In this way, the minewater heat pumps preheat about 30% of annual demand for DHW (see Fig. 6.2.4.7).

All the dwellings at Heerlerheide will have floor heating and cooling. This requires good information to the habitants about the typical thermal behaviour of floor heating and –cooling, including the restrictions on tapestry. The ventilation of all dwellings consists of mechanical supply and exhaust with high-efficiency heat-recovery (η = 90%). Commissioning of these systems is important to get properly functioning heating, ventilation and cooling (HVAC-systems) under all circumstances. The lack of a infrastructure for natural gas forces the habitants to electric cooking, a non-traditional solution in the Netherlands.

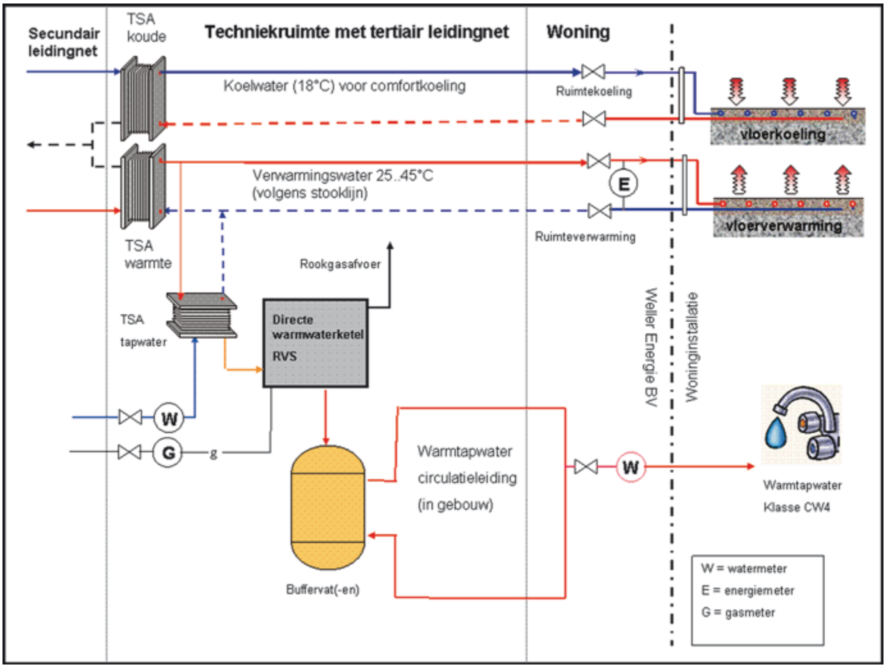

Fig. 6.2.4.7 Energy concept Heerlerheide (see *Color Plates*)

6.2.4.5 Economic Feasibility

Despite the rather high level of investments for the energy installations and buildings measures, this concept can be economically feasible for private organised energy exploitation. In this case, the main investors will also organise the energy exploitation, i.e. in separate privately owned Energy Exploitation constructions. These private companies can use lower internal interest rates, 6–8% instead of the usual 12–15% of utilities and district heating companies. The main reason is that profits generated from selling energy is not considered to be their core business. By establishing connection fees for heating and cooling and avoiding a gas infrastructure on building/dwelling level, as well as avoiding extra cooling installations, these constructions offer possibilities for economically sound energy exploitation.

Economic benefits will also occur because of the integrated design and especially combining heating and cooling in the same emission system (i.e. floor heating and cooling, thermally activated building components, etc.). Using these combined emission systems avoids the investment costs for a separate cooling system. The economic value of the heat and cold out of the minewater is expressed in a giga Joule-price and is determined by three factors:

- Running costs of the minewater company, including electricity for the well pumps and transportation, maintenance, replacements and administration
- Costs of the upgrading of the low valued heat and cold by the heat pumps and gas fired boilers
- The reference energy bill of the end-user as a limit

The first and second cost factors are estimated from the load-duration curves and hydraulic calculations. On the other hand, the end-user will probably compare his energy bill to that of a similar dwelling with conventional heating. The calculations of the reference energy-costs are subject to many discussions and points of view, due to different interests. Basically, for the Minewater project, the reference energy costs (including conventional cooling) are calculated at the level of the actual building decree. The individual consumption of cooling is not metered, but charged at a fixed rate. In this way, metering costs are avoided, habitants start cooling as early as possible to get a maximum effect out of the limited capacity of the floor cooling, and as much as possible heat is returned into the mines (heat storage). A standard or general tariff for low-exergy cooling is not yet available in the Netherlands. Essential for the economic study is the distinction between the variable and fixed costs. This ratio should be roughly equal for supplier and buyer.

6.2.4.6 Conclusions

Abandoned and flooded mines can be reutilised for a new sustainable energy supply for heating and cooling of buildings. The Minewater project in Heerlen shows that temperatures of ~30°C can be found at 700 m; the temperature of the shallow wells is to 15–18°C at 250 m. These temperatures can be used for heating and cooling of buildings, if these buildings are very well insulated, have energy efficient ventilation systems and have emission systems suitable to operate with moderated temperatures, like floor heating or concrete core activation. Despite the rather high investment costs, such projects can be economically profitable by avoiding additional cooling systems and by integrated design, and, if energy exploitation is organised by the investors. The pilot has yet ended and the project is scaled up to include extra buildings. This requires a reliable and efficient distribution system that lasts for at least 30 years, and therefore extra measures are taken like leakage detection and specific materials to prevent scaling and corrosion in the piping.

A important recommendation is to locate the wells as close as possible to the end-users, thus reducing the potential need for necessary permits (archaeological, flora and fauna, civil infrastructure) and costs for transport pipes. Another main recommendation is to integrate the Low-ex concept already in the first drafts of the building design, and continue convincing the building parties that it is a sound concept, with regard to the actual building design. A strict separation should be made between the distinct temperature levels for heating, cooling and DHW on the one hand and seasonal influences at the other hand. The Remining-lowex project, as a follow-up of the minewater pilot, focuses on these points from an exergy point of view. Further expanding of the concept in former mining regions is one of the aims.

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Chapter 6.2.5
The Province of Rovigo Supporting Municipalities with Local Climate Action

Federico Saccardin and Luigi Ferrari

Abstract The European Climate Conference Rovigo 2008 'Climate Protection and Renewable Energy: Medium and Small Communities facing the Challenge', provided a platform for small and medium sized communities to share their views and learn from one another on the topic of local climate action. Leaders in at the provincial level of government of the Province of Rovigo recognised the need to support municipalities with climate protection activities, as many of them do not have the capacity to act. It was decided to have a particular focus on the roll-out of photovoltaics (PV) in municipal buildings in the province.

Keywords Additional economic costs • Conto Energia (the Energy Bill) • cost of inaction • grassroots participation • international climate dialogue • local climate action • local renewable energy sources • photovoltaics (PV) • small and medium sized communities • the 'climate factor'

6.2.5.1 Context of the Province

The Province of Rovigo has 50 municipalities in its geographic region. The capital of the Province is the city of Rovigo (45°4' North latitude and 11°47' East Longitude), with 51,300 inhabitants. It is sited seven metres above sea level.

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The territory is bordered by the two largest Italian rivers, namely the Adige and the Po rivers, with the Regional Park of the Po Delta is situated on the latter (Table 6.2.5.1).

When considering local natural resources, these are mainly solar energy and residual biomass coming from organic crops. Italy has excellent solar radiation – between (measured by impact on the ground) 1,100 and 1,700 kilowatt hours per square meter per year (kWh/m^2) a year. Energy produced by photovoltaics (PV) is on average 1,100 kWh/kWp (kilowatt peak) in the north and 1,500 kWh/kWp in the south. The average solar radiation in the provincial territory of Rovigo is 5,088 MJ m^2/year (1,410 kWh/m^2 a year). The territory is mainly used for agriculture, mostly growing food crops.

The Province of Rovigo, on recognising the impact of a number of key events held for European local governments – including the Aalborg[1] (2004), Stockholm[2] (2006) and Seville (2007) Conferences[3] – decided to host the biennial climate conference within the framework of ICLEI's Cities for Climate Protection (CCP) Campaign, to focus on the importance of local climate action in smaller communities.

This European Climate Conference Rovigo 2008, entitled 'Climate Protection and Renewable Energy: Medium and Small Communities facing the Challenge', was one of several events linked to the Local Government Climate Roadmap, and supported the process leading up to the 15th Conference of the Parties (COP 15) in Copenhagen in December 2009. The President of Rovigo Province, Federico Saccardin, recognised the need such a conference and for Rovigo to host it, to give small and medium communities an opportunity to share their views on challenges they face from a climate protection perspective. These communities are often neglected in international dialogues, and need a platform to get together, learn and exchange ideas and motivation.

Table 6.2.5.1 Rovigo provincial profile

Population	244,750 (2006)
Area	1,788.6 km^2, with a density of population of 137 inhabitants/km^2
eCO_2 targets	6.5% CO_2 reduction by 2010

[1]AALBORG +10, the Fourth European Conference on Sustainable Cities and Towns was held in 2004. This served as starting point for next decade of action for local sustainability in the Campaign framework, with the agreement on the Aalborg Commitments. The European Commission (EC) generously supported the Campaign and Conference (http://www.aalborgplus10.dk).

[2]The conference 'A Future with Zero CO_2 Emissions' (May 2006), hosted by the City of Stockholm in 2006 and supported by the EC, focused on ambitious climate protection targets, effective actions to reduce greenhouse gas (GHG) emissions at a local level, and on adapting to a changing climate (www.iclei.org/stockholm2006).

[3]The Fifth European Conference on Sustainable Cities & Towns took place from 21 to 24 March 2007 Aalborg Process in Seville, Spain. Over 1,500 delegates from European local governments have committed to act and implement advanced policies for local sustainable development. The event culminated with 'The Spirit of Sevilla', calling for local governments to sign up to the Aalborg Commitments and advance the Aalborg process– www.sevilla2007.org

The partners and organisers of the event were ICLEI, the Italian Local Agenda 21 Association, and the territorial laboratory LA.TERR.A. in Rovigo. Councillor Giancarlo Chinaglia, Deputy Mayor of the Province of Rovigo was a key person behind the concept and team, who shared his vision and commitment with the President and the Environmental Department of the Province, focusing on the important climate protection work they are involved in. The conference was a great example of grassroots participation in environmental subjects, in particular in a globally relevant activity such as climate protection, and it helped to underline the need for such engagement also in smaller communities.

6.2.5.2 From Pioneering to Mainstreaming

Cities cover only about 2% of the world surface, but are responsible for three quarters of human contributed carbon dioxide (CO_2) emissions. A strategy and an active role of local authorities and citizens is fundamental in achieving emission reductions. With the combined experiences over the past years we have recognised that nothing revolutionary is needed to address climate change mitigation. We have the technology. We know what measures to take. We only need for people – on a daily basis – to make choices that consider their environmental impact, and that generally have a positive influence on the quality of life – a low emissions way of life that will help to combat global warming.

When the significance of global warming became clear at the end of the 1980s, some local authorities started getting involved in climate protection. For example, in January 1990 Toronto (Canada), as a pioneer city, adopted the target to achieve a reduction of 20% CO_2 by 2005, based on 1988 levels.

The 1990s witnessed an organised effort to reach significant results, with two networks in particular active with an international purpose:

- ICLEI – Local Governments for Sustainability started the Cities for Climate Protection (CCP) Campaign and implemented projects in many countries and continents (e.g. Africa, Australia, Canada, Europe, Mexico, Philippines, Southern Asia, and the USA). The precursor to ICLEI's CCP Campaign initially involved 11 European and North American cities in a 3-year project, analysing emissions, identifying some targets to reduce them and deciding on some intervention strategies. Today the CCP numbers more than 1000 local governments from multiple countries.
- Climate Alliance, which has a focus on action in Europe and combating deforestation in the Amazon rainforests.

National, regional and international networks pointing out areas for action have been very useful in promoting experience exchange and supporting the development of local policies.

Another important aspect is the pressure placed by local administrations on national governments, in particular during the United Nations Climate Conferences.

This aspect was very significant for the USA and Australia, with the former not ratifying to the Kyoto Protocol and the latter only doing so in 2007. The call comes from bottom-up so to speak. An example of local representatives moving forward at the national level is the case where, on 21 October 2006, a group of 155 American mayors made a plea to the American government calling for more attention to the climate crises.

Many people have seen remarkable changes in the climate, with such phenomena expected to increase in the future – temperature increases, frequency and violence of storms, etc. These changes will have a serious impact, not only on the natural environment but also on humans. As a consequence, there will inevitably be additional economic costs, which we could define as ‘inaction costs’ as we are not mitigating our impact on climate change fast enough. These additional economic costs are a frequent topic in the political debate (AEA 2007). It is important to underscore that even if the release of GHGs is completely stopped today, changes in the climate will continue for decades. It is important and necessary to consider many different aspects when looking at climate protection and responding to the changes. National policies on adaptation have been developed in some countries, with the exchange of information, sharing of experiences and learning from these, expected to be of great advantage – to improve the pace of implementing adaptation measures.

Looking at the cost of ‘inaction’ and adaptation, which are relevant to different sectors at the local level, the following is highlighted:

- **Natural ecosystems**: The objective is to stop biodiversity loss by 2010.
- **Costal areas**: These are areas with a high vulnerability. Real and concrete estimates on economic costs of European floods have been already done.
- **Agriculture**: Crop growth for food and fuel production will be affected. Adaptation has good potential to reduce a negative economic impact in the short- to medium term. However, problems are expected to remain especially in the Mediterranean region and in South-eastern European countries.
- **Energy**: The European economic balance, due to a change in energy demand, could drop in the short- to medium term. A changed distribution model is expected, with an increasing energy demand in the South (for more heating in winter), and increasing demand in the North for cooling in the summer period.
- **Tourism**: The tourist flow tends to move southwards and contributes to a flow of money, yet this could change (at least seasonally) because of global warming.
- **Health**: The mortality rate caused by high temperatures in summer will probably increase, while a decreasing mortality rate is expected due to changing (milder) winter temperatures.
- **Water**: Europe has different water availability in the South and in the North, and scarcity will probably increase because of the global warming. It is likely that this will lead to additional economic costs due to a foreseen water deficit.
- **Urban environment**: Extraordinary events will lead to significant costs, for example in the case of floods and tornados – with an increase in frequency and intensity expected.

These aspects need to be considered and addressed, and become part of mainstreamed activities at community level. By saving on mitigation costs there will not be a general saving of money – rather the reverse as the costs will increase if mitigation lags behind, which in turn will mean more needs to be invested into adaptation actions.

The world needs to achieve a new and difficult balance, not only regarding the continuity of economic development and the production and application of technological innovation, but also for environmental policy renewal and integrated sustainability concepts. The Earth could be saved by politics and rational choices of governments and citizens. This is a lesson for everyone: for those who believe in the efficient rationality of markets, as well as those who choose ecological fundamentalism – as two seemingly opposites poles regarding an energy strategy suitable for the new century's challenges.

It is clear that energy should not be held to ransom by conflict and disagreements at national or other political levels. Energy is more important – key for the future, for future generations, the world population and environmental transformation. At national level, parliament should lead by improving framework conditions and exchange innovative ideas. Civil society should implement concrete solutions and be open to dialogue in different cultural and political arenas. We need cross-border and inter-disciplinary cooperation to identify and consider ideas in depth. This will be to the global advantage. The current debate proves this: we can conduct an in-depth examination of all possible solutions, have an open dialogue, and move beyond political differences when making decisions that are essential for our future. Thank you to everyone who is helping to make this dialogue possible and the global cooperation open and inclusive.

Regarding the European targets to achieve 20% electricity production from renewable energy sources by 2020, Italy tries to gain lost ground by means of the new legislation on photovoltaic solar energy, implementing solar thermal solar, wind power and biomass projects. Energy efficiency seems to be forgotten, despite its high potential – especially in Italy.

6.2.5.3 The Involvement of Smaller Communities

With such a difficult scenario, and because climate change is an international issue, it is also necessary to consider the role and level of effectiveness of smaller local administrations, of which there is a large number around the globe. This is the fundamental issue that has been discussed in Rovigo Province, with 50 municipalities in its geographical region. The trend to set increasingly ambitious municipal objectives to become active in all fields has become more complicated due to the reality of climate change. This means a re-prioritisation is required, with climate protection needed high on the list.

The basic process to address climate change mitigation at community level – whether for large or small communities – is as follows: Start by monitoring GHG emissions, which is necessary to determine what the reduction targets should be – i.e. to know where the main problem areas are, and based on this setting GHG reduction targets. The targets help to focus on areas where actions could lead to an improvement in local environmental conditions. Generally speaking, the 'climate factor' represents an important element for planning activities, for example in sustainable transportation, with the improvement of energy efficiency and the implementation of renewable energy technologies, as well as sustainable waste management and creating green areas.

Many local actions, pooled by cities and towns in different countries contribute to a joint global effort. The results obtained thus far, identified by monitoring, show that it is possible to reduce emissions, even if initial ambitious objectives are not always reached in the first round. Continued perseverance is important – moving forward step-by-step. Examples from around the globe show that significant emission reduction is possible, although the majority of communities have had intermittent success, due to changes in the political leadership in local councils. The lack of continuity has had a negative impact overall.

Most local climate protection programmes and projects implemented so far have been volunteer actions – with local administrations and citizens not required by law to act in this field. When the Kyoto Protocol was finally signed, local action in some countries started receiving more attention. From 2008 onwards – with reports due on developments, based on the requirements of the Kyoto Protocol – governments are increasingly interested in activating different solutions to reach their targets. The community level has already shown how to achieve these in part.

6.2.5.4 The Rovigo Provincial Climate Protection Programme

The Provincial Government of Rovigo has charged the Environmental Policies Department with setting up a plan for the energy sector, to implement energy efficient initiatives and promote actions to limit the consumption of fossil fuels energy and reduce the release of GHGs. The result was the Provincial Energy Programme, which outlined the most important renewable energy and energy efficiency interventions to be performed by 2020. In its development the most recently available survey on energy consumption in different economic sectors was used.

In the building sector a local building code that addresses municipal regulations was accepted to address energy use in existing buildings and for new constructions. The majority of existing private and public buildings were constructed adopting inefficient technologies, which created a high energy requirement per square meter – around 100–150 kWh/m^2 or more. By adopting energy classes and implementation local incentives it is estimated that 20% of the existing buildings and all new ones could achieve energy consumption standards around 50–70 kWh/m^2/year.

Planning the construction of energy production systems (thermal energy and electric power) that run on biomass, these have been linked to local farms, and generate up to 1 MW. In addition to the building codes planned to improve energy consumption, photovoltaic (PV) solar systems were also identified to produce electric power and thermal energy for hot water. One announcement every year for 3 years running were issued to subsidise systems with €2,000 per PV system and €500 for every solar thermal system for domestic systems. These subsidies totalled €340,000, provided by the Province (Fig. 6.2.5.1).

Actual projects implemented since 2001 by the Province of Rovigo that specifically pursued the aim to enhance solar energy use as a local available re source, include the following:

- **PV system of 10 kWp at ITIS of Rovigo**: this system produces about 12,000 kWh/year, equal to about 6% of the energetic needs of the institute, allowing savings on the ENEL energy bill of about €1,800/year.
- **PV system of 5 kWp at ITIS of Adria**: the electrical energy production is equivalent to 6,000 kWh/year corresponding to about 4.5% of the energy requirement of the institute, with a saving of €900/year.
- **PV system at ITAS of Badia Polesine**: this system has also the potential to deliver 5 kWp and produces about 6,400 kWh/year. It covers 5.5% of the institute needs allowing a saving of about €960/year.
- **PV streetlamps**: installation of 331 photovoltaic streetlamps on provincial and municipal streets, without lighting required from the public grid.
- **PV facade close to IPSIA of Rovigo**: the system consists of a PV facade with a nominal power of 35 kWp that is connected to the grid. It faces south and is installed close to classrooms, totally comprised of windows. Such a system can

Fig. 6.2.5.1 Lighting on the bridge of the Po River (see *Color Plates*)

produce about 27,000 kWh/year of electrical energy in alternating current, and guarantees electricity cost savings of about 4,000 €/year.[4]

- **Solar thermal system close to the gym located in Via A. Moro, in Adria**: installation of 40 m^2 solar thermal system with evacuated tube collectors for the production of hot water and for heating integration with the gym's ground system. The system was installed on the building façade/roof with a 60° angle.
- **PV car park at the IPSIA Institute in Porto Tolle**: installed in February 2008, this system is composed by 110 PV modules of 180 Wp, providing a total of 19.8 kWp. These modules were placed on a zinc-coated structure with a 20° angle, covering an area of 140 m^2. The direct current produced by these modules is turned into alternating current by three inverters placed in a room on the first floor. The area was rather isolated, and through this system with capacity to produce electric energy around 24,500 kWh/year, it covers about 25% of electric energy used by the institute. This production will benefit from the incentive rates of Conto Energia (the Energy Bill) by which the grid operator will pay €0.46/kWh, meaning the Province of Rovigo will gather an income of about €11,250 a year. Considering that the energy produced will be self-used or exchanged with ENEL, a further €3,700/year will be saved on the current energy costs (and expected to be even higher as energy costs go up). This system will support CO_2 reduction of about 13.5 t/year. The Province of Rovigo, within the same contract,[5] has carried out the installation of the following further three PV photovoltaic systems:
  - Photovoltaic roof of 15.12 kWp at the polyvalent School Complex "Balzan" in Badia Polesine, producing 18,500 kWh/year.
  - Photovoltaic roof of 19.80 kWp at the Secondary School "Paleocapa" in Rovigo, producing 24,500 kWh/year.
  - Extension of the photovoltaic roof of 9.72 kWp at ITIS Institute "Viola" in Rovigo, with further 10 kWp, producing 12,000 kWh/year.

Considering the next systems presented, the energy production will be 79,500 kWh/year in total, which means a reduction of CO_2 emissions of about 44 t/year. The total cost of the intervention was €390,000:

- **Installation of PV street lamps**: the Province of Rovigo changed lighting of the bridge over the Po river in Ca' Venier, in the Municipal district of Porto Tolle, with the installation of 20 PV street lamps (3.78 kWp). The cost was about €60,000.

[4]The Ministry of Environment funded 85% of the capital cost of four projects that were identified based on project merits, with this project in Rovigo achieving second place – among more than 60 submissions requesting public funding from public administrations all over Italy.

[5]These three installations will also benefit from the Conto Energia, with an incentive rate of €0.42/kWh, ensuring an income for the Province of about €23,000/year, and savings of about €8,000/year on the ENEL bill.

- **Installation of a PV cat shelter at the Operations Centre of the Province of Rovigo, Via Grandi**: this PV system of 24.32 kWp will produce about 28,000 kWh/year, which will benefit from the incentive rates of the Conto Energia 2005 edition. The incentive rate for this installation is €0.47/kWh. The Province will collect about €13,000 each year, and save €4,000 more from the ENEL bill. The total cost of this intervention is about €200,000.
- **Support for private citizens to install solar thermal and PV systems**: on 14 May 2007 the Province of Rovigo, in response to success achieved in 2006, published a new announcement that guarantees private citizens the equivalent of €500 for installing a solar thermal systems and €2,000 per PV system. This activity, which ended in November 2007, drew the 63 requests for solar thermal systems (corresponding to about 350 m^2 of panels installed), and 35 requests for PV systems, with total of 95 kWp installed. The financing expenditure was €101,500. The announcements of 2006 and 2007 led to days 158 solar thermal systems and 70 PV systems installed by private citizens, equivalent to about 195 kWp.
- **A building integrated PV (BIPV) project close to the Province's offices in Viale Della Pace**: this BIPV project, with a PV facade of 18.6 kWp architecturally integrated into the building façade, cost €200,000 and was concluded at end of 2008 Fig. 6.2.5.2); Table 6.2.5.2).

Fig. 6.2.5.2 Photovoltaic facade of the secondary school ITIS (see *Color Plates*)

Table 6.2.5.2 Overview of projects

Intervention	Power (kWp)	Production kWh/year)	CO_{2eq} avoided (ton/year)	Cost (€)	Revenue from Conto Energia (€/year)	Savings in the Enel energy bill (€/year)
Four installations in schools	64.44	79,500	44	390,000	34,250	11,700
Shelter of the operations centre	24.32	28,000	15.400	200,000	13,000	4,000
Installation of ITIS Rovigo	10	12,000	6.6	135,000 (54,000)[a]	–	1,800
Installation of ITIS Adria	5	6,000	3.3		–	900
Installation of ITAS Badia Pol.	5	6,400	3.3		–	960
Front facade of IPSIA Rovigo	35	27,000	14.8	405,000 (94,000)[a]	–	4,000
351 photovoltaic streetlamps	58	33,000	18.3	864,000 (445,000)[a]	–	–
Photovoltaic streetlamps in Ca' Venier	3.78	2,000	1.1	60,000	–	–
Announcement for the guarantee of contributions	195	210,000	115,500	140,000	–	–
Front facade of the Province in Via della Pace (under construction)	18.6	13,000	7.1	236,000	Still not linked	Still not linked
Total	**419.14**	**416,900**	**229.3**	**2,430,000 (1,525,000)**	**47,250**	**23,360**

[a]The values between brackets refer to provincial funding, while the difference has been covered by regional and state funding

The next steps of the Province of Rovigo, to address climate protection, have been started. Together with CON.SVI.PO. – the consortium developing the Polesine area, which includes 50 municipalities – the Environmental Policy Department of the Province of Rovigo planned a project, with a call for tender required, for installing at least one PV system in each municipality. The aim is to not add a financial burden to the municipalities, but rather incur expenditures only for Conto Energia. The project aims to generate 1 MWp from 58 systems (with the range from a few kWp to larger systems), as well as a large PV power plant of about 1,420 MWp (about 5.8 Wp/inhabitant); electricity production of 1.64 million kWh/year (about 6.7 kWh/inhabitant*); and the reduction of GHGs by 900 tonnes per year (t/a). Through PV energy production the aim is to achieve by 2015 a reduction in GHGs of around 1,500 t/a, which corresponds to 10 Wp/inhabitant of PV energy generated (Fig. 6.2.5.3).

Fig. 6.2.5.3 Photovoltaic facade of the Province of Rovigo office building (see *Color Plates*)

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Chapter 6.3.1
Focus on Climate Change Communication: The Climate Smart Campaign in Malmö (City of Malmö, Sweden)

Johanna Ekne

Abstract Energy is life. We need and use energy every day. This will not change, but we can change the way we generate and use energy. For this we need to change the way we think, the way we act as citizens, as employees, as employers – in the places we live, work, eat and sleep. Community awareness and engagement are critical elements to achieve success in local climate protection action. It means addressing a broad target audience and is relevant to an extensive range of topics – from waste (reduce, recycle, reuse) to energy consumption in the private life and at the office/school, to personal choices made regarding transportation. In the context of local governments the Local Agenda 21 approach is also important, addressing citizen involvement in processes. The Climate Smart Campaign was carried out in 2006 in the City of Malmö, Sweden. This example is briefly analysed focusing on the communication aspect to achieve impact, illustrated by a case study to show how a local climate change campaign was implemented in Malmö through the Climate Smart Campaign.

Keywords Citizens, communication Climate Smart Campaign • energy choices • employees and employers • lifestyle change • media channels • Working Group on Lifestyle and Citizen Behaviour (WG Lifestyle)

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6.3.1.1 Malmö in Context

Table 6.3.1.1 Malmö municipal profile

Population	280,800 (2008)
Area	155 km^2
Municipal budget	13 billion SEK
eCO_2 targets	25% by 2012 (baseline 1990)

6.3.1.2 Starting 'The Climate Smart Campaign'

The campaign was carried out in 2006 in the City of Malmö, as part of the SECURE project,[1] funded by the European Commission (EC) programme Intelligent Energy for Europe (IEE). The section of the SECURE-project called 'Sustainable energy citizenship' had as overall aim to engage the inhabitants of the participating cities (Malmö, Dublin, Tallinn, Hillerød) and to improve their knowledge regarding energy use and the impact this has on climate change. Activities consisted of developing an exhibition, billboards, advertisements and film commercials (Table 6.3.1.1).

The Campaign in Malmö focused on the development of communication tools in order to:

– Increase the community's knowledge on the connection between energy use and environmental impact
– Show how the inhabitants can reduce their environmental impact from energy use and
– Find successful forms of communication, which could be applied to future activities and shared with other cities

6.3.1.2.1 Defining the Purpose of the Campaign

Before running a campaign, a few crucial questions need to be considered: What is the purpose of the campaign? Why is it being considered? What kind of result is aimed for, and what results are needed? The answer to these questions should form the base, or rather the spine, of the whole campaign.

In the specific case of the Climate Smart Campaign, the overall aim was to engage the interest of the inhabitants of Malmö and other European cities, making them aware of their energy use and considering their impact on climate change.

[1] www.secureproject.org

The intention was to get their interest and draw a response – a change in using energy. On a local level it is necessary to narrow down the aims somewhat, making them very specific to guide the content development.

The aim of a local climate change campaign could be to:

– Make climate change a local issue that concerns the inhabitants of the city. This can be done by showing how the inhabitants affect the climate through their own actions and also how their life will be affected by climate change.
– Show that this is a serious and important matter that concerns the whole community. This can be done by gathering several actors in the city to participate in the campaign, and also by repeating the message over and over again.
– Show that it is meaningful to engage and that there can be, and is, a real impact. This can be done by visualising ongoing activities undertaken by many different actors in the city, showing the joint results and positive effects of these activities.
– Give the inhabitants tools that they can use in the fight against global warming. This can be done by showing them what they can do in their homes and at work to decrease GHG emissions caused by their lifestyle. Show them other options.

Specific issues considered: What should be the result(s) of the campaign? What should people do with the information? Do you want them to be wiser, to **learn** something? Do you want them to be more active, to **do** something? The results aimed for in a climate change campaign is of course to decrease the amounts of carbon dioxide (CO_2) released and so minimise the human impact on global warming. This is a large goal, which is potentially also very hard to grasp. When looking at this on a local level, one can express it as follows: you want citizens to be fully aware of the connection between their own actions and global warming. When they are aware of this connection, you want them to act in order to decrease GHGs. The aim is therefore **both** to increase knowledge regarding climate change, **and** to change peoples' way of behaving.

6.3.1.2.2 Target Groups

It is important to select a target group. The target group 'citizens' is a very large group to handle, and is often huge, containing many different kinds of people (considering demographics) – too many to address in a useful manner from a communication viewpoint. If one were to try and send a message geared towards all demographics, the result will most likely be marginal. By dividing citizens in smaller groups and adjusting the message and channels accordingly, the chance of getting through to them is much higher.

Target groups could for example be:

– Children
– Parents
– Elderly people

– Drivers (car-owners)
– Consumers
– Employees
– Companies
– Residents

These groups in turn could be sub-divided into smaller groups, depending on what you want to say to them, how you want to communicate, which channels you want to use, and how much time and money you have. For example, consider the target group ‘children’ where it would be useful to split this category into sub-groups: teenagers, pre-teens, kindergarten toddlers – looking at places where they gather (schools, free-time) and what outreach opportunities exist in these contexts.

When you have identified your target groups, consider who they really are. How do they live their lives? What level of knowledge are they likely to have about climate change and greenhouse gases? What information do they need? What do they want? What are they afraid of? What can they consider when changing their way of life? If you do not know the answer to these questions when developing a campaign, there is a high likelihood that you will communicate in the wrong way and that they will not listen or understand. One can even annoy some people and taken two steps backward from the starting position.

A good idea is to gather a focus group from each target group, and ask them the above mentioned questions to gain an insight into their challenges and interests, to guide the planning of your campaign.

6.3.1.3 Planning a Campaign: A Long Process or a ‘Detonation’?

Before work starts on compiling or adjusting the message, consider your approach. This depends very much on available resources – staff, time and money and of course on what type of results aimed for.

The use of a long-term process is useful if the message has to be repeated over and over again in different ways, using different channels. This is quite useful when communicating with smaller groups and to really listen to them – in the long run better for all. However, it will take a lot of time and may require waiting long, perhaps for years, before some results are visible. The results, on the other hand, are likely to be long-lasting.

Another way to work is the ‘detonation’ strategy. In this case you bombard people in the city with massive amounts of information in a short time. This can be done in quite a brief period, but could also be quite expensive. The results can be very good, but this is the type of effect that tends to fade away in a short time, where after things will return to ‘normal’ again. Clearly a balance needs to be achieved, depending on what the aim is.

6.3.1.4 Methods of Communication

When it comes to communicating environmental issues there is a tendency to either be rather boring or very idealistic. It should be recognised that not everybody is interested in environmental issues. Not everyone is open to being told what to do, nor do they specifically recognise that this is their problem, or that it can be solved. Furthermore the problem is not necessarily that people do not know what to do, but they do not seem to care. For example, car drivers know that it is not good for the environment to drive, but they drive anyway. The challenge is to make them care, take responsibility for their actions and change their behaviour. The challenge is also to change perceptions about environmental issues, which tend to be global. What an individual does seems to be irrelevant in terms of the here and now. The effects on the environment are mostly not directly visible and, speaking both geographically and in time, a problem that seems to be very far away. So how can this be approached?

To make people feel that the matter of climate change concerns them, one may need to move away from the environment approach, and instead look for other arguments. Two arguments that which could be used are finances and health. Finances work very well when communicating the direct benefits of saving money by saving energy, for example. In nearly all cases it is possible to save financially when saving energy. And we all want to save money. When discussing transportation one can use the health argument, so linked to air quality and better for personal health to ride a bicycle or walk instead of driving. An example of a communication approach here is for example: 'Leave the car at home and bike to work instead. You will have less stress (no traffic jams), lose weight and feel healthier, and it is also good for the environment.' Multiple reasons combined in a line of argumentation tend to have a higher impact (Fig. 6.3.1.1).

6.3.1.5 Media and Media Channels

When communicating, there is a tendency to create new channels instead of using existing ones. Today there is information overload, and few of us want to be informed in yet another way. So consider using channels that are already in place and functioning. Adding a new dimension or gag (joke) may also help to draw attention. Some ideas: visit people where they meet, instead of trying to get them to come to you. Instead of making a new booklet, spread information in existing newsletters that people are reading. Find out what media works (what do people actually read?), and use this as your media channel. A novel idea is to use the pay-slip (right next to the amount they get, add a small one liner), or maybe messages via the landlord or another person who plays an important role in the life of tenants. Use papers that associations send to their members, or information sheets at the local grocery store. It is a good idea to make a list of all the existing

Fig. 6.3.1.1 Cartoon illustrating options to save energy (see *Color Plates*)

channels in your city and consider which ones could best be used, and how this can be done.

Different media and activities can be suitable for a climate change campaign. Below are some examples from Malmö:

6.3.1.5.1 Advertisement Boards and Advertisements in Local Newspapers

Target group: Citizens

Activity: Highlight activities that effectively decrease the emission of GHGs, and mention companies and organisations that carry these out (recognition factor). Inform the inhabitants what they can do themselves to fight global warming. Use powerful images: technology, action by individuals, with a basic clear message.

6.3.1.5.2 Roving Exhibition on Climate Change

Target group: Employees in companies and organisations

Activity: Show action and impact – this is very abstract, and can be well illustrated by combining images with information to send a clear message making climate change a matter that concerns everyone. Show how people are affecting global warming by their choice of lifestyle, and also how they will be affected by climate change.

6.3.1.5.3 Interactive Website Game

Target group: Citizens

Activity: A very simple interactive game on the City website where people can make different choices in their daily life and get feedback on the consequences). Combine fun and information, extend a challenge.

6.3.1.5.4 Cimate ER: Emergency Room (Klimatakuten)

Target Group: Teachers

Activity: Give teachers knowledge and material they can use to teach climate change to their students.

6.3.1.5.5 Energy-Saving in Apartment Buildings

Target group: Residents

Activity: Make inhabitants aware of the connection between energy-use and climate change by informing about energy-saving and the effects on global warming.

6.3.1.5.6 Websites

Target group: Citizens

Activity: Provide useful, clear information for laypeople on climate change: what it is, how it can affect the city and the inhabitants, what the city is doing to fight it, and what the inhabitants can do themselves.

6.3.1.5.7 Efficient Transportation

Target group: Companies

Activity: Help companies to make their transport (products, staff) more efficient by offering advice about efficient options, also giving information about fuels and car-sharing.

6.3.1.5.8 Car-Sharing

Target group: Residents

Activity: Offer the possibility to join a car-pool in the neighbourhood, offer vehicles that run on renewable fuels.

6.3.1.5.9 Information to Newcomers

Target group: New inhabitants of the city

Activity: Inform the newcomers of the possibilities to travel within the city without using a car.

6.3.1.5.10 Evaluating Approach

Information and communication activities can be hard to evaluate. Three different kinds of evaluation options are listed below:

– **Evaluation of knowledge and attitudes** (evaluation of the campaign): Was the target group(s) reached and was it done in the way planned? The best way to determine this is to ask the target group before and after the campaign. This can be done by telephone survey, by letter or by directly asking people. Make sure that enough people are asked, and that they are representative of the target group.
– **Environmental evaluation** (evaluation of the results): Was there a decrease in GHG emissions? This can be hard to measure and is often not possible to measure it directly after the campaign. Even if measuring it is possible, it is difficult to know if the emissions were affected by the campaign or by other circumstances. However, it is very useful to get information on the trend and use this for future campaigns.
– **Evaluation of methods**: Were the campaign media and channel(s) selected the most effective option? Was it handled correctly? This can be evaluated by comparing the results with results obtained when using other methods. It is necessary to

European CCP Campaign: Working Group on Lifestyle and Citizen Behaviour

Malmö is leading this Working Group, working closely with ICLEI Europe on identifying issues relevant to changing citizens' lifestyle and behaviour, making them more aware, more responsible and engaged in climate change mitigation. The City of Malmö is active in an increasingly comprehensive effort to turn Malmö into an eco-city. Extensive investments have been made in renewable energy sources, waste recovery, efficient building and green transport. But these developments are not the only issue to be addressed when talking about a sustainable city. The community – people – need to be considered. Their personal choices have a big cumulative effect. Their lifestyle and daily energy behaviour is particularly relevant from a climate protection perspective.

How can every citizen be encouraged to contribute to the reduction of harmful greenhouse gas (GHG) emissions? How do we communicate with them on this issue? How can we achieve a community-wide engagement in changing the way energy is produced and used locally? These and other questions are addressed in this Working Group, with results feeding into the European Cities for Climate Protection™ (CCP) Campaign, as well as the Local Agenda 21 activities led by ICLEI.

have a discussion amongst the people working on the campaign to determine whether they are satisfied with the way of working, the process and so on.

6.3.1.5.11 Exhibition

A roving (mobile) exhibition can be used by interested groups, borrowed at no cost from the city's Environment Department. The exhibition stands are made of plexi-glass and the information is easy to remove and update. As a package with the exhibition, a quiz is used, set up in eight smaller units that can be arranged e.g. in a row, to make a "quiz-tour" out of it. The target group of the exhibition were employees of companies and organisations in the city. Any company or organisation could borrow the exhibition, free of charge, and exhibit it in their lounge, lunchroom or any other place they find suitable.

The exhibition contents can be divided into three areas:

– General information: what is climate change, how does it affect people, etc.
– 'News' items: Fake news to show what 'happens' locally in the year 2048 if nothing has been done to prevent climate change in 2008, e.g. flooding, diseases, wildlife, storms, etc.

- A cartoon: showing how an individual affects the climate in his/her everyday life. In the cartoon two persons from the city – a man and a woman – are shown in their daily life, and compared regarding the choices they make. The cartoon is created as a competition between them, to see who is the most climate-smart person
- The general idea is that none of them is a heroic kind of person that makes you feel bad about yourself, but both of them are like you and me, sometimes they make good decisions and sometimes they make bad ones

6.3.1.5.12 Billboards and Advertisements

A combination of billboards and advertisements (ads) were used to highlight actions against climate change that have been carried out within the city. The message was directed to the citizens to share effective actions taking place and to highlight that the city is working hard to combat climate change. The intention was also to show that many actors in the city are involved, e.g. different companies and organisations, with work being done in many different areas. Eight different billboards were made, each highlighting a good example. Six different actors, including the municipality, participated in this action.

The first day the billboards were shown, the municipality placed ads in three local papers to inform people what was going on, explaining the campaign and highlighting the actors that participated. The billboards showed the following activities:

- A solar energy project carried out by the municipality
- A wind power plant with 48 wind turbines, built by an energy company
- An eco-driving project carried out by a transportation company
- A GPS-system, installed in all the cars of a delivery firm, to reduce the use of petrol
- A project promoting locally produced food, carried out by the municipality
- A mobility management project performed by an NGO
- A local climate change forum, coordinated by the municipality
- Locally produced renewable energy in a city district, as cooperation between an energy company and the municipality

6.3.1.5.13 Film Commercials: 'Dare to …'

Within the campaign, two film commercials were made. This is an effective way of reaching people but it is also quite expensive. The films where each shown over a 6-week period and were seen by approximately 150,000 people. The aim was to show humorous or clever examples on how to be climate smart in daily life. The contents in brief:

- Locally produced food: A guy visits a run-down neighbourhood. He knocks on a door of a shabby club, and when the door opens he gives the doorman some money. The viewer expects that the doorman in return hands him drugs or an illegal weapon, but instead gives him a cute basket with a ribbon that is filled with vegetables. The punch line is "**Dare to buy locally produced food!**".

– Commuting: A frail old lady using a walker is waiting outside at the curb. The viewer hears loud music and sees a couple of shabby young men arriving in an old car with loud music on the car stereo. The next thing you see is the car leaving very fast and the lady sitting in the back seat with one young man on each side. The punch line is: "**Dare to share a car!**"

6.3.1.5.14 Evaluation

The result of the campaign was evaluated by making telephone interviews, before and after the campaign. The results were very good: people's knowledge and attitudes concerning energy issues and climate change had really changed after the campaign. However, it is not possible to determine how much of the effect was accomplished by the campaign and how much was rather the result of sudden interest in climate change in the Swedish media.

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Chapter 6.3.2
A Coastal Municipality Using the Local Agenda 21 Approach in Developing an Action Plan on Climate Change (San Sebastián, Spain)

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Abstract In January 2008, the City Council of San Sebastián adopted the Action Plan on Climate Change (APCC), after a long process of public participation and deliberation. The strategic plan and urban plan were used to support the development of the community's APCC, with inter-departmental cooperation leading to a coherent strategy. Furthermore, building on the results of the inclusive process – the Local Agenda 21 (LA21) approach – the Plan was developed based on four strategic themes, with more than 220 actions implemented. An economic study was carried out to analyse the cost of the Local Action Plan, and research was conducted to develop future reduction scenarios, to consider the potential impact of different climate protection actions. The integration of the Local Agenda 21 process and climate protection strategies is regarded as one of the main success factors, and forms the foundation of sustainability policy-making in San Sebastian.

Keywords consultation, economic study • inter-departmental cooperation • integrated approach • Local Agenda 21 (LA21) • mitigation • compensation and adaptation' • research • sustainability policy-making • tourism

6.3.2.1 San Sebastián in Context

San Sebastián is located on the north-eastern coast of Spain and is the provincial capital of Gipuzkoa. It is a coastal municipality and one of the most important tourist destinations in Spain. The main economic activity is based on trade and tourism. The city is therefore sensitive to climate change. The Council is aware of the importance

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Table 6.3.2.1 San Sebastián municipal profile

Population	184,554 inhabitants (2008)
Land area	60.93 km^2
Municipal budget	€66,978,000 (2008)
eCO_2 reduction targets	Short-term target to reduce GHGs by 9% between the period 2008 and 2013 (baseline year 2005). Long-term target to reduce GHGs by 90% by 2050

of cities and towns engaging in global action to reduce human impact on climate change, and has decided to act (Table 6.3.2.1).

In 1998, the City Council of San Sebastián signed the Aalborg Charter and also started with the Local Agenda 21[1] process to enhance citizen involvement in local governance activities. For the development of this process, thematic seminars were held with the participation of technical staff from different administration departments and citizens. In addition to this, an Environmental Advisory Council was created.

6.3.2.2 Goals

The objective of the City Council was to elaborate an Action Plan on Climate Change, with a widely inclusive participation process designed to involve local stakeholders. A greenhouse gas (GHG) emissions inventory was conducted as well as an assessment of the impact of the Action Plan on anticipated future GHG emissions of the municipality.

6. 3.2.3 Starting with Climate Protection

In August 2004, the first Local Climate Action Plan was approved for the period 2004–2007. Since the plan was launched, external monitoring reviews have been carried out annually to determine the development of municipal implementation actions and results achieved. The overall results of these evaluations were satisfactory.

In 2007, the Council of San Sebastián decided to prepare an Action Plan on Climate Change (APCC). Through this tool the City joined voluntary actions to address GHG reductions, thereby also indirectly supporting the Kyoto Protocol as the main international instrument defining actions to address global climate change. As a starting point for the APCC, a new instrument to measure GHGs – designed by the Network of Basque Municipalities for Sustainability (Udalsarea 21) – was tested. Emissions that were calculated derived from fuel and electricity consumption, transport, waste generation and industry. The tool also takes into account the impact

[1] www.agenda21donostia.org

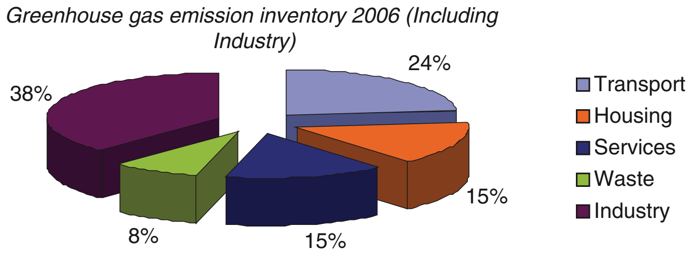

Fig. 6.3.2.1 Greenhouse gas emissions inventory results from 2006 (including industry) (see *Color Plates*)

of renewable energies. It shows detailed emissions for each sector, and comparisons can be made between different scenarios – supporting the observation of GHGs from a council and/or community perspective and making it possible to evaluate the effect of actions taken by the council and community at both general and sectoral levels. Expected GHG reductions, as a result from implementing the APCC, have been estimated and built into future emissions scenarios.

Although San Sebastián is not a very industrial city, it became clear in this process that the industrial sector contributes to a high percentage of GHGs. Excluding industry emissions, the sectors buildings, residential and services account for almost 60% of total emissions (Fig. 6.3.2.1).

In addition to the inventory, the Local Agenda 21, the Strategic Plan of the Municipality, as well as the General Urban Development Plan have also been taken into account in the overall process. Through the APCC, the city aims to work in three fields over different spatial and temporal scales with an integrated policy of ‘mitigation, compensation and adaptation’. This involves the development of a long-term strategy based on social learning, on the contribution of technological innovation to reduce GHG emissions and the effects of climate change on the local and global well-being.

The document development of the APCC has undergone a wide process of public accounting and participation in order to:

- Obtain different opinions and points of view, and get contributions from a range of social sectors that may help to design an enriched APCC adapted to the City.
- Make the departments and local bodies aware of the issue, and completely involve them in the design and further implementation of the Plan.
- Engage other organisations so that they can assume the responsibility to carry out actions.
- Make citizens aware of the problem, to involve them at their utmost in the fight against climate change, making it easier to achieve the objectives of the Plan in the shortest possible timeframe.

To achieve this several workshops were organised in city neighbourhoods, as well as holding working sessions with politicians, seminars at universities and schools, and conference cycles and film forums. A process to make on-line contributions to the plan was also established.

6.3.2.4 Four Strategic Approaches

After the participation process, the APCC for San Sebastián was finally approved. The four strategic lines of the plan are as follows:

- **1st strategic line**: Integrated planning for sustainable mobility, including the promotion of public transport, development of a bicycle observatory, increase cycling paths and pedestrian ways.
- **2nd strategic line**: Move towards an energy pattern, having an integrated strategy of energy saving, energy efficiency and the use of renewable energies. Some of the main actions included are the progressive implementation of solar photovoltaic energy in all municipal buildings where possible, an energy efficiency plan to be developed for municipal buildings, as well as an energy efficiency plan for municipal lighting. A detailed evaluation of the street lighting and an action plan is under development, several municipal buildings under construction are being built with high energy efficiency and renewable energy standards, and a new neighbourhood is planned with central energy and heating production. Another key action of this strategic line was the development of an Eco-building Regulation, which was recently approved. With this law the Council seeks higher energy efficiency and renewable energy standards than those set in the national legal framework. One of the main objectives of the Eco-building Regulation is the energetic renovation of existing buildings.
- **3rd strategic line**: Promote responsible consumption in the city as the base for waste prevention and to strengthen the re-utilisation and recycling of waste also by ensuring its correct management. The three main actions included in this line are annual programmes on waste prevention promotion of recycling, the “50% recycling” campaign and a composting test using containers on public walkways, as well as a community composting test. The waste prevention programme includes sustainable festivals/celebrations, re-usable nappies, green purchase in the administration, using glass containers for water (instead of plastic bottles) in hotels, second-hand street markets, and a waste prevention programme for the municipality.
- **4th strategic line**: Protect rural areas and to efficiently manage water and carbon sinks of the municipality. The main actions included in this line are a strategic plan on biodiversity, the creation of a Water Museum, a sectoral division of the water consumption network to detect water leaks, and the creation of the Urumea River Park.

By implementing this Plan, San Sebastián aims to achieve the short-term objective of reducing GHGs from the baseline 2005 level by 9% between the period 2008 and 2013 (Fig. 6.3.2.2).

The following reduction percentages are expected to be achieved by 2013:

- Fifty-five percent due to modal changes on urban transport of the city – i.e. passengers changing from private to public transport and to non-motored mobility transport, as well as the use of biofuels.

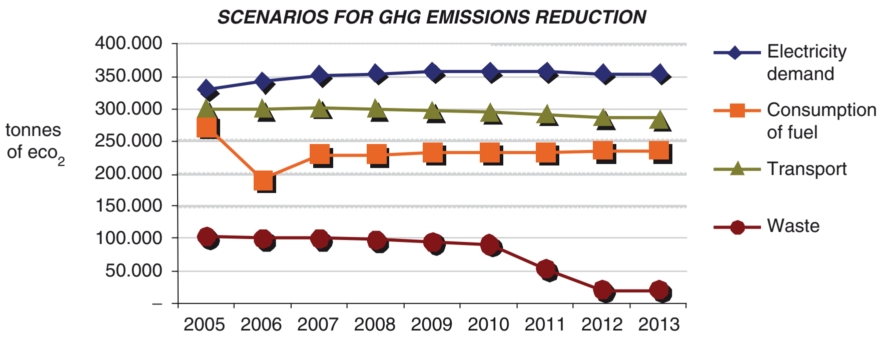

Fig. 6.3.2.2 Predicted scenarios of diffused sectors

- Twenty-six percent due to the decrease on urban waste creation and to changes on the management of such waste, promoting recycling and composting.
- Sixteen percent due to energy savings and efficiency in electric energy use.

The long-term target is to reduce GHGs by 90% by the year 2050, compared to the 2005 baseline.

6.3.2.5 Considering Financial Implications

The municipality carried out an economic study on the actions and expected impact of CO_2 reductions, with an external consultant gathering the information from the manager of each action (each action has one or more technicians involved in the implementation phase). The consultant asked every manager to estimate the cost of the action, the same approach used since the first Action plan of Local Agenda 21, needed to approve the Action Plans. This also gives them an idea of the budget required. Yet it only remains an estimate, and can be impacted on by many factors that can not be accounted for prior to implementation, such as the economic crisis which led to the reduction of annual budgets, or subsidies which can be obtained from other levels of government.

Factor Co2 consultants have carried out the research on future scenarios. A technical model has been carried out in order to estimate two scenarios (BaU scenario and an APCC scenario) using critical variables for each activity sector or emission source. This research was carried out after approving the APCC in order to estimate our reductions. All the information in reductions included above springs from this study.

The APCC has altogether 220 actions to be implemented between 2008 and 2013. The initially estimated cost for those 6 years is €85,179,897. Support from the national, autonomous and provincial government is expected. The public participation process of the APCC had a cost of €9,000, which included organising workshops in neighbourhoods, holding the first local conference on climate change, arranging seminars and developing online services.

6.3.2.6 Results

The results of the public participation process were very positive, with active participation levels and a large number of contributions received. Altogether 183 contributions were received, 60 from political groups, 18 from the Advisor Youth Assembly, 52 contributions from participants in workshops and other activities, and 43 contributions through the on-line system. With the Local Agenda 21 process used as the main approach in San Sebastián, the APCC is integrated into the Second Action Plan of Agenda 21. All actions described in the APCC are considered to be sustainable. As San Sebastián has an informative system to conduct follow-up and annual evaluations of the implementation of Agenda 21 actions, efforts were pooled to also use this for the APCC. To integrate the APCC in the Second Action Plan of Agenda 21, the APCC document was seen as a basis documents for discussion for the Second Action Plan. Citizens who participated in the APCC workshops were also invited to join the Agenda 21 groups (11 groups, where municipal technicians, administration staff and citizens, environmental groups, neighbourhood associations, etc get together). An evaluation is carried out every year, and due to the high number of actions and many stakeholders involved, a simple, systematic tool was needed for the evaluation. Every other year citizen involvement in the Environmental Advisory activity is evaluated, and as part of the Agenda 21 process annual monitoring and evaluation takes place to complete the Annual Sustainability Report (monitoring of 22 indicators for sustainability). This in turn feeds into the Aalborg reporting process (through MUGI 21 elaborated for Udalsarea 21).

The first inventory indicated a surprisingly high percentage of GHGs released from the industrial sector. This is contributed by a single factory where cement is manufactured. There is an interest in working with the factory to reduce these emissions, but it is a new field and further research on options has to be done. A framework agreement ('Convenio Marco') will be signed with the factory to work on improving the environment as well. The initial focus is on reducing GHGs in the corporate and community areas, using the four strategic focal areas to guide actions. Results will be assessed by the annual GHG inventory for the municipality and also by the annual assessment of the implementation of the APCC, handled by the Agenda 21 and Climate Change Service. The information for the annual assessment will be gathered from all managers involved, which means that almost all the municipal departments are involved.

6.3.2.7 Lessons Learned

Having started with strategic sustainability processes such as Agenda 21, it is important to integrate climate change actions into this process. Channels of communication and participation set for Agenda 21 can also very effectively be used. As climate protection is most likely a more familiar concept to citizens than 'sustainability', it is interesting to give the leading role to climate change, indirectly also using this to encourage the development of a more sustainable community.

One of the main barriers identified in the public process has been how to motivate citizens to participate in the APCC, which is a rather technical document. This problem has been initially addressed by avoiding the use of technical conferences and instead discussing documents in workshops. Nevertheless, more work needs to be done in the field of "translating" technical documents and processes, making it easier understandable to citizens.

Leadership is a very important point, especially when boosting participation. In meetings where the mayor participated, there was a larger attendance of citizens than in other meetings or activities. On-line contributions have also been very important in gaining citizen participation (Fig. 6.3.2.3).

Fig. 6.3.2.3 Pedestrians and cyclists in tourist city San Sebastián

Key replication aspects

- Public involvement is an essential aspect – leading to a high acceptance rate among citizens, and excellent levels of participation that are also reflected in the media. This provides a strong foundation for planned actions, many of which are linked to changing citizen behaviour.
- The integration of the climate action plan into the Local Agenda 21 action plan assists the evaluation multiple action implementation. A single evaluation method can be used for the annual evaluation, the results are then analysed, with immediate follow-up action on issues that have been identified as problematic.
- The development of future scenarios is very important – this is used as a tool to identify options and set realistic GHG reduction goals.

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Chapter 6.3.3
Reducing Environmental Impact: The 'CAMBIERESTI?' (Will You Change?) Community Involvement Project (Comune di Casalecchio di Reno, Bologna, Italy)

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Abstract 'CAMBIERESTI? – Will you change?' is a project implemented by the Town of Casalecchio di Reno addressing consumption, environment, energy savings and lifestyle change. It offers a journey for all Casalecchio di Reno citizens, aiming to raise awareness on the importance of reducing citizens' environmental impact. CAMBIERESTI is the Italian term for 'will you change?', and a word comprised of the following: 'consumi' (consumption), 'ambiente' (environment), 'risparmio energetico' (energy saving) and 'stile di vita' (lifestyle). The project focuses on the relationship between lifestyle and environment through a journey that enables citizens to reduce their environmental impact, and to measure well being along parameters based on quality rather than on quantity. This is illustrated by a famous quote by anthropologist Margaret Mead "*Never doubt a small group of thoughtful people could change the world. Indeed, it's the only thing that ever has*."

Keywords Citizens • lifestyle • importance of personal choices • quality of life • raising awareness and changing behaviour • reducing environmental impact

6.3.3.1 Town of Casalecchio di Reno in Context

Casalecchio di Reno[1] is situated in an area where hills join a valley and the Reno river. Land is mainly covered by residential settlements, has limited farming in the area and extensive transportation infrastructure (e.g. 105 km of roads). It is very densely populated, providing citizens with a high level of urban services. The population

[1] http://www.comune.casalecchio.bo.it

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Table 6.3.3.1 Municipal profile

Population	34.829 inhabitants (2007)
Land area	17 km²
Municipal budget	€31 million (2007)

demographics are similar to those in Bologna, the capital of the region Emilia-Romagna and the Province of Bologna. Of particular interest is the significant growth in the over-65 age group, which in some areas represents 30% plus of the population. Immigrants represent 7.1% of total population. Over the past 3 years the national and international economic crisis has slightly affected the employment rate, which dropped from 13,813 in 2005 to 12,849 in 2007, and the number of businesses also decreasing over this period (Table 6.3.3.1).

Casalecchio di Reno has two Special Protection Areas – natural reservations as specified in La Rete Natura 2000 directive number 43 of 1992 Habitat. These sites were established in 2006 and form part of 2,200,000 m^2 of parks and gardens that make up the city green area – 2.200.000 m^2 of parks and gardens.

6.3.3.2 Goals

Environmental issues have never before been as internationally topical as today. They are often discussed in combination with complex scenarios that range from future climatic change to the increasing scarcity of resources. However, information on these topics is often contradictory and conflicting. This situation, combined with limited political courage, has led to a perception that environmental issues are too big to be addressed by regular citizens. Yet there is clearly a need to act at the individual level. By raising individuals' awareness on environmental impact of daily actions can help to clarify their actual impact, also the relevance thereof at the global level. This means focusing on and reaffirming the importance of personal choices – placing them at the core of a strategy and line of action needed to protect the environment and natural resources.

The project 'CAMBIERESTI' aimed at raising awareness and changing citizens' behaviour regarding energy – encouraging them to make different choices when acting as consumers, to become more energy savings-oriented, and so reduce their environmental impact. The project was realised through a 'social game' that shows the global impact of individual choices, presenting new consumption models, and suggesting ways to produce own energy from renewable resources, to save energy and to minimise the use of natural resources. The project participants had to deal with six main issues, namely:

- Waste
- Water
- Consumption of goods

- Thermal energy
- Electricity
- Transportation

6.3.3.3 Setting the Scene

The Town of Casalecchio places the ‘Cambieresti’ project within a wider environmental policy that consistently enforces the concept of sustainability. In 15 March 2007 the City Administration signed up to Aalborg Commitments, which constitutes an important point of reference for local politics. Sustainability is broadly defined as a vision that makes environment protection pivotal to all choices, and making sure the action of today does not harm tomorrow. In this context the environment is not a passive subject to be exploited senselessly, but rather a subject with which one can enter a harmonic relationship. This is a relationship that sees mankind and human actions as a part of a whole that is constructed on the understanding that development based on infinite growth can not add value, but rather leads to exhaustion of raw materials and polluting of the environment. The aim is to rather define the quality of life not on parameters based on quantity (such as Gross Domestic Product), but on parameters based on quality of life. The point is thus stressed that there is value on a kind of life that recognises the importance of the relationship between man and the environment, similar to that which exists in an ecosystem.

The City Administration tried to put these principles into practice through projects meant to beautify the area, to encourage the use of renewable energy and to promote citizen awareness regarding these aspects. The City energy plan under development in collaboration with the University of Bologna is looking to find strategies that would, in the long run, cut down usage of fossil fuels within the city boundaries, also in collaboration with industrial and trade unions.

The City CO_2 emission reduction commitment is also addressed through the preservation of green areas, and the development of tree lined streets, with 2,000 trees planted in the last 4 years. In ‘Seven complex lessons in education for the future’ the French sociologist Egard Morin argues that future generations must understand the notion of earth identity: a vision characterized by the knowledge of inter-solidarity of all parts of the world and of their shared destiny. Earth identity is based on the values of ecological conscience and conviviality with all living beings. It is in this light that regenerative counter-currents are most important. These are qualitative rather than quantitative, they reject standardised consumption for a discipline of temperance and frugality, and resist the tyranny of money with human solidarity: in short offer a sharp change of paradigm from the current socio-economical models.

‘Cambieresti?’ can thus be proudly defined as a qualitative counter-current that aims to offer **awareness to the citizens** and new ways to interpret the contemporary complexity. ‘Cambieresti?’ is not intended as a dogmatic itinerary, but as a way to incentivise free thought and discussion, to provide every citizen with information and knowledge and to let him/her choose freely.

6.3.3.4 Project Development and Implementation

'Cambieresti?' began in Casalecchio di Reno in November 2006 and lasted for 18 months, through May 2008. The project comprised of three stages.

Stage 1 – Preparation

The first stage, taking about 6 months, was devoted to planning and involving different parties and people who volunteered their contribution (along the lines of Agenda 21, planning was open to all interested parties). All stages of experimentation were developed in conjunction with all parties: from the informational campaign, to incentives, sample choosing, and detailing the work to be handled with the families. In parallel to this, an informational campaign was held between March and April 2007 to collect applicants for the project. Potential applicants were solicited via flyers, city newspapers and website, local radio and other papers. No selection criteria were applied. The only binding commitment for participants who signed up was to abiding to strict self-monitoring rules.

The issues dealt with in the project were: waste, water, critical consumption, thermal energy, electricity, and transport. These issues were chosen as key areas for daily action. The intention was to let participants observe and experiment different ways to approach these issues on a day-to-day basis. The participants were free to choose which issue(s) they wanted to commit to, with the prerequisite that they had to become actively involved in their journey. A party was organised in May 2007, to present the initiative, inviting citizens and the 125 families that joined the project. In addition to this core group of families, schools, foundations, as well as several private parties and the city administration were also involved.

Stage 2 – Implementation

The experimental stage started in mid June and lasted for 9 months. The families that participated were for the most part highly educated and middle aged. Only 2.5% of participants did not have a stable occupation, and people aged between 14 and 24 years represented 9.3% of the participants. Fifty percent of the participants claimed to participate in the project out of curiosity and to not possess specific knowledge on environmental matters and/or sustainability.

Participants were split into four groups that met monthly over a period of 7 months, with meetings coordinated by a facilitator. The meetings were intended to provide citizens with information and environmental knowledge, but were also the place for the participants to share ideas and experiences, supporting the realization that they have similar goals and interests, thus reinforcing their choices and acting as motivation.

In addition to the above, other meetings on specific topics were held, involving representatives from local associations and other experts. They offered participants more detailed information on the issues at stake, as well as practical tips and technical information to enable them to put into practice concrete changes. These events certainly represent the most innovative and founding aspect of 'Cambieresti?'. Citizens, schools, volunteer associations, trade unions, the waste disposal service and the city administration were involved in an active social and cultural network.

Each partner contributed: from scheduling information meetings on available products and services, to providing compact fluorescent light bulbs, timers, water saving devices, waste oils containers, composters, canvas shopping bags, software to calculate individual environmental impact and household energy savings, etc. Participants were also provided with a manual, specifically developed for Cambieresti, which contained useful environmental tips and actions, with local, bibliographic and web references.

The 125 families involved participated in about 50 meetings, conferences, seminars and workshop throughout a whole year. The administration of Casalecchio di Reno had the task to file a list of the good practices actually executed and to renew citizens' commitment by signing a "paper of intent' detailing their plan of action for the future. Administration and citizens were therefore sharing the same journey.

Stage 3 – Monitoring

Participants were requested to fill out two surveys to self-monitor their consumption. This was used to make clear to the participants what the real effects of the project was on their lifestyle and to give them control of qualitative and quantitative data.

6.3.3.5 Results

Overall 'Cambieresti?' represents an important experience of collective work on different social levels: from the city administration, to foundations, schools, business, private parties. 'Cambieresti' initiated a radical process of change in lifestyle towards reducing environmental impact, taking some 125 families through a journey of change. The project registered significant quantitative results, including the following:

- An increase in recycling: 87% of the participants stated they always recycled.
- Water: 70% of the participants claimed to use water saving devices, 66.7% drink tap water (against an initial 46.3%).
- Products: 60% say they chose products based on their environmental impact. Also consumption reduction.
- Energy saving: 53.3% of the participants turn off appliances and do not leave them on stand-by (against an initial 31.4%).

Effects on a relational level are also important. Participants claimed to have found through Cambieresti a meeting point where they could share an alternative vision, based on solidarity and awareness of their social responsibilities. A fair trade and fair purchase group was started and there were several instance of self-education by the participants (e.g. following up on web-links provided to learn more details).

The work done in and with schools was also important – both from an educational perspective as well as from a lifestyle change angle. Actions implemented included recycling, material reuse, reduction of energy and water consumption and reinforced the use of the pedobus. Two schools in Casalecchio di Reno initiated the pedobus project, an experience which simply consists in going to school walking, giving an important contribute for what concern the reduction of the traffic.

Energy saving initiatives were promoted with the election of a student energy manager. The importance of handwork was stressed through classes on reuse of materials.

A further impact was seen within the City administration itself: with the reinforcement of environmentally friendly purchases, the creation of a work group to monitor energy consumption, water savings, recycling and the creation of a fair purchase solidarity group.

As far as partners and associations are concerned, while adhering to the principles of the project and offering contributions to it, they did not modify their habits, did not internalise good practices, and finally did not make internal changes. The internal organization of the associations is often very 'strong', so the lack of flexibility does not allow them to change easily their habits. In this case, Cambieresti? is the first step to the acknowledgement of the item of the sustainability.

The network created by Cambieresti was instead an invaluable resource for the City Administration, also used to promote other projects in line with reducing environmental impact. These include the development of a bio-dynamic farm created to reinforce the relationship between citizens and the land, and to promote consumption of local farm products. The farm was developed on the grounds of the Chiusa park, a 110 ha green area including the remains of the eighteenth century Villa Sampieri Talon. This project promoted a city-country osmosis and re-engaged citizens in the production process, while also promoting groups of economic solidarity (so-called short distribution system), through a shared vegetable garden.

Cambieresti? also created a group of involved citizens that functions as an important counterpart for the City Administration in the development of policies to reduce environmental impact.

The project helped the City to gain an overview of actions that were already undertaken in different areas. It was decided to reinforce some (such as the purchase of trees) and to develop new actions, such as establishing a group of economic solidarity and fair purchase amongst city employees. 'Cambieresti?' dared participants to challenge themselves and question their routines, to revise the meaning of well-being and ultimately understand how our actions, as trivial as they may seem, can impact on global issues such as climate change and peace.

The total cost of the project was €25,000, of which €20,000 was provided by Casalecchio di Reno's Environmental Department and €5,000 was provided by private parties. A wide range of resources were also donated by private parties, including composters, water saving devices, compact fluorescent light bulbs, canvas shopping bags, etc.

6.3.3.6 Lessons Learned

- The journey of awareness was started with the citizens and helped to reinforce the bond and trust relationship between the City Administration and city inhabitants.
- Such a process requires the city government to be extremely receptive to input and to be able to live up to the expectations generated by the journey itself.

The most important lesson for the City Administrations was that it has to be able to correctly evaluate room of action (considering both political aspects and available resources), so as not to frustrate citizens expectations, and thus nullifying the impact.

- The working method itself was a challenge. The intention was to create or reinforce a social network of all the parties that compose the social make-up: citizens, institutions, schools, associations and business. Every group contributed according to its inclination, and in turn also helped to disseminate the good practices.
- Several participants indicated that self-monitoring was very valuable, and acted as a substantial incentive to achieve an improved use of resources and energy, and ultimately, in some cases, significantly reducing bills.
- This project shows that extensive financing is not needed to achieve success. This type of activity could easily be incorporated into a standard municipal budget, as part of raising local awareness on sustainable energy, environment, waste and transport solutions.

Key Replication Aspects

- The 'Cambieresti?' project has a very clear format that can easily be replicated in different settings.
- The preparatory stage of the project is extremely important, and needs to be developed involving all social actors: association, schools, businesses, trade associations, etc. Their contributions will be pivotal in clarifying the territory, needs, problems and potentials from different point of views.
- Use these initial meetings to choose the issues that will be dealt with.
- One part-time employee was needed throughout the duration of the project to manage the network of relationships created between several city departments and the citizens.

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Chapter 6.3.4
Municipal Climate Protection: Success Through an Integrated Approach (Viernheim, Germany)

Philipp Granzow

Abstract The experience of Viernheim shows that the complex topic of climate protection can only be dealt with when based on an integrated approach, with multiple activities on all social levels and in many technical areas throughout the community. Numerous actions and committed actors are contributing to success, as is illustrated in the case below. Yet it is also clear that motivation and perseverance by all full-time actors is needed, in addition to political backing over an extensive period. With more than 15 years of experience in municipal climate protection, extensive knowledge is available, but the challenge remains to maintain (and reinvent) a suitable way to reach the mind and heart of people to ensure their continued engagement. It is clear that the aim for action needs to be constantly in focus to determine the actual course of the action and achieve results. The strategy required for this should be adapted from time to time without losing sight of the objective.

Keywords Brundtland city • community engagement • eco-sensitive urban development • energy management is cost neutral • integrated approach • minimum standards • multiple activities with multiple actors • participative process • public relations

6.3.4.1 Vierheim in Context

Viernheim is located on the northern edge of the densely populated region Rhein-Neckar which is heavily exposed to atmospheric pollutants. Directly surrounded by two motorways and a secondary road and thus exposed to 120,000 vehicles daily, people here have long been sensitised regarding environmental aspects. At the start of the 1980s, local politicians, the administration and population started on the path for an eco-sensitive urban development, developing a sustainable climate protection strategy, and an efficient energy policy (Table 6.3.4.1).

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Table 6.3.4.1 Viernheim municipal profile

Municipal profile	
Population	33,000 inhabitants (2008)
Land area	48 km²
Municipal budget	€55,000,000 (2008)

6.3.4.2 Goals

Already in 1994 the ground-breaking energy policy and the ecological urban development of Viernheim was met with approval and support, with Viernheim awarded the title 'Brundtland city' by the State of Hessen's Department of Environment. The aim was to establish a functioning municipal example as model for other local governments based on the Brundtland report, with a strong emphasis on participative processes. Being a 'Brundtland city' means an energy saving city.[1] The award is linked to the obligation not only to continue the path chosen, but also to intensify climate protection activities. Viernheim is known as an ecological pioneering municipality across Germany and Europe. In 2005 Viernheim was awarded the first prize in the Federal Energy Saving Municipality Competition organised by the Deutsche Umwelthilfe, a non-profit environmental organisation, for the category of communities up to 100,000 inhabitants. The high number of successful climate protection measures taken by the municipality for its own building stock and other areas were acknowledged. Overall, it came fifth when compared to large German cities – an excellent achievement.

6.3.4.3 Public Relations Overcoming Passive Acceptance

Already in 1987 the Brundtland report recommended following a broad participatory process involving citizens in moving towards sustainable development. Here their focus was on advertising measures for climate protection, as well as on energy management and the sponsoring programme for the energy efficient refurbishment of old buildings. The aim was to ensure that climate protection would become a topic for all and lead to action by all. The whole concept was brought together in a professional social marketing campaign, addressing three levels:

- On the information level, Viernheim was presented and positioned as a Brundtland city, with the CO_2 problems explained and local solutions presented.

[1] Gro Harlem Brundtland former Prime Minister of Norway and Director General of the World Health Organization (WHO) chaired 'The World Commission on the Environment and Development' (1983–1987) which resulted in a report – the Brundtland Report – whereafter 'sustainable development' became a globally used concept. In Brundtland Cities there is a recognition that energy plays a pivotal role in both economic development and quality of life – – but that both are seriously threatened this century by the environmental problems associated with current energy use patterns (http://brundtlandnet.esbensen.dk/)

- On the image level, Viernheim was presented as an ecological pioneering municipality and became known as such nationally in the course of the project.
- On the involvement level, local partners were motivated to participate, supported by the project slogan 'Climate protection – we act'.

A number of activities formed part of this marketing campaign, with a few of these highlighted below that address all three levels:

6.3.4.3.1 Climate Protection Magazine 'KliMa na KLARO'

Since 1998 the climate protection magazine has been published in cooperation with a local newspaper. At first only in Viernheim, then expanding to include two neighbouring cities, it is now disseminated in the entire district. The magazine with six pages comes in a newspaper format and quality, and is distributed to all households as a supplement to a weekly newspaper with a circulation of 90,000 copies. The editors are the Viernheim Brundtland office and the two other municipal energy consultation offices of the district of Bergstrasse. KLARO reports on current climate protection issues and activities with a local and regional reference. It is also used to show how citizens get engaged, e.g. people report on their experience with heat insulation in old buildings or living in a passive house. New technical developments in the field of efficient energy use and regenerative generation are also explained in layman language. A 'kids corner' is available for comments by school pupils.

6.3.4.3.1 Annual Brundtland Festival

The annual Brundtland festival takes place on the central square of Viernheim when the shops are open on a Sunday. Priority is given to information about energy issues. For children, an energy theatre is offered. In the past years, the Brundtland festival also became a small craftsmen trade fair, showing energy efficiency products and services which draw the visitors' interest, and supporting local industry and businesses. Interested citizens can obtain information and keep themselves up-to-date with no obligation, but are offered the possibility of a further consultation appointment (Fig. 6.3.4.1).

6.3.4.3.3 Working Groups on Wood Pellets and Photovoltaics (PV)

These working groups were established to aid citizens interested in these technologies to acquire systems, providing support from the consultation phase to implementation. The decision is made easy for many participants with three evenings of support

Fig. 6.3.4.1 Climate and energy information for the public (see *Color Plates*)

offered by an external expert. With their new systems these users also become multipliers – addressing family, friends, colleagues and neighbours. Some participants even established a community of PV users.

6.3.4.3.4 Prototype Construction Sites New Buildings and Refurbishment

Regular informative events are offered at construction sites. A practical example demonstrating energy efficient refurbishment is often more informative than reading a brochure or having a consultation in the office, as it provides the opportunity to speak directly with the owner – often more convincing than speaking with a consultant, who wants to sell his services and thus has something else to gain.

6.3.4.3.5 Trade Fair for Environment and Energy

On the initiative of the energy efficiency agency of Rhine-Neckar, and supported by the City of Viernheim, a trade fair is regularly held in the Rhine-Neckar Centre focusing on energy. This has taken place three times, with approximately 60 exhibitors (mostly craftsmen and manufacturers) from the region presenting their products and services, ranging from heat insulation and PV to wood pellet systems.

6.3.4.3.6 Direct Mailing to All Owners of Old Buildings

With around 66% of CO_2 emissions caused by space heating of private households, predominantly in old buildings, the latter was a particular area for action. All house owners of old building stock in the city have received mail to inform them of the profitability of heat insulation measures (external walls, windows, basement ceiling, attic floor), listing existing consultation options and available sponsoring programmes. To date 19% of existing building stock has been improved from an energy efficiency perspective, contributing to CO_2 savings of 3,400 t as part of the subsidy programme.

6.3.4.3.7 Exhibition of Passive Houses

The exhibition of passive houses and the accompanying campaigns (lectures and excursions) directly address potential principals and architects. Technical details were deliberately not used, but the focus is rather on versatile architecture and living quality.

6.3.4.3.8 Regular Press Reports

The local newspapers regularly publish press reports of the Viernheim Brundtland office. In Viernheim, climate protection had been an issue for a long time before it received this large amount of press attention in the past years.

6.3.4.3.9 Viernheim Citizens Giving Testimonials

The campaign, 'Testimonials', presents active Viernheim citizens as leaders in climate protection, and encourages other citizens to follow suit. In cooperation with a daily newspaper, a corresponding series was implemented:

- "I am building a passive house, because …"
- "I am insulating my house, because …"
- "I am installing solar panels, because …"
- "I decided in favour of a photovoltaics system, because …"
- "I am using wood pellets for heating, because …"
- "I am using natural gas, because …"

The report is comprised of a short text with central messages of the persons and a photo of the actors in front of 'their measure'. The focus is on the person with her/

his individual opinions and decisions. The motto is 'Readers report to other readers', with photos and interviews done by the newspaper, and the Brundtland office providing the contacts.

6.3.4.3.10 Market Stall

True to the motto 'we bring it on the market', each office presents itself once over the course of a year on the weekly farmers' market with a certain topic. The relaxed market atmosphere on a Saturday morning is deliberately used to be closer to the citizen, and make outreach easier. The Brundtland office usually presents an energy topic.

6.3.4.3.11 CO_2 Pass for Viernheim Citizens

'Energy-aware' citizens were invited to participate in the CO_2 pass campaign. The aim is to call on people to recognise personal responsibility for their emissions. The participating citizens agreed to make their CO_2 emissions public, and in this way the usually abstract concept of tonnes of CO_2 could be made more real, linked to a specific person. This helps to create transparency in an area that is complex and rather difficult to communicate interlinkages. The campaign raised awareness of people to become more energy aware and efficient.

6.3.4.3.12 Promoting Natural Gas-Powered Cars

In Germany, natural gas has not yet been widely accepted as a vehicle fuel, despite its environmental benefit as an efficient fuel type and causing lower greenhouse gas emissions compared to other fossil fuels. Public consultation on natural gas-powered cars is held by a committed citizen and logistically supported by the Brundtland office (Fig. 6.3.4.2).

6.3.4.3.13 Brundtland Sport Sponsoring

'Dancing for the Brundtland cup', the 'Brundtland triathlon' and 'Brundtland city run' – these activities show that sport can be used to send the climate protection message. Sport sponsoring is a rather standard activity, but attracting attention to climate protection in this way is innovative. There are numerous advertising opportunities that can be considered, for example using the registration form and results list, sponsor meetings with the press, using flags and banners at the stadium, announcements

Fig. 6.3.4.2 Brundtland city Viernheim promoting natural gas vehicles

during the event on current climate issues, and the presentation ceremony – here the mayor takes the opportunity to address the issue.

This diverse range of activities present but a few examples used in the City of Viernheim, helping to gradually convince more people to switch from a rather passive attitude, in other words ‘yes, it is good that something happens’, to active participation in climate protection. The local press is a valuable partner, and has supported the Brundtland project from its inception, assisting outreach to the public.

6.3.4.4 A Focus on Sustainable Energy Action in Town

To set a good example and lead citizens in climate protection activities, the municipality itself should also utilise its own options. Many possibilities are available, from addressing municipal building stock, to using the municipal planning authority and its own utilities. A few actions that can be easily replicated are listed below:

6.3.4.4.1 Increased Use of Renewable Energy Sources

Up to now, RES accounts for only a very small percentage of the energy supply for the city. A concept is needed on how to increase the percentage and which technologies should be used. In this regard cooperation with one or several neighbouring cities is under consideration, to optimise local energy cooperation.

Energy customers of the Viernheim Municipal Utility can actively participate in the construction of PV and wind power plants by purchasing ‘sun certificates’ (in German called the ‘Viernheimer Sonnen-Schein’, with wordplay on sunshine and a money bill) starting with an amount of €100 (handled in the form of a loan). The utility invests in new plants, the certificates generate an interest of 4%, and crediting is handled together with the electricity bill. The entrepreneurial risk lies with the utility. Everyone investing €1 for each kilowatt-hour purchased, supplies his/her household with renewable energy, and at the same time invests money safely. This has been a very succesful approach with wide acceptance by the public.

With the bio-region wood (Bioregio Holz) project, the Hesse Federal State Government promotes the use of wood as a fuel in public buildings, and supports this project by consultation and a preferential consideration for subsidies. Viernheim participates in the project and intends to meet at least 20% of the heating demand of public buildings with bio-energy from wood by 2015.

Renting out urban roof space to third parties to install photovoltaic (PV) plants on is a relatively new topic for the administration. The implementation of the first plants and the pertinent public relations has given new impetus to PV roll-out.

6.3.4.4.2 Energy Manual for Administration and Politicians

The energy manual comprehensively governs the economic use of energy in the municipal sphere of influence, in particular in municipal buildings. It guides the administration’s actions in many ways, outlining what has to become common practice. Priority is given to efforts for the efficient use energy and water (saving and energy efficientcy measures/technologies) thereby contributing to climate protection and reducing the budget. Investment is still needed and budgets need to accommodate this, in additional to considering anticipated financial savings. Minimum standards are specified for all refurbishment measures. Facility managers or employees responsible for buildings and installation receive precise specifications for their work on how the energy savings aspect is to be considered in future are provided to urban planning staff and politicians. For a smaller development area for example the specification is that the primary energy value for space heating and hot water supply of the buildings may not exceed 40 kWh/m^2 and year.

6.3.4.4.3 Heating Plant Contracting with Municipal Utilities

Early 2008, all municipal heating plants were transferred to the ownership of the Viernheim municipal utility. The utility will operate, maintain and modernise the plants, with the municipality paying a basic rate for this service and a kilowatt-hour rate for used heat. The municipal utilities are obliged to provide at least 20% of the thermal heat from renewable energy sources (RES) by 2015. Preliminary planning for implementing a large wood pellet system are well underway.

6.3.4.4.4 Energy Advice

About 300 citizens per year consult the Brundtland office for independent and product-neutral energy advice. The questions mainly address heat insulation, subsidies and the energy pass, as well as efficient heating systems and the use of solar energy. Consulting is handled in an integrated manner. The objective for building refurbishment is usually to considerably reduce energy consumption as a first step, and then a heating system is identified for the remaining energy requirements. Measures are proposed depending on their cost (economic efficiency). It is often the case that an initially planned solar plant is not the most cost effective option, but rather insulation improvement leading to higher savings with an identical investment. A useful approach is the possibility for citizens to borrow an energy testing module to determine which devices have a high energy demand – thus they do not have to purchase such a device, and can do a quick check at home where devices are inefficient for future replacement.

6.3.4.4.5 The Brundtland Office Becomes a Communication and Information Centre

For 15 years the municipal Brundtland office has been offering a sponsoring programme for energy efficient refurbishment of old buildings. From the start, consultation has accompanied measures, as a key element of the programme. This has been intensified in the past 4 years, in particular when it became clear that many home owners are not comfortable making the required (multiple) agreements with craftsmen of various trades and applying for all the available subsidy schemes. Further to this, on-site management is also required due to the increasing complexity of a complete renovation. Offering support was identified as a service the Brundtland office could provide. It was changed into the Communication and Information Centre for Energy Efficient Construction and Refurbishment offering a complete service from initial consultation to planning, solicitation of quotations, on-site management and use of subsidy programmes. This extended service is offered against a fee by a freelance employee (engineer) of the Viernheim Brundtland office.

6.3.4.4.6 Subsidy Programme: Saves Energy, Supports Crafts and Trade

With two thirds of CO_2 emissions in private households coming from space heating – an even higher rate in old buildings (~85%) – a subsidy programme for energy efficient refurbishment was established. It addresses private home owners and rented multi-apartment buildings. Achieving a significant improvement in heat insulation of the building envelope is supported, and the following conditions apply:

- Residential buildings must be of construction year 1983 or older.
- Minimum insulation material thickness (referring to thermal conductivity group 040): Exterior wall 12 cm, roof 20 cm, basement ceiling 8 cm.
- Window heat transfer value of glazing maximum 1.1 W/m^{2}K.

Apart from these conditions, minimum qualities for the installation of insulation and windows apply. These refer to the reduction of thermal bridges (allowing heat to escape) and permanent air-tightness. The subsidy provided is unusual in that the amount paid depends on success of achieving real impacts. On the basis of the prepared energy analysis, the energy amount saved can be exactly determined. Heat losses through one or several component parts before and after refurbishment are compared. Every kilowatt-hour saved is subsidised with 7 Euro cent. In addition, a measure-related consultation by a renovation expert forms part of the programme. This includes an energy analysis conducted before the implementation of measures, and explaining the results during a consultation session. Here the cost of insulation measures, as well as the additionally available state and federal subsidy programmes are presented. Once decided on the company that will handle the contract, the concrete implementation of measures is discussed with this company, the house owner and the renovation expert of the Brundtland office. Solutions and details are discussed and specified. For major or particularly difficult measures, a second consultation is offered during the refurbishment period. From time to time quality inspection is conducted on-site.

Over the past 15 years, a total of 1,000 measures were subsidised, with 2,400 residential units – corresponding to 19% of the old building stock – were refurbished. With €1.8 million spent on subsidies, an annual heat energy saving of 10,000 MWh was achieved resulting in a CO_2 reduction of 3,400 t. Investments of €12 million were triggered which predominantly benefited the local and regional market. The sponsoring programme is thus not only a climate protection programme but also active promotion of industry (Fig. 6.3.4.3).

6.3.4.4.7 'Energy Caravan' in 2009

In the case of Viernheim, despite the subsidy programme in the city and increasing energy prices, the achieved renovation rate is still too low. Even with opportunities, the cost-effective refurbishment potential of entire residential streets are not being taken on. This means that the climate protection objectives in the building sector are also not being achieved as planned. The reasons for this are manifold. These include: the building users' preference to avoid the noise, dirt and stress of building renovation. It is also possible that information provision about the technical-economical basic conditions is not adequate. If these aspects are all available, some zplexity. The perception apparently also persists with some people that the insulation

Fig. 6.3.4.3 Craftsman preparing wall insulation

would be ‘bad for the house. The craftsman initially approached may not have provided sufficient and comprehensive advice, or only had his own work in mind. There is a lack of motivation to deal with the refurbishment of one’s house because other problems are presently given priority. Some home owners can financially deal with even higher energy prices without any problems, while others already now today have no longer have any financial leeway. The owner of a rented object, for short-term considerations, does not tend to invest much money in refurbishment from which he benefits in the long term (satisfied tenants with affordable incidentals). A major part of the buildings in need of refurbishment belongs to older people who tend to argue that “this would no longer be of benefit to them”. And many hope that ‘energy will not always become more expensive’. From experiences made it is clear that people do not always act in a rational manner.

As the City is not achieving optimal renovation levels, Viernheim decided to use the ‘energy caravan’ to draw attention to options and provide an offer to all hesitant, uncertain or uninformed refurbishment candidates. It was valuable in drawing attention to the issue, contacting people, breaking down barriers, generating an interest and positive attitude, and finally communicate detailed information on energy efficient building refurbishment.

Approximately 500 home owners in one district with similar building structures were selected, and received a letter from the mayor to inform them about the potentials of an energetic refurbishment. The energy caravan was then set up in a central area, and in a pleasant atmosphere, for example during shopping or visiting a coffee house, these people had the possibility to inform themselves, without any obligation, about home refurbishment options. Specially trained experts were available top provide advice, and another appointment with one of these experts could be arranged for a detailed consultation at their own home. Only a few people decided to make use of this opportunity, and all the other home owners, who did not arrange an appointment were visited at home. The experts knocked at every door. Interested house owners and tenants spontaneously agreed to a consultation or fixed an appointment. The owner was then informed on energetic weak points, measures and costs to remedy these, and sponsoring programmes they could apply for. Through the first caravan 30% of the owners/tenants were reached for a consultation and an additional 10% received booklets. The follow-up The caravan results are evaluated by a social scientist, but the first impression was already very positive. The caravan was considered as well prepared and a special action in town. Even those owners and tenants who declined the offered consultation would welcome a second caravan in another district. From 32 interviewees who requested a consultation, 11 plan to refurbish the roof or exterior walls. Knowledge gained will help planning of a second caravan perhaps in October 2009.

6.3.4.5 Energy Management: A Financial Perpetual Mobile?!

With correct energy management there is definitely a return on invested money. Two things needs to be considered here: firstly, starting the action, and secondly, staying on course. Success is also possible in the short term, but a span of at least 4–5 years needs to be allowed for to achieve amortisation (payback on investment). This has been successfully tested in Viernheim and many other cities. Energy management can be roughly divided into three main sections:

- Identification and evaluation of energy consumption
- Optimisation of the operation of existing facilities
- Use of efficient technology

The finance department of the municipality can most likely provide information on how high energy costs are, also for municipal enterprises. If these are known, the first step has already been taken and the next question can be raised, namely what is the consumption distribution in the buildings over the course of the year. It is recommended to take buildings with the highest consumption figures and making a tour through their engineering rooms with the facility manager – who will be a key partner. Ventilation systems, boilers, pumps, etc. need to be checked, looking at:

- Do their operating times correspond to the energy need?
- Can output be reduced?
- Do the controls function?
- It is easy to adjust everything for optimal functioning.
- Check if any devices are malfunctioning.

This is a good time to consider replacing the old products with a new more efficient one, and to achieve savings in the following year. A person has to be identified to lead this activity – ideally an ‘energy commissioner who has the mandate and responsibility to act. Energy management integrates and coordinates new and old tasks, as well as methods for energy saving, which hitherto were largely independent, to form a uniform strategy.

6.3.4.5.1 Energy Management as an Internal Cross-sectional Task

Many departments of an administration are entrusted with partial aspects of energy (e.g. the finance department, building authority, planners, municipal enterprises, facility managers). This makes things complicated. To ensure effective coordination, cooperation and handling diverse tasks, the administration requires specific staff for this activity, as external actors would not have the contact to the internal offices.

6.3.4.5.2 Energy Management Is Successful and Has Potential

Over the past 5 years, the energy management team established a network of co-actors which is regularly managed. This includes facility managers, technicians, and other municipal staff responsible for buildings. The cooperation with the building authority developed very well, was accepted and functions smoothly.

Savings achieved, are comprised of the savings from the previous year, which have to be achieved every year, and the savings from new measures which are supplemented each year. In this way the energy consumption of municipal buildings could be reduced by 29% by 2007. In the coming years, further savings will be made as the savings potential is not yet exhausted. Examples from other cities show what will be possible to achieve in 10 and 20 years. It should be clear that energy management is a permanent task.

6.3.4.5.3 Energy Management Is Cost-Neutral

In Viernheim, the saved costs exceeded the personnel costs incurred each year. Because the remaining money was invested in economic measures, the net energy management involved no costs over the past 9 years, but on the contrary, it saved €782,000. This trend will continue in the future.

A certain energy service (e.g. heated rooms) is achieved either by using cheap technology (such as an external temperature control) and a high amount of heat, or through high-tech solutions (such as individual room control with heating curve adaptation) and accordingly reduced energy consumption. For Viernheim, it was shown that the use of energy service through energy management has a more economic effect. Taking into consideration the personnel costs and the budget for

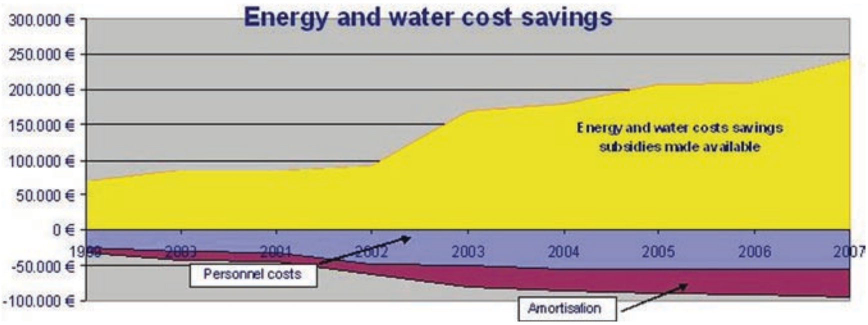

Fig. 6.3.4.4 Energy and water costs savings and amortisation period (see *Color Plates*)

energy saving measures, the savings achieved since its introduction show costs of 2.4 cent/kWh. The purchase of the saved energy, however, would have cost 6.8 cent/kWh. The savings of energy and water costs have been higher at any time than the expense for personnel and amortisation. The energy management and its success achieved in energy saving have find positive resonance with the public. The balance sheet presented annually together with the energy report is a material part of economic housekeeping for the municipality (Fig. 6.3.4.4).

6.3.4.5.4 Energy Management as Insurance Against Increasing Energy Prices

The realised savings continuously increased in the past years: From €68,000 in 1999 to €72,000 in 2000, and then again to €85,000 in 2001. Savings of €91,000 were achieved in 2002, €134,000 saved in 2003, €202,000 in 2005 and €243,000 in 2007. This clearly shows that it is a worthwhile investment. The increase in energy prices could easily be compensated for in this way.

6.3.4.6 Lessons Learned

The experience of Viernheim has been that the complex topic of climate protection, and considering sustainable energy solutions, can only be dealt with based on an integrated approach, with a coherent strategy needed to handle this. Activities are required on all social levels and in many technical areas throughout the community – numerous actions and actors involved contribute to success. Motivation and perseverance of all full-time actors is needed, as well as political backing over a long period of time. After 15 years of experience in municipal climate protection, the conclusion is that it is not knowledge which is lacking, but rather the suitable way to reach the mind and heart of people that would encourage them to engage even further.

The best time to start with actions is right away. Getting an energy manager is essential, and if there is no financing available for such a full-time person (then start with a part-time position). It will soon become possible to fill this on a full-time basis from the financial savings generated. For small communities sharing such an energy manager among neighbouring communities should also be considered as an option.

The direction aimed for should determine the actual action plan. So a strategy is required, which should also be reviewed and adapted from time to time without losing sight of the overall objective. Viernheim regards the solution as the strategy and its implementation, making use of available technology and know-how.

The following questions should be raised when considering the planned impact:

- How can the actors be motivated?
- Who should cooperate with whom and achieve what?
- How does a local and regional marketing campaign look like?
- What has to be done to reach the people?

From this perspective the aim of the action is the identified priority and should be applied to achieve real results, with Vierheim aiming:

- Each new building to be constructed to the passive house standard.
- Implementation of all technical-economical insulation measures in old buildings.
- Car-sharing scheme for every 100 inhabitants to be available.

Key replication factors

- When implementing a climate protection project over a longer period of time, several factors are required for its success:
- Convinced and convincing decision-makers on several levels (major and politics, key offices in municipal administration and energy supply) over a longer period of time
- Qualified and motivated full-time actors
- Perseverance when implementing the projects
- Acceptance of the activities by a large number of public figures and by the population
- Contribution of central persons on all levels
- Cooperation with regional actors and organisations

Project-related evaluation and adaptation of the strategy, if necessary, without losing sight of the objective

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Chapter 6.3.5
A Systematic Approach to Climate Protection: Towards a Fossil Fuel Free Stockholm 2050 (Stockholm, Sweden)

Jonas Tolf

Abstract Since the start of its climate protection action in 1995 until today, the City of Stockholm has been working systematically and efficiently in this field, starting with mitigation actions and from 2006 including climate change adaptation. By 2005 the second greenhouse gas (GHG) reduction targets were met and emissions per inhabitant of Stockholm have been reduced by around 25% from the baseline levels of 1990. The City's long-term goal is to be fossil fuel-free by 2050, and the City has now established the ambitious target of reducing greenhouse gas emissions to 3 t of CO_2 per resident by 2015. The early start and the methodical character of Stockholm's climate work in part explain the success story thus far. Other contributing factors are political support and networking with other municipalities, as well as organisations devoted to climate change related issues. The early decision to move from theory to practice, and to have ambitious policies matched by concrete action and a large number of practical measures, helped the City to move forward step-by-step. The climate protection activities of the City of Stockholm can serve as an inspirational model for other municipalities. In February 2009 Stockholm was awarded Europe's first Green Capital for 2010 partly due do decades of climate efforts and partly due to the environmental and climate goals we have established for the future.

Keywords Awareness-raising • biofuels • climate action programme • communication • district heating and cooling • fossil fuel free target • public transport • population growth • European Green Capital

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Table 6.3.5.1 Stockholm municipal profile

Municipal profile	
Population	818,603 (2009)
Area	188 km²
Municipal budget	Approx. € 3.3 billion (2009)
eCO_2targets	Fossil fuel free city by 2050

6.3.5.1 Stockholm in Context

Stockholm is centrally situated in Northern Europe, and is the capital of Sweden. It was built on 14 islands, where Lake Mälaren feeds into the Baltic Sea. The population of the City of Stockholm is around 820,000 inhabitants, with approximately two million people living within the Stockholm metropolitan region. The City Council consists of 101 members, and the current political majority of the City of Stockholm is comprised of a coalition between the Moderaterna Party (conservative), the Liberal Party and the Christian Democrats (election period 2006–2010). The Stockholm City Administration is divided into 14 specialist committees and 17 companies, with about 47,000 employees (Table 6.3.5.1).

Stockholm is in one of Europe's leading economic regions, with a high concentration of information technology, biomedicine, finance and research. The city is growing and faces the challenge of both retaining and developing its unique character, with the aim to have a sustainable and attractive place for people to live and work in. Early in 2009 Stockholm was awarded Europe's first Green Capital for 2010 following a competition with 35 other European cities. Stockholm's success was partly due do decades of climate efforts and partly due to the environmental and climate goals we have established for the future (Fig. 6.3.5.1).

6.3.5.2 Goals

It is clear that no single city, nation or organisation can turn the tide regarding climate change, but by joining forces making an impact is possible. By continuing to be a good example of successful climate initiatives, the City of Stockholm believes it can make a difference and contribute towards a positive development. It started a series of Action Programmes against Greenhouse Gases (GHGs) in 1995, and to this day continues with its systematic and efficient work in the field of climate protection.

The aim of the City of Stockholm's climate work is to reduce GHG emissions and to raise the awareness of the climate issue among the residents of Stockholm – reaching the target to become a fossil fuel free city by 2050. A proposed intermediate goal to reduce greenhouse gas emissions to 3.0 t eCO_2 (carbon dioxide equivalent) by 2015 has been adopted by the Stockholm City Council in 2008. As an essential framework and complementing the climate programme, the City has set up an ambitious Environmental Programme in 2007, with six goals for the most critical environmental issues:

- Environmentally efficient transports
- Non toxic goods and buildings
- Sustainable use of energy

Fig. 6.3.5.1 The Stockholm City hall (see *Color Plates*)

- Sustainable use of land and water
- Environmentally efficient waste management
- Healthy indoor environment

6.3.5.3 The Strategy: Starting with a Climate Programme

The City of Stockholm has worked within the field of climate protection for more than 14 years (from 1995). Climate protection activities include mitigation and adaptation steps in different sectors – addressing energy, transport, water, waste, and increasingly urban planning. In order to ensure that all forces are pulling in the same direction, the city works closely with various stakeholders. Yet before some measures and actions are presented an overview is first provided on the process of setting up such a programme.

6.3.5.3.1 Environment 2000

The first goals to reduce eCO_2 emissions were instituted as early as 1995, when the City listed a number of targets in an environmental programme, Environment 2000. The targets pertaining to GHGs were:

- By the year 2000: net emissions of eCO_2 from traffic should not exceed 1990 levels
- By the year 2000: net emissions of eCO_2 from energy consumption (heat and electricity) should not exceed 1990 levels

6.3.5.3.2 Stockholm's Action Programme Against Greenhouse Gases 1997–2000

To reach the goals of Environment 2000, the first Action Programme against GHGs was drawn up. The programme was submitted to all ruling bodies, city public sector companies and administrations, various regional authorities and organisations, for acceptance and implementation. The Action Programme against Greenhouse Gases 1997–2000 was adopted by the City Council in June 1998. By the end of the programme period Stockholm had not only reached the goals of Environment 2000, which stated 'no increase' goals, but had in fact reduced levels of emissions from traffic, heating and electricity by 4%.

6.3.5.3.3 Stockholm's Action Programme Against Greenhouse Gases 2000–2005

The next challenge for the city was expressed in a new Action Programme against GHGs 2000–2005, which was adopted by the City Council in 2003. The target: by the year 2005 – net emissions of CO_2e/capita should be reduced to 4.0 t/year (i.e. a reduction with approximately 25% from the 1990 level). The target was reached in 2005. The Stockholm Action Programmes against Greenhouse Gases and the Stockholm Environment Programme complement each other. The greenhouse gas targets set up in the Action Programme make up a cross section of the six targets set out in the Environment Programme. Unlike the Environment Programme, where the focus is entirely on targets, the Action Programme is also a strategy for climate activities and actions that together will achieve the predicted targets.

6.3.5.3.4 Now Towards Cost-Effective Reductions by 2015

In 2007 the City of Stockholm made an ambitious investigation into the most cost-effective actions to be taken to further reduce eCO_2 emissions to 3.0 t/capita by 2015. Furthermore, the most cost-effective ways to reduce energy consumption with 25% were investigated. The investigation showed that the most cost-effective actions were to be taken in the transport and building sectors. A follow-up study in early 2009 showed that actions in the transport sector had reduced the emissions with 14% from 1990 to 2009. Correspondent figures for the energy sector was 7% and for the heating sector 40%.

The investigation has formed the basis for a new goal for 2015, to reduce the net emissions of carbon dioxide to 3.0 tonnes per capita (t/capita), a reduction with 43% from the 1990 level. The goal was taken by the City Council in 2008 and the work to form a new action programme was started in early 2009. The new programme will be the City of Stockholm's Sustainable Energy Action Plan within the commitments of Covenant of Mayors, which the City of Stockholm signed in February 2009.

6.3.5.4 Adapting to a Changing Climate

Until recently the issue of reduced emissions (mitigation) has received more attention than the question of how society should in fact adapt to a changing climate. Today it is known that even if the emissions would be reduced to a level that the International Panel on Climate Change (IPCC) considers low-risk (approximately 1.5 t of CO_2 per person) there is still a need to prepare for a changing climate. Therefore, the scope of the City of Stockholm's climate work has been broadened, to also address climate adaptation. Warmer summers with more frequent heat waves, milder winters with heavier rainfall and rising sea levels with risk for flooding are anticipated. As a platform for vulnerability analyses, the City of Stockholm has performed a survey of expected flooding in relation to a 100-year forecast. The survey has identified several risk areas. Stockholm is situated between Lake Mälaren and the Baltic Sea with a floodgate in the central city. The floodgate regulates the water level of Lake Mälaren. In an ongoing project to reconstruct the floodgate, the identified risk for flooding has led to a new construction with a doubled outlet capacity.

Today a raised level of awareness of the consequences of climate change can be noticed within the city planning processes, i.e. within departments and companies with responsibilities for energy supply, traffic infrastructure, water treatment etc. The city is currently working on a new master plan, in which the expected consequences of climate change are taken into account. The City of Stockholm have produced three reports on relevant themes:

- Risk for flooding and awareness in the city
- Effects on contaminated soil
- Effects on biodiversity

The reports are based on a study by the Swedish Meteorological and Hydrological Institute (SMHI), in which the risks of altered water levels, increased levels of precipitation and periods of heat wave are described. The importance of this issue means that it is now a matter for the City Executive Office.

6.3.5.5 A Selection of Effective Mitigation Actions: Addressing Technology and People

The success of Stockholm's work within the field of climate protection is to a large extent the result of the decisive and efficient action taken. Collaboration between the City of Stockholm, stakeholders outside the city's organisation, private companies and the citizens, has created a platform for success.

An extensive number of measures have already been carried out, and there are at least 50 different measures currently in progress – ranging from physical investments to awareness-raising – in the fields of heating, energy use, transportation and waste management. A selection is presented below.

6.3.5.5.1 Wastewater Treatment

Since the 1960s, wastewater treatment facilities have been expanded to all developed areas. With continuously refined technology, the water in Stockholm has become so clean that today it is possible to swim in the middle of the city. Wastewater sludge is now also an important resource for biogas production.

6.3.5.5.2 Expansion of District Heating and Cooling

A good example of mitigation is the extension of the district heating system, which covers approximately 80% of Stockholm's total heating needs. Construction of the city's first district heating system began 1959 in the north western part of the city. Since then the district heating system has been built out in different parts of the city and step by step been connected to each other. The latest connection was in 2008 when the central and southern system were connected to each other. Since the mid-1960s, oil and coal have been gradually replaced with biofuel. 2008 were the last plant with combined power and heating taken in operation. Today, district heating comprises nearly 80% renewable fuel or energy from waste or residual heat. The district heating network is being continuously expanded to further increase the proportion of district heating in the city. Here the utilities, the public, businesses and the municipality have worked together to consider using green energy. Oil used for heating outside of the district heating system is rapidly diminishing. It is estimated that heating for individual use could be almost fossil fuel free by 2020. Another example is the construction of a new production facility, where cold water from lakes and the sea is used to produce district cooling. District cooling contributes to an annual environmental gain of approximately 50,000 t in reduced CO_2 emissions.

6.3.5.5.3 City Districts with Environmental Profiles

The Hammarby Waterfront was built 1995 as one of the first city districts with an environmental profile. The city district has 10,400 flats and has a renewable energy use. Stockholm Royal Seaport and Västra Liljeholmen are two new sustainable city districts with experiences from the Hammarby waterfront, with environmental profiles that entail both greenhouse gas emission reductions and an adaption to the anticipated climate changes. The challenge for Stockholm Royal Seaport, one of Europe's largest urban development projects, is to combine a growing city with the values that make Stockholm unique: the proximity to water and nature. The three overall environmental targets for Stockholm Royal Seaport are: by 2030, Stockholm Royal Seaport is free of fossil fuels, by 2020, carbon emissions are lower than 1.5 t per inhabitant, Stockholm Royal Seaport is adapted to future changes in climate. The Stockholm Royal Seaport development has been announced as one among 16 founding projects of the Climate Positive Development Program, a Clinton Climate Initiative (CCI) program that will support the development of large-scale urban projects that demonstrate cities can grow in ways that are climate positive.

6.3.5.5.4 Energy Efficiency in Existing Building Stocks

Stockholm has three municipal housing companies. All three companies are strongly pursuing energy efficiency in their existing building stocks. Often the goal is a reduction with 50%. A special programme to refurbish social housing units in the north western part of Stockholm has been set up. The buildings in the district will be refurbished to low energy standards and gain environmental profiles as in the new sustainable city districts. Micasa, the housing company for the elderly, is in the middle of a mayor renovation activity, also with ambitious energy goals. The facility management organisation, FSK, is just starting up a similar process for a great part of their building stock.

6.3.5.5.5 Congestion Tax

To deal with congestion and traffic disturbances, a congestion tax was implemented in Stockholm in 2007. Since then, traffic to and from the city centre has declined by an average of 20%, and queuing times in and around the city centre have decreased by 30–50%. The number of clean vehicles passing the congestion tax stations has increased from 3% 2006 to 15% today. Greenhouse gas emissions have declined by up to 14% in the city centre and by approximately 3% in the entire Stockholm region. Before the congestion tax was introduced, many people opposed it. Accordingly, a trial of the congestion tax was carried out in 2006. The trial resulted in an increase in popular support for the tax because the number of cars in the city centre decreased and because the system worked well. The outcome was that the majority of Stockholmers now have a positive view of the congestion tax.

6.3.5.5.6 Stockholm Climate Pact

The Climate Pact, launched in 2007, is an alliance between the City of Stockholm and a number of companies in the Stockholm region. The aim is to create a platform for companies that want to achieve the same goals as the City. The Climate Pact is also an important forum for inspiration and exchange of experience. The commitments the members make are based on their own individual aims and levels of ambition. An example illustrates what this means: Taxi Stockholm has set a target to decrease fossil CO_2 emissions by 40% by 2012 compared to 2005, and has achieved 18%, despite the increase in fuel costs. Until 2009 approximately 75 companies in Stockholm have joined the Climate Pact.

6.3.5.5.7 Fossil Fuel Free Public Transport

The region's public transport company, which is run by the County Council, passed a resolution to become fossil fuel free by 2025. Nearly 75% of the company's traffic now runs on renewable energy. The rail bound traffic runs on electricity generated by wind power and hydropower. In Stockholm's city centre, all buses run on renewable energy, with about 400 ethanol buses, and approximately 100 biogas buses.

6.3.5.5.8 Municipal Green Fleet

Traffic is the main source of health-hazardous emissions and noise, as well as a major source of GHGs in Stockholm. To address this, the City initiated the project Clean Vehicles Stockholm, with the objective to reach a market breakthrough for clean vehicles. The aim was to have a municipal green fleet, but to make this work it was realised that a wider roll-out was needed – to create demand hat would lead to fuel and vehicle availability. The work carried out by the City over more than 10 years to promote bio fuel-driven light and heavy vehicles has been extensive. Due to persistence and policies, e.g. exemption from congestion charges and free parking for local residents with clean vehicles, a market breakthrough for clean vehicles was achieved in 2006. From 0% in the early 1990s to around 40% of all new sold cars in the Stockholm region were bio fuel vehicles in January 2008. The City of Stockholm drives clean vehicles. The target is for 100% of the City of Stockholm's vehicles to be clean vehicles by 2011.

6.3.5.5.9 Blended Petrol

The City of Stockholm initiated a five percent blend of ethanol in petrol in 1997, with the support of a petrol company, impacting on the whole region. The measure was first introduced in the region of Stockholm and has spread to the entire country. The use of E5 petrol instead of unblended reduces GHGs with approximately 4%/l (City of Stockholm 1997).

6.3.5.5.10 Stockholm Energy Centre and Energy Advice Centre

The Energy Centre in Stockholm has as its task to introduce energy efficient solution for the administrations and companies owned by the city. The Centre monitors the City's energy consumption, offers energy-efficiency advice, implements techniques and arranges seminars Information activities on new technologies, such as LED for common lighting and individual measurements of domestic hot water are some examples of recent activities. Photovoltaics and wind power are other areas for long term implementation. The Energy Advice Centre is a group effort of 27 municipalities in the Stockholm region. The Centre offers energy efficiency advice to residents and companies alike.

6.3.5.5.11 Communication Projects

During the last 4–5 years the City has carried out several interactive communication activities and projects with a range of stakeholders: youth, business and industry, car owners, city employees and citizens in general. The overall aim was to communicate the City Council's target – Fossil Fuel Free Stockholm 2050, and to encourage people and organisations to take action. Generally, the interactive communication projects have been found to be cost-efficient measures to reduce emissions. A series of campaigns are running between 2008 and 2010, in which the vital point will be to inform people living and working in Stockholm of the City's undertakings for the climate and also offer advice on what people in general can do to reduce emissions and curb climate change.

6.3.5.5.12 Climate Neutral Stockholmers

The purpose of this project is to inform people living and working in Stockholm what actions the city is taking to reduce GHG emissions and what a citizen can do in daily life to reduce GHG emissions.

The first campaign in the project was the produce of a brochure which was sent out to all Stockholmers with advices how people can reduce emissions in their own households.

6.3.5.5.13 Energy Efficiency and Alternatives to Oil-Based Heating

The overall aim of the project was to reduce the number of houses heated with oil and electricity by informing of alternatives, such as pellets, district heating, etc. The target groups were:

- Owners of houses heated with oil or electricity within the City of Stockholm
- Plumbers, heating and sanitary engineers and chimney sweepers active within Stockholm
- Suppliers of pellets and/or pellet equipment to the citizens of Stockholm.

6.3.5.5.14 More Examples

Smart Consumption, the tyre pressure campaign, Climate First Aid and Climate Hunt are other examples of communication projects for special target groups. The Smart Consumption project focused on the households' entire energy consumption, i.e. consumption of goods and services, such as food, energy, heating and transport. Fifty households were selected in each of the 18 town districts of Stockholm and a GHG profile was established for each household. The Agenda 21 Office and environmental coordinators of the city districts participated in the project. In the Tyre Pressure Campaign several tyre pressure campaigns were carried out at gas stations in Stockholm during the period 2004–2007, when car drivers in Stockholm were informed of best conduct to reduce emissions of CO_2. The Climate First Aid programme focus on climate issues within education. Schools and teachers are offered training, such as teacher tutorials, classes for pupils, competitions and school visits. Pupils can also participate in the Climate Youth Parliament. The Climate Hunt is an educational team-quiz and assignment competition for companies and municipal administrations in Stockholm. The aim is to bring about changes in patterns of behaviour through increased awareness and knowledge of the greenhouse effect

6.3.5.5.15 Sharing and Motivating

In addition to achieving its internal goals, another aspect the city is very interested in is outreach and informing other local governments about the need for climate protection action and the range of options available. In this context Stockholm played host to Conference 'A Future with Zero CO_2 Emissions' in May 2006. This event, a biennial conference of the European CCP Campaign, focused on ways to effectively reduce GHGs at a local level, moving towards climate neutrality and adapting to a changing climate (ICLEI 2006). The Stockholm Conference took place following long-standing cooperation between Stockholm and ICLEI, in particular within the framework of the CCP Campaign.

6.3.5.6 Results

The early start and the methodical character of the City's climate work explain the Stockholm success story in part. Political support and networking with other municipalities and organisations devoted to climate change related issues are other contributing factors. Of crucial importance for the achievements has been the early decision to go from theory to practice; policies have been matched by concrete action and a large number of practical measures to reach the overall goals.

The ambitious climate work carried out by the City of Stockholm has so far led to extensive GHG reductions. Despite a population growth – during the period 1990–2005 – of approximately 14%, GHGs were reduced by 15% in this period. This means that the per capita emissions were reduced by 26% during a 15-year period. In particular GHGs from transport, heating/cooling and electricity were reduced by around 25% from the baseline levels of 1990. In real figures, this means that the emissions have been reduced by 500,000 t of eCO_2, even though the population has grown by 60,000 inhabitants. By 2005 the per capita emissions in Stockholm were down to 4.0 t/year, compared to the 5.3 t of 1990. An analysis on what must be done to achieve further GHG reductions to a level of 3 t eCO_2 per capita in 2015 has been carried out. This analysis formed the basis for a proposed intermediate goal, which was accepted by the Stockholm City Council in 2008.

The most important contributing factor to these reductions was the conversion from fossil to renewable fuel for the heating of houses and premises. Considerable GHG reductions were achieved in the energy supply sector, with the development of district heating. Local systems, often oil-heated, were abolished by connecting most of Stockholm's houses and premises to the district heating system. Thus the heating became more energy efficient. In the area of transport, more public buses now run on bio fuels, and there has been a huge increase in the number of green vehicles in the city. Emissions from traffic have more or less remained the same, despite an increase in traffic intensity by 1%/year.

The incentive to reduce the use of energy has, until recently, mainly been to gain financial savings. Now, due to the City's climate campaigns, a situation has developed where various actors are considering such climate change mitigation measures and/or adaptation to a changing climate as primary objectives. This applies to the City's companies and administrations, organisations and private individuals alike.

6.3.5.7 Lessons Learned

Political support has been a key element in achieving success. The systematic climate work in Stockholm for over more than fives decades has of course drawn the attention and interest on the political scene. Political commitment to the climate issue is naturally a decisive success factor, as it would not be possible to carry out climate protection programmes without this support. The programme goals, which have been clear and set to be reached by a specific time, have been adopted at the highest political level. The tough goals have been matched by clear action plans, showing the actual input, including funding, required to reach the goals.

The City of Stockholm's involvement in international organisations and networks generates project based cooperation and exchanges of knowledge, experiences and best practices in the climate work. Examples of such cooperation with international organisations are ICLEI and its Cities for Climate Protection (CCP) Campaign, the C40 and EUROCITIES.

The City of Stockholm's strategy to concentrate city development, e.g. to use centrally located areas (old industrial plots, overbuilt railroad tracks, etc.) for new housing projects, has assisted the climate focused actions to improve public transport and the district heating system. A dense city, it has certain advantages from the pedestrian and cycle traffic point of view, where there has been a constant increase of cycling in Stockholm.

As there was initially limited knowledge about how to create a Climate Action Plan within the municipality, several prominent researchers were tied to the project at the start-up phase. An important factor of Stockholm's climate work has been the close cooperation with colleges and universities. When setting up the first action programme, an expert panel was formed with, among others, late professor Bert Bolin as one of the founders and the first chairperson (1988–1998) of the IPCC. There remains a well-established collaboration with the Royal Institute of Technology (KTH), which guarantees the quality of forecast analysis. The close collaboration with universities also gives scope for academic analysis and studies of Stockholm as an example.

Another key success factor has been the collaboration with local actors where a potential for GHG reductions has been identified, such as public authorities, companies etc. Collaboration with the district heating company has resulted in an extended district heating and the increased use of RE for district heating. Cooperation with the regional public transport company means that a greater part of their vehicles now run on RE. Furthermore collaboration with the residents of Stockholm has been very valuable. Activities and measures have been tailored to suit the different needs and trends of society.

Key replication aspects

- A systematic approach and clear goals and objectives have been essential to the success of the work.
- Measures have been concrete and it was possible to follow up on these with further actions, thereby building on previous actions, seeing improvements and this has motivated people to follow-up.
- Two areas have been particularly important to reduce emissions through effective action, namely energy supply and transport sectors.

(continued)

Key replication aspects **(continued)**

- The new district heating system ensured a conversion to a larger percentage of renewable fuel, providing heating for most buildings in the city.
- A well-developed public transport system, with a high proportion of buses running on renewable fuels, and rail bound traffic on green electricity, led to extensive CO_2 reductions in the transport sector.
- The removal of market obstructions connected to the sales of clean vehicles was another success factor. Clean vehicles are now taking an increased market share, although there are now fewer supportive measures in place.

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Chapter 6.3.6
Monitoring Energy in Schools in the Veneto Region: The Legambiente Campaign 'Switch to Savings' (Veneto Region, Italy)

Marco Boscolo

Abstract In the Veneto Region, with close to five million inhabitants, energy consumption in buildings represents 40% of the total energy consumption – an area with interesting greenhouse gas reduction and energy savings potential. Every building uses around 75% of its energy for heating and cooling. This high percentage is largely due to inefficient construction of the building envelope. To address this issue and related health problems, the organisation Legambiente started an awareness-raising campaign 'Switch to Savings' (Italian – *Accendi il risparmio*) in schools in the Veneto Region in March 2008. The intention was to draw attention to energy use in school buildings from a behaviour perspective. In parallel to this process a technical project was initiated, to identify the energy improvement margin of school buildings in the region. This type of building was selected as schools play an important role in Italian community life, functioning as educational centers and community facilities. An analysis was conducted in 50 buildings, typical of the style built in the post-war (Second World War) era, with results used to present a case for urgent energy efficient refurbishment.

Keywords Building envelope • construction • energy consumption • energy efficiency • environmental comfort • health • in-door comfort • monitoring • regional government • schools • user behaviour

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6.3.6.1 Veneto Region in Context

Table 6.3.6.1 Veneto Region profile

Municipal profile	
Population	4,845,832 (2008)
Area	18,391 km^2
Budget	
eCO_2 targets	

6.3.6.2 Moving Away from an Oil-Based Economy

Energy is one of the central themes where environmental and innovation objectives can be combined with competitiveness and development (Table 6.3.6.1). Indeed, energy underlines the inherent relationship between local and global issues, industrial models and energy costs, as well as instability and conflicts regarding increasingly scarce oil resources and control over prices. People have to find an answer to these challenging issues and their consequences. This can be done by promoting an alternative model, planning projects based on energy savings and the use of renewable energy sources, relaunching innovation and conducting research, so that the world can move away from an oil-based economy and become safe, clean and modern.

During 2008 the general warning about rising oil prices and the impact thereof has spread across the world. This is a matter of concern, but it also provides a window of opportunity for considering counter-proposals that address the energy issue as a whole, including environmental impact and new opportunities for change. People should understand that the world is facing a new era in energy transition, and during this period of uncertainty and slow movement, the 'past' will be represented by oil, coal and nuclear fusion as energy carriers.

6.3.6.3 Improved Energy Potentials in Italy

The new route suggested by Legambiente[1] is based on consumption reduction and energy efficiency (EE) improvements in transport, industry and housing. This route is supported by the roll-out of renewable energy sources (RES) seen around the world, for example illustrated by mega-watt potovoltaics (PV) installed in any

[1] Legambiente is a voluntary association established in 1980. It is the most inclusive Italian association in the country, including 1,000 local groups, 20 regional committees, 115,000 partners and supporters – www.legambiente.eu. Acknowledged by MATTM (Ministero dell'Ambiente e della Tutela del Territorio e del Mare), Legambiente is also involved in the Bureau Européen de l'Environnement, which includes all the main European environmental associations, and in the International Union for Conservation of Nature *and Natural Resources* (IUCN).

(1,537.2 MW) Spain (57.5 MW) and Japan (402 MW).[2] Considering wind power, which has the highest generation capacity globally at this stage, this is satisfying an increasing percentage of energy demand in different European regions. A growing interest in the potential for biofuel development has also been seen in 2008. These results, obtained in a relatively short time period, shows that there is likely to be change when technical maturity has been achieved and market conditions exist.

Italy depends on fossil fuel imports (43% of total consumption) and can benefit from the current technological and energy revolution to reduce its energy costs and also actively reduce carbon dioxide (CO_2) emissions, in accordance to the Kyoto Protocol, as important steps in reducing the human impact on climate change. Global warming is already visible, and producing frightening effects. In Italy, despite some difficulties such as the lack of a long strategy to reach the Kyoto commitments, it is according to Legambiente possible to reach the new 2020 European Union (EU) targets of achieving a 20% CO_2 reduction, with a 20% energy efficiency increase, and 20% energy consumption coming from RES. The technologies are available. What is needed are environmental, fiscal, industrial, research and development (R&D), as well as a strong and integrated policies. Future Italian energy priorities should be set to reach these objectives, namely:

– Twenty percent energy consumption reduction
– Twenty-five percent electricity production coming from renewable energy
– Energy efficiency and safety increase of the electricity network, considering the future wide energy production, and gas as the transition energy resource

The future in terms of climate change mitigation does not necessarily include the early closure of cinemas, theatres and restaurants or reducing public lighting, but it most certainly includes energy savings. This change should respect human comfort, with buildings designed and built according to bioclimatic principles, generating electricity, space and water heating or cooling through the use of RES, and continuously improving energy savings technologies. To become less 'oil-addicted' there is a need to promote research and innovation, and move towards a modern stable economy. It should be able to address future energy production for cities and regions through solar thermal energy and micro combined heat and power (micro-CHP) systems using methane. Electricity demand should be covered by using and integrating the local RE potential (solar energy, wind power, biomass, small hydro power, etc.) with the most efficient technologies. Extensive energy and bioclimatic renovation of buildings needs to be done – considering the rational energy use of energy, reducing residential waste, using passive solar energy, generating solar thermal energy, as well as highly efficient systems and appliances.

In March 2007, the European Council (heads of state) reached an agreement, namely to reduce emissions by 20%, improve efficiency by 20% and increase the share of RES by 20% by 2020, from 1990 baseline levels.

[2] Source: Legambiente 2007, *Comuni Rinnovabili 2007* (Legambiente on data EWEA, ESTIF, Eurobserv'ER).

The Italian National Agency for New Technologies, Energy and the Environment (Enea 2006), estimates that Italian energy consumption in the civil sector (residential and tertiary) had a 2% increase per year between 1990 and 2006. The primary total consumption moved from 62.4 million tonnes of oil equivalent (Mtoe) in 1991 (on 167 Mtoe national availability) to 80 Mtoe in 2006 (on 197 Mtoe availability).

6.3.6.4 Energy in Buildings

Despite its good climate conditions, Italy is the European country with the largest energy loss in building stock. If the new energy standards[3] are only applied to new buildings, it will not achieve the main aim of improving overall building efficiency. Indeed, new housing represent a miniscule percentage of Italian building stock, and this number will not really affect energy demand. It will also be impossible to verify the energy consumption trend, because the turnover rate will be too low. Thus it is more important to consider energy in all the existing building stock, in particular the 75% of buildings constructed after 1945 that were built very quickly and with low cost materials, and no attention to energy saving – this is where the problem lies.

The liberalisation of the energy market and the increase of energy costs are providing new opportunities regarding energy saving and improving efficiency in buildings. Italian cities are mainly comprised of buildings built between 1960 and 1990. In their planning and construction energy efficiency was not considered, yet people spend the majority of their working and family life here and require comfortable environments that should require limited resources to maintain the comfort levels. It is clear that the buildings can not all be replaced, so an important solution is the energy efficient renovation aiming for a good return on investment (Figs. 6.3.6.1 and 6.3.6.2).

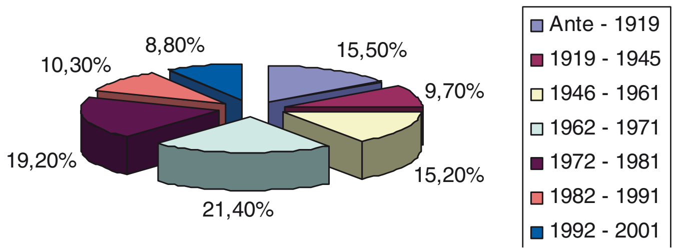

Fig. 6.3.6.1 Veneto region, buildings by construction period (see *Color Plates*)

[3] Eu 2006, Directive 2006/32 on energy efficiency and final uses of energy (Increase of 1% per year). Eu 2002, directive 2002/91 Indication on energy performance in building sector. Veneto Regional Government 2004, Regional Plan of Atmospheric Improvement.

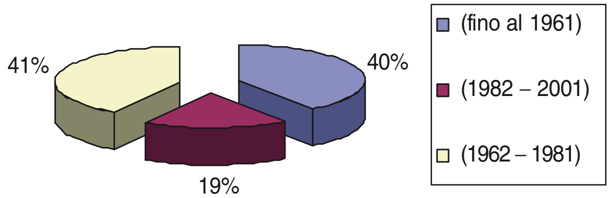

Fig. 6.3.6.2 Average surface of dwelling 110 m^2. Annual energy consumption 1.6 toe/around 170 kwh/m^2 per year (Veneto Region Sistar on National Institute of Statistics Data) (see *Color Plates*)

6.3.6.5 The Project in Brief

6.3.6.5.1 Motivation for Action

School buildings in Italy tend to have a low level of user comfort. This requires urgent action to address the unsatisfactory conditions such as biological pollution, mould, humidity, cold walls, and also the associated problem of high fuel consumption. From this problem perspective, Legambiente Veneto started a building monitoring campaign using simple tools, such as weather stations and liquid crystals thermometers, and blower door tests (using testing equipment used to measure the rate of air leakage and to perform a thorough energy efficiency analysis of the building) to determine the environmental parameters.

Public buildings in general and schools in particular were selected for this project, because these are normally used over a long period of time. The users – school employees, teachers and students – generally need to face difficult environmental conditions such as noise, indoor pollution, as well as energy inefficiency concerning building structures and old systems. Furthermore, currently many public administrations have allocated funds for energy production through RES (mainly photovoltaics), but are not focusing on energy efficient renovation or any energy savings measures. To encourage a change in this decision-making process a range of arguments had to be prepared that could be presented to politicians and technicians in charge of wide-scale change.

6.3.6.5.2 Main Aims

The project focused on both quality and quantity evaluation of energy consumption in buildings, and the identification of data based on climate, type-functional and building construction parameters. An energy waste analysis and evaluation of possible energy reduction strategies would follow. The first issue the project addressed was how to move towards energy innovation interventions regarding maintenance and renovation of existing buildings. The project aimed at establishing a solid foundation which would allow the public administration to start with renovation based on the analysis. Also the selection of improving energy efficiency would need to become standardised, making this more effective on a broad scale. A second area for action is energy management of buildings. The aim is to create an 'energy savings market' that already exists in other countries. In other words, develop a need for building managers with skills to improve energy efficiency[4] – with companies as candidates to manage energy systems of residential buildings and apartments, commercial buildings, as well as tertiary users and even whole districts. Such companies, in a competitive market place, could carry out actions that are funded by earnings from energy savings realised, thereby not only improving actual efficiency of systems, but also reducing energy waste. This can for example be done through using thermal insulators, terraces and greening spaces to protect overheating from the sun, or bioclimatic atria and greenhouses.

A first level of analysis was limited to energy issue, in order to consider:

- The high costs of winter heating and summer cooling, and
- A more direct and effective awareness campaign for the owners/users

The research objective was to make the users aware that in-door living quality – a new concept for the majority of the population – could be obtained by reducing dependency on fossil fuels and by reducing energy waste. The monitoring campaign promoted by Legambiente, aims at not only obtaining information regarding the actual building stock built after 1945 (relevance: different construction techniques and materials, e.g. bricks, concrete framed structures or buildings completely in concrete), but also aims to involve young people, the future promoters of projects in urban renovation issues.

The largest number of buildings in use, were built in the 1945s and 1980s. Maintenance was rarely performed, and most buildings retained their original envelopes (frames – windows, walls, roofs). Even when replaced, these tended to be of low quality, i.e. not energy efficient. The next challenge faced was an extensive re-qualification, starting new projects, involving new actors and getting innovative ideas. From this perspective trade unions were also involved in the Legambiente project, to convince them to put more projects into practice. This was achieved working together with technicians of public administrations and starting a debate on energy inefficiencies that were identified.

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[4] Action Plan for Energy Efficiency: Realising the Potential – Priority Action 2. Building performance requirements and very low energy buildings ('passive houses'). The Commission will propose expanding the scope of the Energy Performance of Buildings Directive substantially in 2009, after its complete implementation. It will also propose EU minimum performance requirements for new and renovated buildings (kWh/m^2). For new buildings, the Commission will also by the end of 2008 develop a strategy for very low energy or passive houses in dialogue with Member States and key stakeholders towards more wide-spread deployment of these houses by 2015. The Commission will also set a good example by leading the way, as far as its own buildings are concerned.

Using the term ‘negawatt’ is rather an odd word when speaking about energy saved due to a consumption control policy. Yet negawatt has led Legambiente Veneto in promoting a campaign in 2008 against energy waste – addressing teachers and pupils, with a survey conducted by operators who were supervised by IUAV of Venice. This was an important step, when considering that one third of the energy demand in Italy is used to heat buildings, producing 30% of CO_2 emissions (180 million tonnes). The project, funded by the Veneto Region, involved 50 buildings.

6.3.6.5.3 Activity Timeline

In 2007, a test case was made at a school involving teachers and pupils, to make them aware of the issue. They monitored the liquid crystal thermometers installed in the classrooms, and the weather stations on the teachers’ desks over a period of some weeks. Following up on this in 2008, the energy use in 50 public buildings (46 schools, one municipal library and three municipal offices) were to be tracked, to promote energy efficiency initiatives. The project officially started with the Regional Committee resolution number 606 on 18/03/2008, published on 15 April 2008 in the Bollettino Ufficiale Regionale, Veneto Regional Government (2008) with a budget of €390,000 allocated. In April, all municipalities of the region were contacted, and 50 sample buildings were selected in the municipalities which joined the project. These buildings were selected after an inspection to determine the most representative structures that required improvement.

Further steps:

- In June 2008 some detector teams were established to perform surveys and develop a standard high-level procedure.
- From July to September the building survey was conducted.
- In October all data resulting from inspections were processed.
- In November the tests, by means of a thermal flow measurement, started in situ.
- In December the tests start to verify intervention typologies and possible results.
- Between the end of November and the beginning of December some buildings were constantly monitored to gain an understanding of the temperature and humidity trend during the coldest periods.
- Between January and February 2009 the results achieved are presented to the city and province and some provincial meetings are scheduled with technicians of the public administrations.
- At the end of February a final meeting of the project results is planned.

6.3.6.5.4 The Team

The project required the involvement of a multi-disciplinary group, with an operational (technical) team, scientific coordination and the organization office from the administration’s side.

The project team was comprised of:

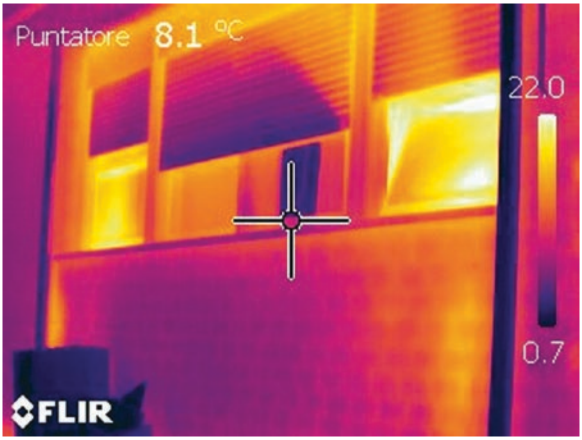
- Technicians in civil engineering and architecture, skilled in the use of specific instrumentation
- People skilled in thermal camera use
- Technical physics lecturers from the Architecture University in Venice (IUAV)
- Technology lecturers from the Architecture University of Bologna, in Cesena
- Members of ANCE Veneto, the private association of private construction contractors in Veneto region

The group discussion started with an analysis on the state-of-the-art in the sector of the energy savings. The analysis intended to identify options to reduce energy waste, identifying quality and quantity issues – as regards to construction, maintenance and performance/user mistakes. The technical instrumentation required, ensure that people skilled in the use of a thermal camera and its data analysis were on board. They also supported the first on-the-spot survey. Experts in the use of the blower door test were also required. The instrumentation used included a thermal camera (which could be rented), a blower door test (optional), an endoscope (building stratigraphy) and a digital camera (Figs. 6.3.6.3 and 6.3.6.4).

6.3.6.5.5 Implementation

As a starting point data was required concerning the climatic conditions in the last few years and graphs about the real building consumption. After analysing these documents, an inspection was performed to detect actual conditions of the structure, and a thermal camera survey was done to detect thermal bridges and other weaknesses.

[Au1] **Figs. 6.3.6.3** (see *Color Plates*)



6.3.6.4 Respectively showing photograph of school building and thermal image showing problem zones where heat escapes in winter (see *Color Plates*)

A blower door test and an analysis by means of endoscopic drills were performed to test the thickness of the building envelope. These data were then considered in the analysis and evaluated with an algorithm to homogenize all information and find a limited number of parameters.

The analysis objective is to perform an integrated approach of the scientific-didactic competences of every building, cataloguing the buildings according to their building typology and pointing out the major weaknesses of building shell and systems. An analysis of possible solutions, considering the different building typologies, was also performed considering a theoretical (academic competencies), applicative (CMR role) achievable and manageable (ANCE role) point of view. Minimal environmental impact solutions, that are easy to re-use and recover is another main element for Legambiente.

In November 2008 the data regarding each building was analysed, to obtain an evaluation based on the building typology (e.g. brickwork, concrete and bricks, reinforced concrete, precast concrete), geometric parameters of the building, as well as the climatic conditions and use. The team identified the needs of an evaluating tool which would allow public administrations to quickly choose and select single actions, following an investment cost–benefit analysis. The underlying aim is to initiate a project where single actions are fundamental to build up a plan from problem identification, to finding a hypothetical solution and determine project feasibility (Fig. 6.3.6.5).

6.3.6.5.6 First Results

6.3.6.5.6.1 Outreach to Actors

Public administrations involved have positively responded to the requests coming from the organisation office and from the individual teams. Awareness-raising meetings were held to involve people (in particular building users) to learn about

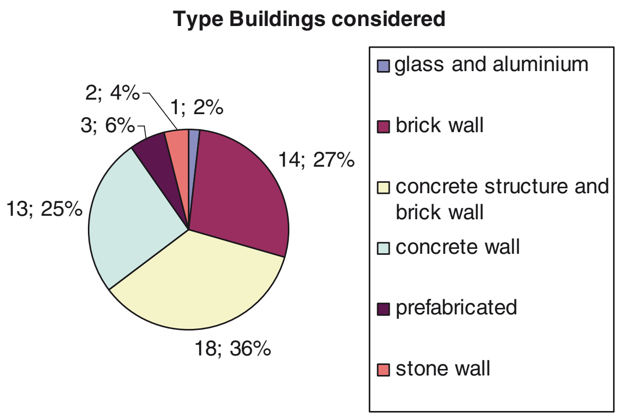


Fig. 6.3.6.5 Building typologies included in the project (see *Color Plates*)

energy savings and environmental comfort. Some technicians of local administrations have been waiting for publication of results, and some provincial meetings organised to progressively involve technicians to discuss the collected data and elaborate common strategies.

6.3.6.5.6.2 Analysis

After the energy efficient renovation many of the analysed buildings have required ordinary maintenance for the correct operation of frames and solar control systems. The major weaknesses revealed in buildings survey have already been pointed out to the owner administrations. Some buildings show problems on the building envelope (such as: thermal bridges, losing air, inefficient facilities) which need additional maintenance.

The first results underline that the analysed buildings do not conform to the minimum requirements for building envelopes, frames and thermal bridges. Some urgent maintenance work is required to correct the buildings to achieve event minimum standards required by regulation. None of the checked buildings used a mechanical air exchanger, despite the Italian regulation (National Decree 18 December 1975) that requires the clearing of air periodically for certain type of school buildings. In some buildings, not specifically addressed in this survey, the devices had been switched off or were inefficient due to a lack of maintenance.

If this were done, improved results would be reached not only in terms of efficiency, but also for visibility on how buildings can be made more efficient and comfortable for users, as well as drawing attention and ideally general consent from the administrations for a standard renovation procedure. Due to this project a 10% reduction on the actual consumption has been achieved, and many buildings could easily reach this result when considering their structure and location. Local energy generation, using RES and technologies with a high efficiency (e.g. cogeneration, trigeneration) of fossil fuels, would definitively contribute to a reduction of real consumption.

6.3.6.5.6.3 A New Methodology for the Veneto Region

The idea is for future developments to integrate a relevant methodology, concerning building energy efficiency, with other information addressed to the public administration technicians in charge of building maintenance and with operators training. Data acquisition and analysis could also be used for other building types and uses. During this first phase only schools were considered because they usually involve a high number of users (personnel, teachers, students and families). These buildings were built between 1945 and 1980 using material that needed little maintenance (e.g. concrete, plasterwork, metallic frames).

6.3.6.5.6.4 Tools Used

For the survey, free on-line tools were used. Free software for building efficiency evaluation include ECODOMUS, Casaclima, and Cened.[5] Information was transmitted via Skype (verbally), and by Google for emails. The most important data were made available on the internet, using this as an electronic capturing system which each member of the team could use and constantly update. Document analysis and rapid information retrieval were identified as two critical aspects.

6.3.6.5.6.5 Mixed Overview of Available Data

It was determined that some municipalities do not have a complete overview of actual building stock and maintenance conducted. There are exceptions, with some municipalities having a comprehensive updated system in place. Most technicians involved have not received adequate trained on building energy efficiency, and tend to underestimate issues regarding system updating. Many buildings lack maintenance regarding frames and lighting systems, but have well-managed heating systems.

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[5] http://www.vienergia.it/a_22_IT_70_1.html, http://www.agenziacasaclima.it/it/certificato/certificato-energetico.html, http://www.cened.it/cenedhome

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Chapter 7
Conclusion

Franceso Musco and Maryke van Staden

Abstract The changing approach towards energy, increasingly regarding it as a comodity that needs to be reassessed in terms of its value, is visible throughout the modern world. This change can also be seen at the community level, with local governments and citizens being impacted by rising fuel prices and issues of energy scarcity and stability. The need for sufficient and affordable energy, as elements of energy security, are among others leading to a review of local resources, developing new concepts for generating and using energy more efficiently, considering how people as energy users should change their lifestyles.

Keywords Energy security • lifestyle change • local climate action • local governments • mandate for action • smart grids • sustainable energy • valuable commodity

There is an increasing trend towards including the real cost of energy (e.g. looking at life-cycle implications), energy sufficiency but also other energy security aspects, as well as the need for greenhouse gas reduction, climate change adaptation, and sustainability on the political and economic agendas of communities. This is particularly the case as realisation grows about the cross-cutting impact of all these issues on socio-economic, political and security concerns in a community. Considering the numbers of local governments around the globe, combined with the growing realisation among people that they must respond to global challenges for their own benefit and that of the world they live in, it is anticipated that more local leaders and citizens will start engaging in climate protection and sustainable energy implementation. It is expected the ‘local to global’ phenomena, also a core

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theme of the Local Government Climate Roadmap and other community movements, will continue to gain in prominence.

In general, communities in developed countries tend to more strongly focus on climate protection and sustainable development, while those in developing countries are more inclined to look more at stable energy provision and the provision of affordable energy. This is likely to change (equalise) as the impact of fossil fuel resource depletion become more obvious and reflected in rising fossil fuel costs, impacting on everyone using fossil fuels. By viewing energy as a valuable resource, this will already be a significant step towards changing into a more sustainable society.

Of concern is the negative trend seen today, where national governments prefer to focus on expensive and insecure nuclear energy options where all costs are not properly presented (e.g. insurance, waste management), as opposed to more secure and sustainable energy solutions that are either more affordable or can be delivered at the same cost and where plants can be erected in a shorter timeframe. The only way communities can block this, in addition to calling for a change in government, seems to be the refusal to handle/store nuclear waste. Without a place to dump waste anywhere in the world, the rationale is that generating such waste would stop. Clearly rational and sustainable energy solutions are needed today. This starts with energy savings – reducing the need for energy as far as possible, and regarding energy as a valuable commodity. Secondly, there should be a move towards improved efficiency of technologies and material, which are increasingly available, and, last but not least, also making use of the abundant natural resources (renewable energy sources) to generate clean, sustainable energy. It is clear that the transition to a sustainable energy future can not be instantaneous, but certainly the tempo can be improved dramatically and sustainability should be at its core. Why even consider any unsustainable, even threatening solutions, where there are excellent secure alternatives available?

As local climate action is still mostly a voluntary activity for local governments, and sustainable energy is not yet perceived from the broader view when considering a changing environment, a changing world, and the need to live in harmony with one's surroundings, these two areas can be regarded as 'new' for the majority of communities around the globe. Those relatively few advanced communities that are active, have gained significant benefits for their communities, in addition to supporting climate protection and reducing their impact on the environment. They have created more 'liveable' communities by improving the quality of live of their citizens, and look towards the future, not in complacency, but with an expectation of enjoying higher resilience than their neighbours in a changing world, making them more attractive to live and work in. The most successful communities are those that are combining sustainability with climate change mitigation, climate change adaptation, as well as energy security. This is seen as the way forward for all communities.

When considering the challenge of climate change and all its associated impacts, every community needs to face its own unique situation – not only by adapting, but in particular also by reducing their impact on the climate. This is not only social responsibility, but also makes economic sense – as many of the cases presented in this publication illustrate. The examples selected clearly demonstrated that having a vision and strategy to move towards a particular aim, such as becoming a carbon zero community, provides a valuable framework within which actions can take place. The more successful approaches can be seen where the integration into frameworks such as Local Agenda 21 take place, as is illustrated by the case of San Sebastián where citizen involvement in climate actions is high. Continuity of commitment is another element that is visible from the successful cases, where continued political and financial support is made available to realise goals. In a typical democratic political process, with an election cycle of 3–5 years, achieving this consistency is rather challenging, unless there is cross-party political consensus on the priority of addressing climate change. This in turn needs real political leadership across all parties, setting aside petty political differences, or rather moving beyond these, and outlining a joint vision for the community. Växjö and Woking both set are great examples in this regard, having identified problems and solutions, obtained general agreement that climate protection is a priority, and allowing the majority party of the day to shape the details while the overall path is clear to all.

Moving forward from having a vision and outlining a strategy, a diverse set of actions is needed. Ideally these need to be embedded into a Local Action Plan that is monitored, regularly reviewed and adapted as needed. It is useful to conduct an assessment of where the community is in terms of energy use, identifying types of fuels used, where these come from, and what local resources are available that could potentially replace imported fuels. The transition towards a sustainable energy community should include a plan on how to move away from imported fossil fuels (and nuclear energy), and becoming as independent as possible – preferably using locally generated renewable energy that minimises transmission losses and provides economic stimulus to the local community and its surrounding areas (also referred to as Local Renewables). Furthermore it should also include selecting suitable and relevant options that fit into the local community, addressing local needs and challenges. All the cases selected illustrate these points, regardless of their actual entry point for action.

As can be seen in many cities, the starting point is often a move towards energy savings, followed by improved energy efficiency and then switching to the use of renewable energy sources. All communities can act in the first two areas. The example of Freiburg with its waste management approach illustrates the approach to all three areas: focusing on the reduction of waste (energy savings), re-using what is possible to use (energy efficiency), generating energy from waste (renewable energy), and leaving a small percentage of 'actual waste'. Most communities have some form or another of RE – be it solar radiation, wind, water (rivers, lakes, waves, tides), or other forms of natural energy. These need to be effectively harnessed and used, preferably feeding into smart grids that can smooth out peaks and troughs in intermittent energy generation. Where higher targets have been set, for example to become a CO_2 neutral community, the combination of all three areas is essential, in addition to adding carbon trading as a fourth level – off-setting those emissions that are the moist difficult to reduce. The latter has not been fully explored in this publication, as it is indeed regarded as a last resort. Improving own municipal and community energy should be the priority.

There is a need for more concrete action at community level, as well as for sharing experiences and results that will minimise 'reinventing the wheel' and will maximise efficient replication of proven aspects. It is clear from projects around the globe that energy efficient and renewable energy technology is mature and ready for extensive roll-out. If we know this, and we know what measures to apply (to reduce GHGs and how to implement sustainable energy solutions), as well as seeing the real financial opportunities in moving away from burning fossil fuels for electricity and heat – why is this not happening in all communities around the globe? Why are community leaders not jumping to use these opportunities? The challenge seems to be a lack of realisation by leaders and citizens alike that time is indeed running out to avoid reaching the climate change tipping point, that communities are highly vulnerable to climate change (i.e. temperature change, frequency and violence of storms, rising sea levels), and that there are no longer unlimited resources available. On top of this, very few political leaders are courageous enough to break out of the traditional mould, point out these threats and present solutions that have a long-term impact. Not enough of them are considering that the 'greater global good' is not only idealistic, but also realistic and inseparable from the 'local community good'. We need more courageous leaders on all sides of the political spectrum. Being courageous means recognising that 'now' is a critical time to regard climate protection and sustainable energy as a basic necessity and to incorporate this in all dimensions of politics and in all walks of life, also to ensure change actually takes place. We need courageous leadership when it comes to providing direction, to implementation and to redirect as needed. In this context the opposite of courageous leadership can actually be regarded as moral cowardice. Political parties should urgently review their basic underlying concepts and include an approach towards sustainability. This is no longer just a 'green' political element. It is a reality check. Voters need to be encouraged to be more disciplined and use their votes to demand clearly outlined long-term visions and strategies that will improve their quality of life in balance with the well-being of the world. Policy changes are needed that ensure aspects are addressed, such as life-cycle assessments of all products and materials, and taking on personal responsibility for emissions generated.

The implementation process – of local climate and sustainable energy action – may be somewhat more complicated in some cases, yet the step-by-step approach illustrated by many of the cases in Chapter 6, show that tenacity brings results. A complicating factor that can seem quite daunting is to establish a sustainable long-term solution. Yet this is what is specifically needed – longer-term thinking and a sustainability strategy that goes beyond the current generation, and definitely beyond the short political life-span of political leaders. This provides room for thinking things through when planning and implementing, and not just responding to a specific problem, without considering the impacts on other areas. The Province of Rovigo has illustrated this for the province, assisting smaller municipalities with implementing small-scale renewables projects, bringing financial and energy benefits to the municipalities, as part of its strategy to improve the provincial energy and climate balance. Short-term projects and ad hoc activities are useful, and can contribute to an overall picture or demonstrate a particular technology. But these are not useful from the continuity perspective. It is valuable to incorporate sustainability as a basic element in Action Plans – to provide a wider perspective to our lives, as individuals, groups, communities, regions, countries and the world.

The advanced communities are leaders, and gain recognitions for their role – rightly so. Yet, they also recognise the need for faster action on an immense scale and are keen to share their experiences to develop the capacity of others to act. There are many different types of cooperation opportunities, from city twinning to peer-to-peer exchanges, from developing cooperation clusters to analysing good practice cases fro replicable factors. A more scientific approach will certainly be useful, and an openness to change is indispensable. Smaller communities need particular support, with cooperation clusters recommended – thereby allowing them to pool their resources, learn from leaders and move forward together. This not only optimises human, and even financial resources, but can also help to motivate and keep them engaged, also in difficult times. Typically, there has been a tendency to disengage when things become more difficult. Disengaging is no longer an option, considering the short time-span available for aggressive climate change mitigation.

When considering all of the above, it is likely that the role and mandates of local governments will change, as other levels of government recognise that they can not adequately deal with the local impacts of climate change and community security. A growing inter-connection between different levels of government could occur, and the strengthening of the local political base is likely to happen. Political life as we know it today is thus likely to change, with aspects such as improving the quality of life becoming a stronger driving force at all political levels. The vast potential for change towards more sustainable communities – not only from the energy perspective, but overall – provides hope. Yet, the question remains whether the recognition of the need to change will come soon enough to allow the potential to be unfolded. Enabling framework conditions from national level are essential to support faster, effective action. We know what to do, we know how to do it. What is needed now is support to act coherently and in a timely manner. A sustainability approach is essential. Gaining an interest and the engagement of the community is critical. The involvement of citizens right from the start of and throughout the process is valuable. Courageous leaders are needed. Without commitment and decisions nothing will happen.

In this publication we have provided several excellent examples and shared a great diversity of approaches possible when addressing climate change mitigation, and to a more limited extent adaptation. These show that many different renewable energy technologies have been rolled. However, it was also made clear that the fundamental starting point remains energy savings and energy efficiency – without these two elements as a foundation renewable energy sources become far less effective. All local governments are called on to engage – to implement or improving policies and strategies, involve all relevant stakeholders, communicate with their citizens, and apply relevant technologies and measures. These important steps need to be incorporated into the local climate and sustainable energy approach – to achieve success, together.

Glossary and Abbreviations

This glossary has been compiled using definitions found on European Commission, Intergovernmental Panel on Climate Change and other relevant sources, with brief descriptions provided on main topics.

anthropogenic greenhouse emissions – Greenhouse gas emissions resulting from human activities. Also called enhanced greenhouse effect.

biofuels – A fuel produced from dry organic matter or combustible oils produced by plants. These fuels are considered renewable as long as the vegetation producing them is maintained or replanted, such as firewood, alcohol fermented from sugar, and combustible oils extracted from soy beans. Their use in place of fossil fuels cuts greenhouse gas emissions because the plants that are the fuel sources capture carbon dioxide from the atmosphere.

brownfields – Abandoned and idle industrial and commercial sites in cities and other urban areas, often characterised by environmental degradation and contamination.

carbon dioxide (CO_2) – A colorless, odorless, incombustible gas, formed during respiration, combustion, and organic decomposition and used in food refrigeration, carbonated beverages, inert atmospheres, fire extinguishers, and aerosols. It is the principal anthropogenic greenhouse gas that affects the earth's radiative balance. It has a Global Warming Potential (GWP) of 1, and is used as the reference gas for GWP of other greenhouse gases.

carbon dioxide equivalent (eCO_2) – A quantity that describes, for a given mixture and amount of greenhouse gas, the amount of CO_2 that would have the same global warming potential (GWP) when measured over a specified timescale (generally 100 years).

climate change adaptation – Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.

climate change mitigation – Attempts to slow the process of global climate change by lowering the level of greenhouse gases in the atmosphere.

Combined heat and power (CHP) – Also known as cogeneration, this is an efficient, clean and reliable approach to generate electricity (power) and thermal energy from a single fuel source. CHP can greatly increase the facility's operational efficiency and decrease energy costs. At the same time, CHP reduces the emission of greenhouse gases, which contribute to global climate change.

Conference of the Parties (COP) – All countries that have ratified the United Nations Framework Convention on Climate Change (UNFCCC) are referred to as the Parties. The COP is responsible for implementing the objectives of the Convention and there have been regular meetings since 1995, these are often referred to as the United Nations Climate Conferences.

Covenant of Mayors – A movement of mayors of Europe's most pioneering cities joining a permanent network to exchange and apply good practices to improve their energy efficiency and promote low-carbon business and economic development. The development of the Covenant of Mayors was supported by the Directorate Transport and Energy (DG TREN) of the European Commission (EC).

degression rate – The degression mechanism was chosen in part as a means for gradually eliminating the premium paid to renewables relative to the so-called market price. It was believed at the time this measure was necessary to circumvent the European Union's prohibition against state aid. This "degression" rate varies with technology.

district heating – A system for distributing heat generated in a centralised location for residential and commercial heating requirements such as space heating and water heating. The heat is often obtained from a cogeneration plant burning fossil fuels but increasingly biomass, although heat-only boiler stations, geothermal heating and central solar heating are also used, as well as nuclear power. District heating plants can provide higher efficiencies and better pollution control than localised boilers.

electricity from renewable energy sources (RES-E) – Electricity produced from renewable energy sources shall mean electricity produced by plants using only renewable energy sources, as well as the proportion of electricity produced from renewable energy sources in hybrid plants also using conventional energy sources and including renewable electricity used for filling storage systems, and excluding electricity produced as a result of storage systems.

emissions inventory – An itemised list of emission estimates for sources of air pollution in a given area for a specified time period. It can also include information on activities that cause emissions and removals, as well as background on the methods used to make the calculations. Policy makers use greenhouse gas inventories to track emission trends, develop strategies and policies and assess progress. Scientists use greenhouse gas inventories as inputs to atmospheric and economic models.

energy efficiency – Measures undertaken as part of Demand-Side Management to reduce the consumption of electricity for a specific task or function.

Energy Performance Contracting (EPC) – An innovative financing technique that uses cost savings from reduced energy consumption to repay the cost of installing energy conservation measures.

European Union (EU) – Originally a regional economic integration organisation, known as the EEC (European Economic Community), the European Union has grown into a geographical political and economic entity. Also see Member States.

feed-in tariff system – Renewable energy payment as an incentive structure to encourage the adoption of renewable energy through government legislation, with the government regulating the tariff rate. The price per unit of electricity that a utility or supplier has to pay for renewable electricity from private generators is fixed.

Fischer–Tropsch (FT) process – A method for the synthesis of hydrocarbons and other aliphatic compounds. Synthesis gas, a mixture of hydrogen and carbon monoxide, is reacted in the presence of an iron or cobalt catalyst; much heat is evolved, and such products as methane, synthetic gasoline and waxes, and alcohols are made, with water or carbon dioxide produced as a by-product. Combination of biomass gasification and Fischer-Tropsch (FT) synthesis is a possible route to produce renewable transportation fuels.

fossil fuels – Also called mineral fuels, these are finite fuels from fossil carbon deposits such as oil, natural gas and coal. When burned to gain energy, greenhouse gases are released during the combustion processes.

gasification – A thermochemical conversion of a solid fuel to a gaseous fuel.

Gigawatt (GW) – A unit of power equal to 1 billion watts; 1 million kilowatts, or 1,000 megawatts

global warming – An increase in the average temperature of the Earth's surface. Global warming is one of the consequences of the enhanced greenhouse effect and will cause worldwide changes to climate patterns.

Global warming potential (GWP) – The index used to translate the level of emissions of various gases into a common measure in order to compare the relative radiative forcing of different gases without directly calculating the changes in atmospheric concentrations. The International Panel on Climate Change (IPCC) has presented these GWPs and regularly updates them in new assessments (see http://unfccc.int/ghg_data/items/3825.php)

greenhouse effect – The trapping and build-up of heat in the lower atmosphere near a planet's surface. Some of the heat flowing back towards space from the Earth's surface is absorbed by water vapour, carbon dioxide, methane and other gases in the atmosphere. If the atmospheric concentration of these gases rises, then theory predicts that the average temperature of the lower atmosphere will gradually increase.

greenhouse gases (GHGs) – The atmospheric gases responsible for causing global warming and climate change. The major GHGs are carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). Less prevalent – but very powerful – greenhouse gases are hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6).

gross domestic product (GDP) – Defined as the measure of the total output of goods and services for final use occurring within the domestic territory of a given country, regardless of the allocation to domestic and foreign claims.

heat pumps – Heat pumps offer the most energy-efficient way to provide heating and cooling in many applications, as they can use renewable heat sources in our surroundings. A typical electrical heat pump will just need 100 kWh of power to turn 200 kWh of freely available environmental or waste heat into 300 kWh of useful heat.

Intergovernmental Panel on Climate Change (IPCC) – A scientific intergovernmental body set up by the World Meteorological Organization (WMO) and by the United Nations Environment Programme (UNEP) to provide the decision-makers and others interested in climate change with an objective source of information about climate change. In accordance with its mandate and as reaffirmed in various decisions by the Panel, the IPCC prepares at regular intervals comprehensive Assessment Reports of scientific, technical and socio-economic information relevant for the understanding of human induced climate change, potential impacts of climate change and options for mitigation and adaptation.

IPCC Fourth Assessment Report (AR4), "Climate Change 2007" – The most recent IPCC report, as a consensus report on the state of knowledge on climate change, with scientific, technical and socio-economic information presented to decision-makers. It is comprised of four volumes, with contributions by working groups composed of experts. The fourth volume is the Synthesis Report, which was published in November 2007.

kilowatt hour (kWh) is a unit of energy: is the product of power in kilowatts multiplied by time in hours. Energy delivered by electric utilities is usually expressed and charged for in kWh.

light-emitting diodes [LED] lighting – This is a semiconductor diode that emits light when an electric current is applied in the forward direction of the device, as in the simple LED circuit. The effect is a form of electroluminescence where incoherent and narrow- spectrum light is emitted.

Local Agenda 21 (LA21) – Local Agenda 21 is a local-government-led, community-wide, and participatory effort to establish a comprehensive action strategy for environmental protection, economic prosperity and community well-being in the local jurisdiction or area.

megawatt hours (MW) is a unit of energy equal to 1 million watt hours.

Member states – The EU-27 countries are split into New Member States (NMS) and Old Member States (OMS), based on their date of their accession into the European Union (EU). The OMS are Austria, Belgium, Denmark, Finland, France, Germany, Greece, Italy, Ireland, Luxembourg, the Netherlands, Portugal, Spain, Sweden and the United Kingdom. The NMS include the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, Slovenia, Malta and Cyprus, with the most recent expansion including Bulgaria and Romania in 2007.

Methane – A hydrocarbon that is a greenhouse gas with a high global warming potential (estimated GWP is 24,5). Methane (CH_4) is produced through anaerobic (without oxygen) decomposition of waste in landfills, animal digestion, decomposition of animal wastes, production and distribution of natural gas and oil, coal production and incomplete fossil fuel combustion.

Metric tonne carbon dioxide equivalent (Mt CO2 e) – A metric measure used to compare the emissions from various greenhouse gases based upon their global warming potential (GWP). Carbon dioxide equivalents are commonly expressed as 'million metric tonnes of carbon dioxide equivalents (MMTCDE)'. The carbon dioxide equivalent for a gas is derived by multiplying the tonnes of the gas by the associated GWP.

Public private partnership (PPP) – A mechanism to use the private sector to deliver outcomes for the public sector, usually on the basis of a long term funding agreement, in a win-win scenario.

renewable energy sources (RES) – Renewable energy is energy generated from natural resources naturally replenished in a short period of time. The renewable sources used most often are: wind, solar, geothermal heat, wave motion, tidal, hydraulic, biomass, landfill gas, treatment process gas and biogas.

Renewable heating and cooling (RES-H) – Heating and cooling are necessary elements of any comprehensive strategy to develop renewables and to achieve sustainability in the energy sector. Renewable heating and cooling can significantly contribute to security of energy supply in the EU and reducing CO_2 emissions.

Stern Review (SR) – The Stern Review on the Economics of Climate Change, the most comprehensive review ever carried out on the economics of climate change, was published on October 30, 2006 and was lead by Lord Stern. The Review set out to provide the report assessing the nature of the economic challenges of climate change and how they can be met, both in the UK and globally.

third party financing (TPF) – This is an appropriate tool for funding of optimisation strategies without financial charge to the final user. This is due to budget savings from increased energy efficiency and more appropriate allocation of financial resources made available.

terawatt hours (TWh) is a unit of energy equal to 1 billion kilowatt-hours

parts per million (ppm) – Commonly used as a measure of small levels of pollutants in air, water, body fluids, etc. This is a way of expressing very dilute concentration of substances. One ppm is equivalent to 1 milligram of something per liter of water (mg/l) or 1 milligram of something per kilogram soil (mg/kg).

United Nations Framework Convention on Climate Change (UNFCCC) – An international treaty signed at the Rio Earth Summit in 1992 in which 150 countries promised stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. The UNFCCC supports all institutions involved in the climate change process.

urban planning – Design and regulation of the uses of space that focus on the physical form, economic functions, and social impacts of the urban environment and on the location of different activities within it. Urban planning concerns itself with both the development of open land and the revitalization of existing parts of the city, thereby involving goal setting, data collection and analysis, forecasting, design, strategic thinking, and public consultation. The holistic approach of landscape and urban research was stimulated by the introduction of aerial photography. This proved to be a valuable instrument, not only to make thematic inventories and monitor changes, but also to describe holistic aspects of complex landscapes.

urban sprawl – The expansive growth of an uncontrolled or unplanned extension of urban areas into the countryside. Urban sprawl is commonly used to describe physically expanding urban areas. The European Environment Agency

(EEA) has described sprawl as the physical pattern of low-density expansion of large urban areas, under market conditions, mainly into the surrounding agricultural areas. Sprawl is the leading edge of urban growth and implies little planning control of land subdivision. Development is patchy, scattered and strung out, with a tendency for discontinuity. It leap-frogs over areas, leaving agricultural enclaves. Sprawling cities are the opposite of compact cities – full of empty spaces that indicate the inefficiencies in development and highlight the consequences of uncontrolled growth (EU 2008).

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Color Plates

Fig. 2.1.1 Adaptation measure: a rainwater infiltration area below a building in Tilburg. A wadi *(Arabic word meaning dry riverbed that contains water only during times of heavy rain*) offers a way to deal with heavy rainfalls by buffering overflowing water and reducing the risk of flooding. In addition the wadi cools the area and offers a nice environment for plants, animals and insects (Photographer: Maartje Ansems)

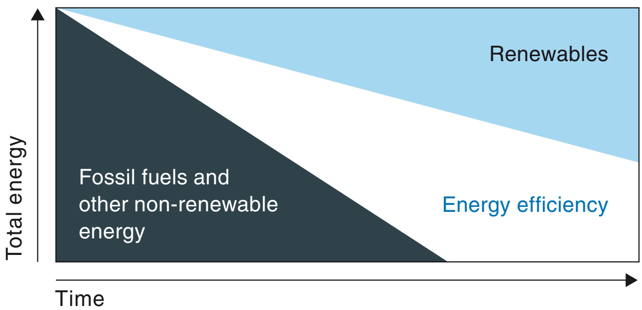


Fig. 2.4.1 Energy efficiency provides us with the time needed to replace fossil fuels and other non-sustainable energy sources with renewables in an ecological, economic and socially responsible manner (Image source: eceee)

Fig. 3.1.1 The International Local Government Climate Roadmap as a process with key events and a vision for the final outcome

Fig. 3.1.2 Commissioner Jantre of Thane Municipal Corporation (India) and Environmental Mayor of Copenhagen (Denmark) Klaus Bondam during the Local Government Climate Change Sessions in Poznan, December 2008

Fig. 3.2.1 Mayors and Deputy Mayors at the launch of the Covenant of Mayors, February 2008 (Image courtesy of DG TREN)

Fig. 3.2.2 Mayors and Deputy Mayors at the 2009 ceremony in the Hemicycle (Image courtesy of DG TREN)

Fig. 3.3.1 The CCP five-milestone cycle (Courtesy of ICLEI European Secretariat)

	Share of energy from renewable sources in final consumption of energy, 2005	Target for share of energy from renewable sources in final consumption of energy, 2020
Belgium	2.2%	13%
Bulgaria	9.4%	16%
The Czech Republic	6.1%	13%
Denmark	17.0%	30%
Germany	5.8%	18%
Estonia	18.0%	25%
Ireland	3.1%	16%
Greece	6.9%	18%
Spain	8.7%	20%
France	10.3%	23%
Italy	5.2%	17%
Cyprus	2.9%	13%
Latvia	34.9%	42%
Lithuania	15.0%	23%
Luxembourg	0.9%	11%
Hungary	4.3%	13%
Malta	0.0%	10%
The Netherlands	2.4%	14%
Austria	23.3%	34%
Poland	7.2%	15%
Portugal	20.5%	31%
Romania	17.8%	24%
Slovenia	16.0%	25%
The Slovak Republic	6.7%	14%
Finland	28.5%	38%
Sweden	39.8%	49%
United Kingdom	1.3%	15%

Fig. 4.3.1 Mandatory national targets set out in the Directive (2005 and 2020)

	2005 Eurostat TWh	2006 Eurostat TWh	2010 Projections TWh	2020 Targets TWh
Wind	70.5	82.0	176	477
Hydro [1]	346.9	357.2	360	384
Photovoltaic	1.5	2.5	20	180
Biomass	80.0	89.9	135	250
Geothermal	5.4	5.6	10	31
Solar thermal elect.	-	-	2	43
Ocean	-	-	1	5
TOTAL RES	504.3	537.2	704	1370
Total Gross Electricity Generation EU27	3320.4	3361.5		
(Trends to 2030-Baseline) *			3568	4078
(Combined RES and EE) **				3391
Share of RES	15.2%	16.0%	19.7%	33.6-40.4%

1 - Normalised according to the formula proposed in the RES Directive

* - European Energy and Transport: trends to 2030 – update 2007, 2008, European Commission Directorate General for Energy and Transport
** - European energy and transport: Scenarios on energy efficiency and renewables, 2006, European Commission Directorate General for Energy and Transport

Fig. 4.3.2 Contribution of RE to electricity consumption

	2005 Eurostat Mtoe	2006 Eurostat Mtoe	2010 Projections Mtoe	2020 Projections Mtoe
Biomass [1]	57.5	60.0	75	120 [2]
Solar thermal	0.68	0.77	1.5	12 [3]
Geothermal	0.63	0.68	3	7
TOTAL RES HEAT	58.8	61.45	79.5	139
Total Heat Generation EU27	579.2	570.1		
(Trends to 2030) *			583.5	606
(Combined RES and EE) **				541
Share of RES	10.2%	10.8%	13.6%	22.9-25.7%

1 - Biomass for heat and heat derived from co-generation and district heating
2 - AEBIOM (European Biomass Association) believes that a target of 147 Mtoe is achievable by 2020 for biomass for heat and derived heat
3 - Based on the assumption that 1m² of solar thermal collector area per EU inhabitant is achievable by 2020, ESTIF's target is 21 Mtoe of solar thermal energy in 2020.

*- Includes only district heating
**- Includes all applications incl. shallow geothermal heat pumps

Fig. 4.3.3 Contribution of RE to heat consumption (2006–2020)

	2005 Eurostat Mtoe	2006 Eurostat Mtoe	2010 Projection Mtoe	2020 Projection Mtoe
Transportation Biofuels	3.13	5.38	16	34.0
Gasoline and oil consumption (Trends to 2030-Baseline) * (Combined RES and EE) **	297.2	300.4	317.3	349.5 323.9
Biofuels' Share %	1.05	1.79	5.0	9.7-10.5

* - European Energy and Transport: trends to 2030 – update 2007, 2008, European Commission Directorate General for Energy and Transport
** - European energy and transport: Scenarios on energy efficiency and renewables, 2006, European Commission Directorate General for Energy and Transport

Fig. 4.3.4 Contribution of RE to transport consumption

Fig. 4.4.1 Banca Etica headquarters in Padova, designed and constructed according to bio-ecological architecture principles

	up to 150 kW	up to 500 kW	up to 5 MW	> 5 MW
Hydropower[1]	9.38	9.38	5.45	special agreements
Landfill/ Marsh Gases[2]	7.33	7.33	6.36	special agreements
Biomass	10.99	9.46	8.51	8.03

	up to 5MW	up to 10MW	up to 20 MW	>20MW
Geothermal energy[3]	15.0	14	8.95	8.03

	up to 30kW	up to 100kW	>100kW	
Photovoltaics				
on rooftops, noise protection walls[4]	49.21	46,81	46.3	
as solar facades[4]	54.21	51.81	51.3	
on open space[5]	37.95	37.95	37.95	special agreements

	without power limitation	
Wind energy[6]		
On-shore	8.19	for at least 5 years (max 20 years), afterwards 5,18 ct/kWh
Off-shore	9.10	for at least 5 years, special agreements

Reductions for construction after 2007:

[1]degression 1 %/a
[2]degression 1.5 %/a
[3]degression 1 %/a (from 2010 onwards)
[4]degression 5 %/a
[5]degression 6.5 %/a
[6]degression 2 %/a

Table 5.1.1 German EEG remuneration for different technologies differentiated by plant capacity in the year 2007 (Witzel and Seifried 2007)

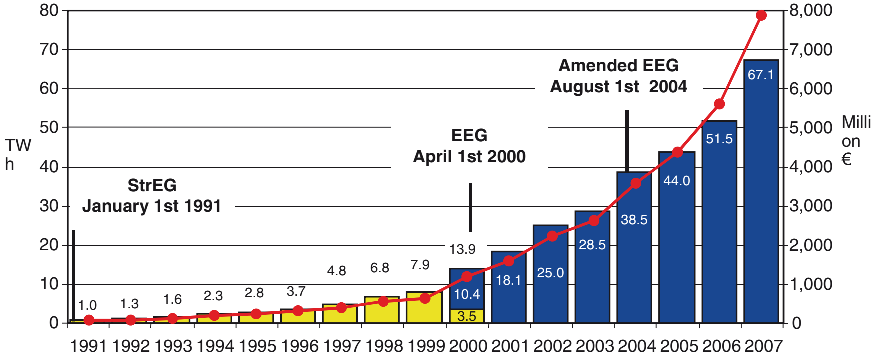


Fig. 5.1.1 Feed-in and fees under the Act on the sale of electricity to the grid and the Renewable Energy Sources Act (EEG)

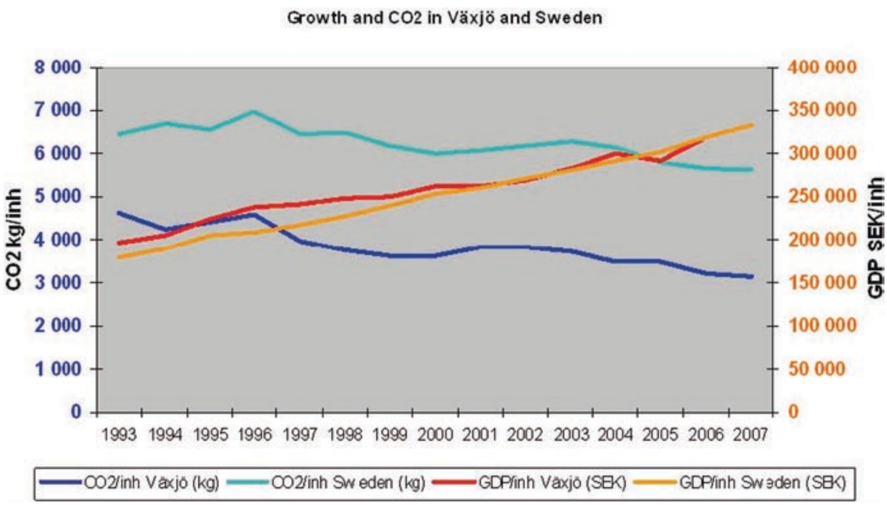


Fig. 6.1.1.1 Decoupling of economic growth from CO_2 (Courtesy: Växjö kommun and SCB)

Fig. 6.1.1.2 New concepts in development – eight-storey high wooden buildings constructed within the CONCERTO SESAC project (Photographer: Anders Nordenskiöld)

Fig. 6.1.2.1 The first co-generation biomass plant to use direct gasification of wood chips instead of burning the biomass (Courtesy: EEE/RENET)

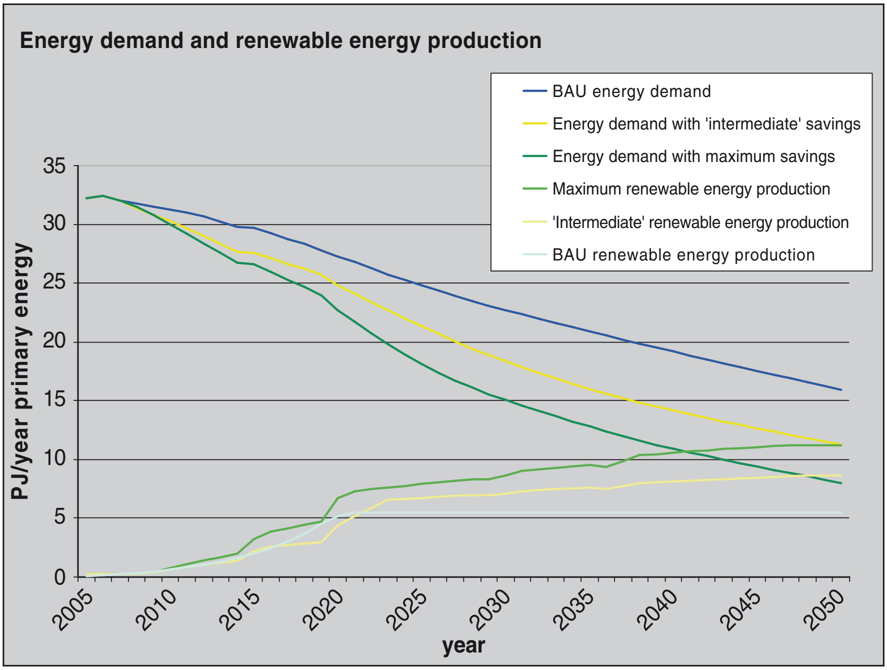


Fig. 6.1.3.1 Scenarios for CO_2 neutrality in Tilburg (Braber et al. 2007)

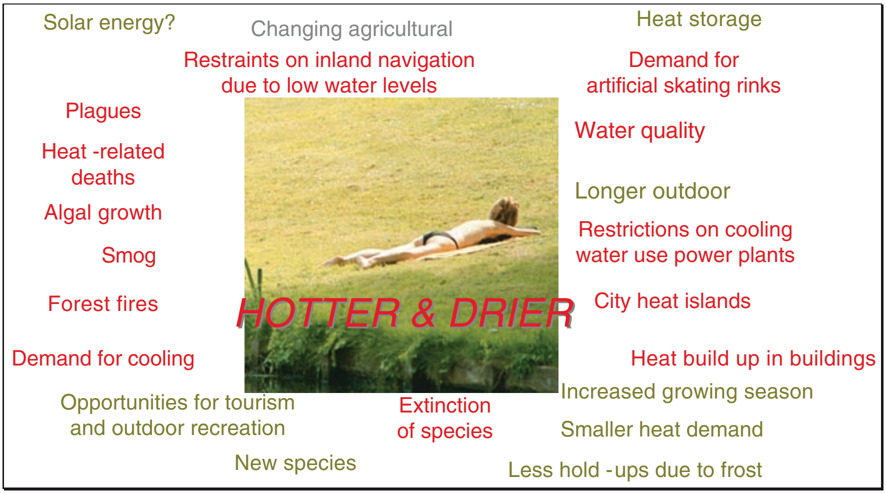


Fig. 6.1.3.2 Mood-board with climate change impacts for Tilburg

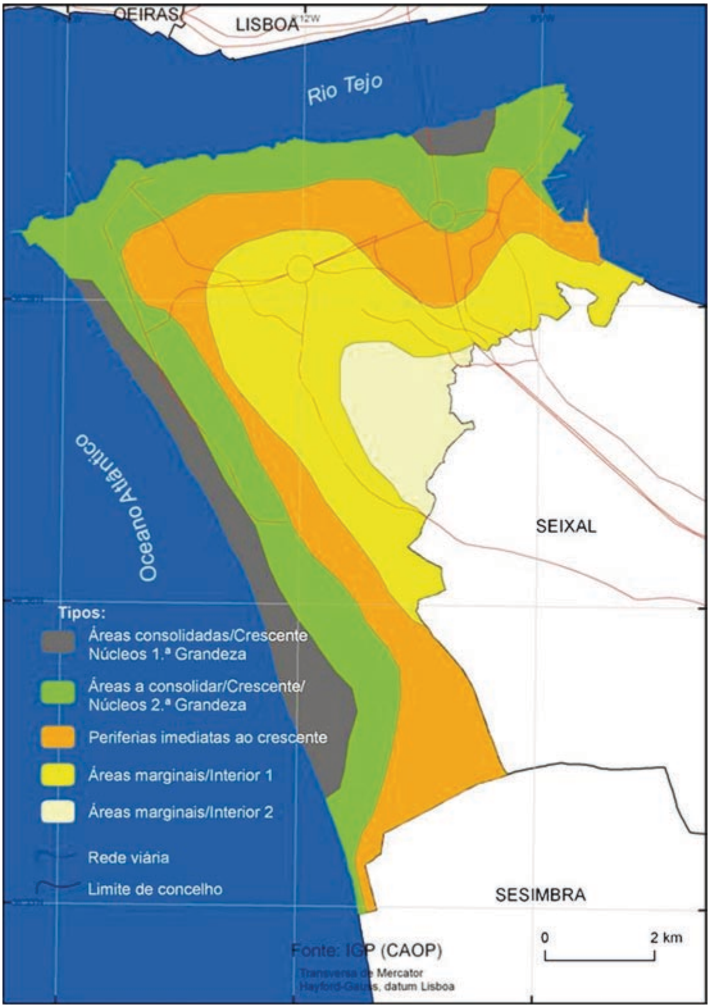


Fig. 6.1.4.1 Characterisation of potential tourist areas in Almada (From Plan of Touristic Valorization of Almada– 1st Phase Report: Characteristics and Diagnosis, Almada City Council, 2007)

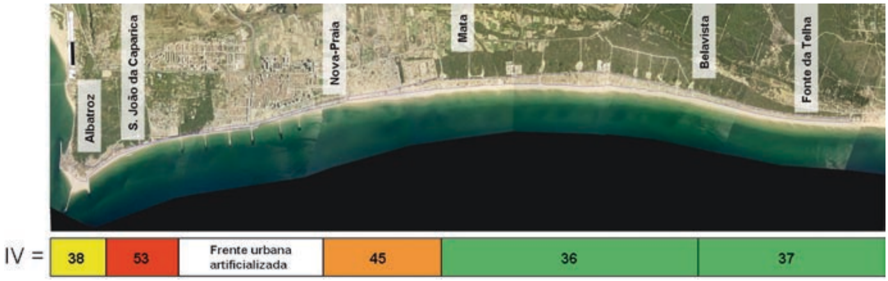


Fig. 6.1.4.3 Coastal vulnerability assessment, with the colour variation representing the vulnerability level to disturbances and alterations in coastal ecosystems (green – low to average vulnerability, yellow – average, orange – average to high vulnerability, and red – high vulnerability) (From Almada City Council)

Fig. 6.1.5.1 Photovoltaic array at the station (Courtesy: ICLEI)

Fig. 6.1.5.2 Brockhill retirement village with a huge photovoltaic (PV) array on the roof and a residential Combined Heat and Power (CHP) system

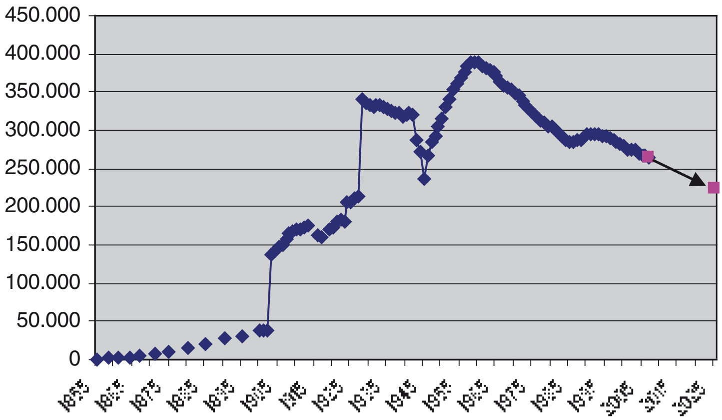


Fig. 6.2.1.1 City of Gelsenkirchen's population between 1855 and 2007 with a projection for 2025 (Landesamt für Datenverarbeitung und Statistik Nordrhein-Westfalen and City of Gelsenkirchen)

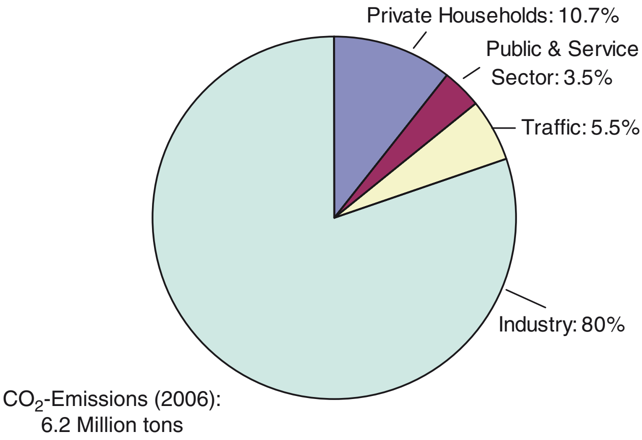


Fig. 6.2.1.2 Sectoral CO_2 emissions in Gelsenkirchen in 2006 (Energy consumption data from the City of Gelsenkirchen)

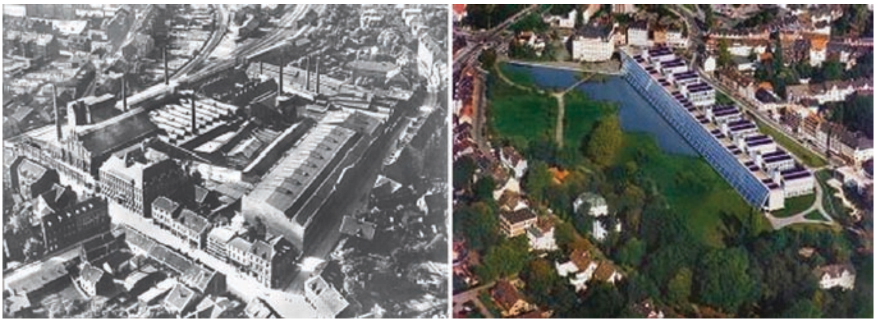


Fig. 6.2.1.3 Old and new – (*left*) Gelsenkirchener Gußstahl- und Eisenwerke AG in 1929 and (*right*) Wissenschaftspark Gelsenkirchen with its 210 kW PV plant (1996)

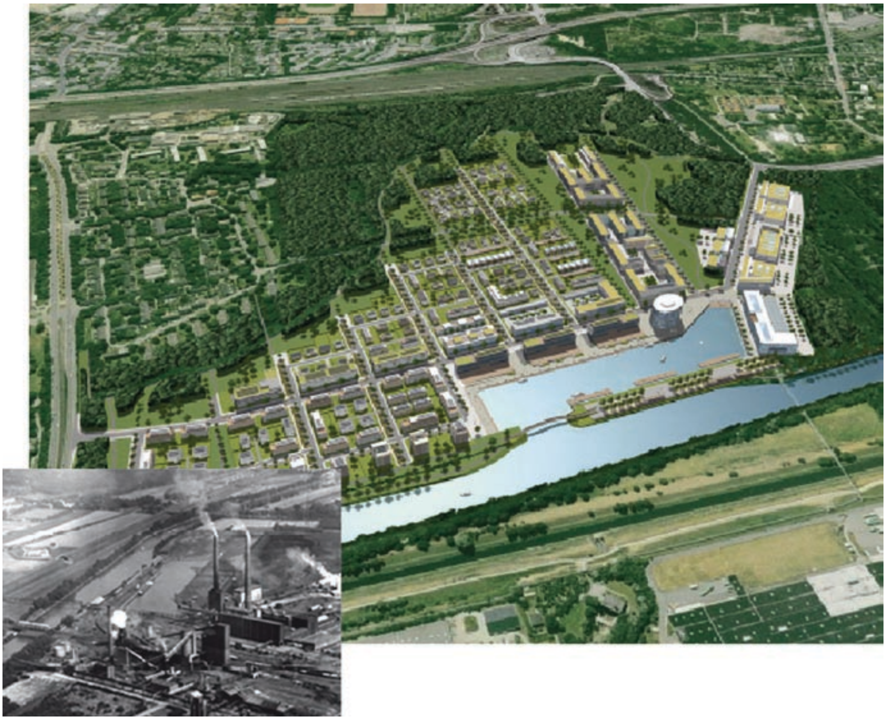


Fig. 6.2.1.4 (*Bottom left*) The former coal mine, cokery and power plant Graf Bismarck in the 1950s, and (*right*) the same area with an urban design concept for the new city quarter Graf Bismarck (From City of Gelsenkirchen)

Fig. 6.2.2.1 Light bulb replacement in progress

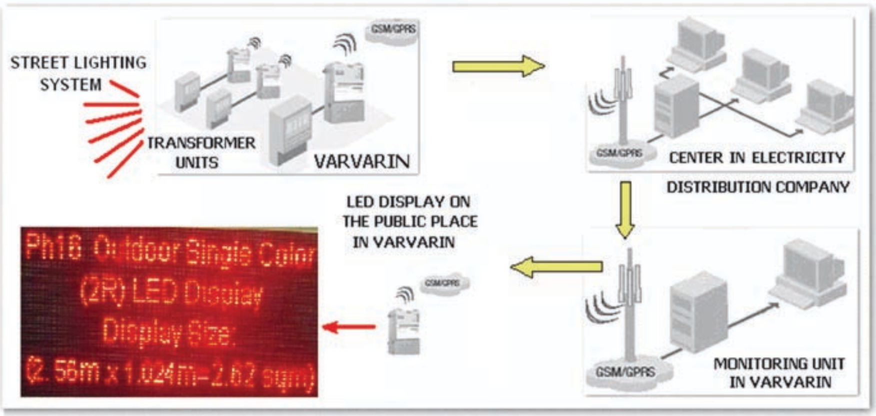


Fig. 6.2.2.2 Structure of the monitoring system (additional display on www.mku.rs)

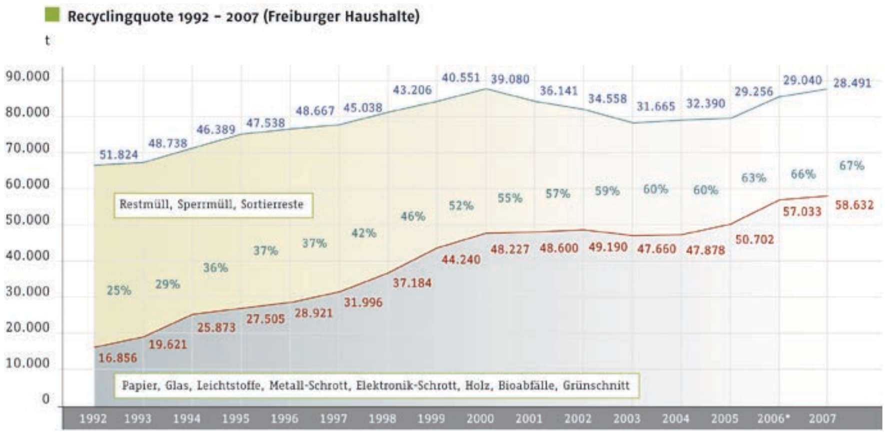


Fig. 6.2.3.2 Amount and proportion of recycled waste (red line) compared to total amount of waste (green line) between 1992 and 2007. It shows the increase of recycling, while the amount of non-recyclable material is constantly decreasing

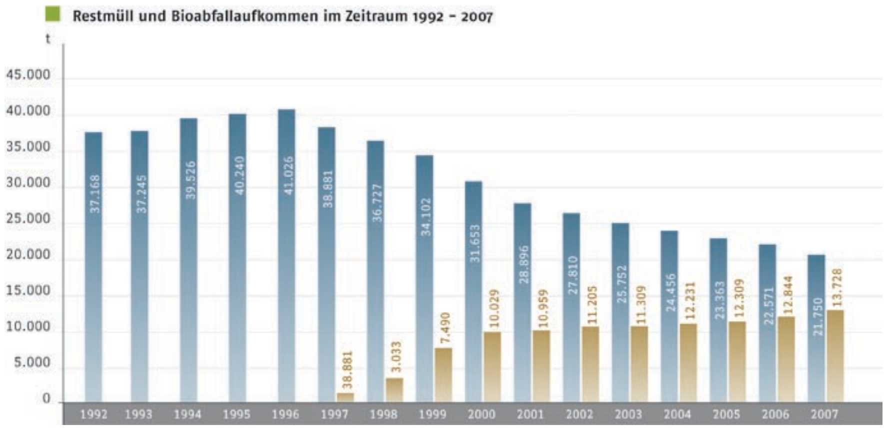


Fig. 6.2.3.3 The amount of solid waste (in blue) compared to organic waste (in brown) between 1992 and 2007, clearly shows a reduction in solid waste and higher separation leading to the collection of more organic waste

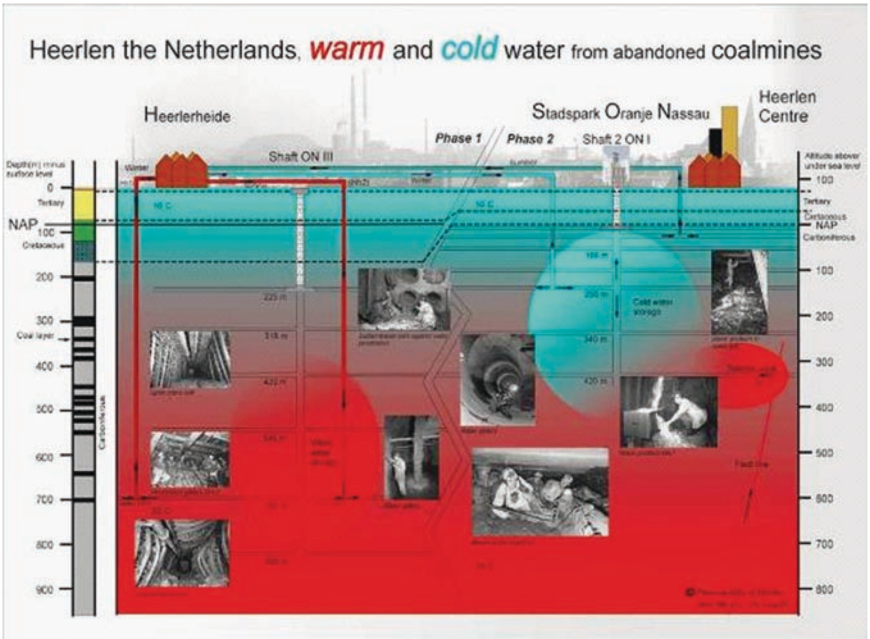


Fig. 6.2.4.1 Schematic cross section of the underground conditions of the ON I and ON III mines (From Municipality of Heerlen)

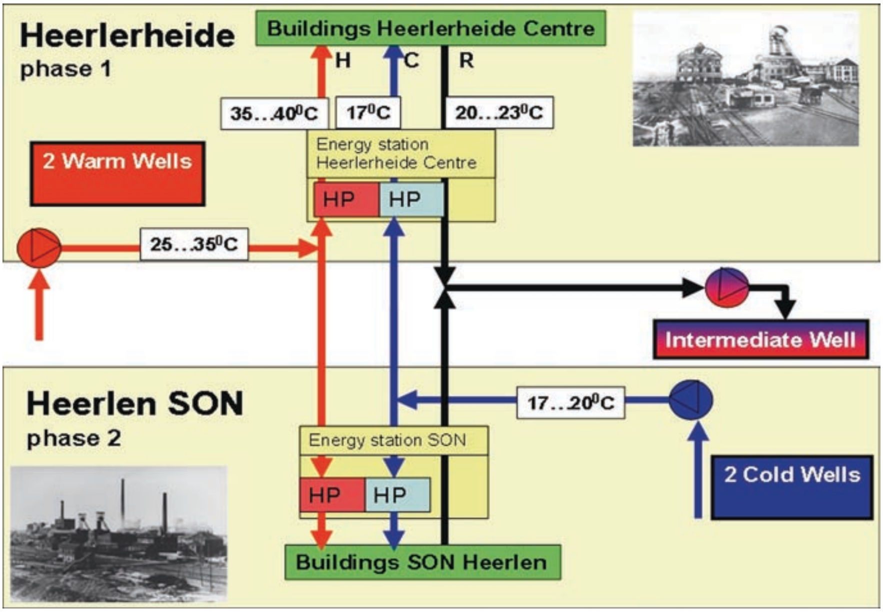


Fig. 6.2.4.2 Schematic view of the energy concept in Heerlen, connection of the wells and energy stations

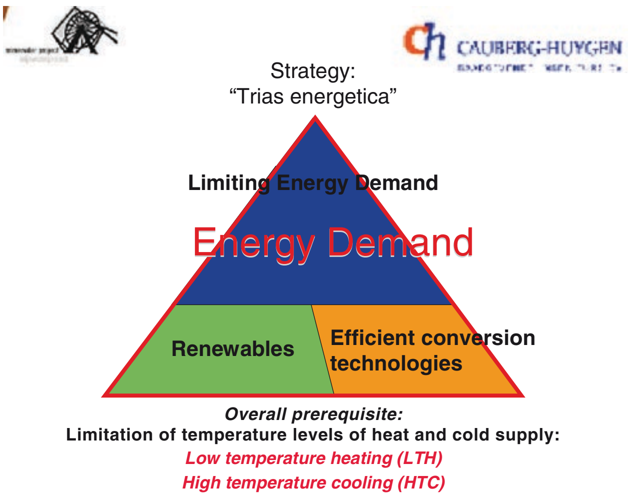


Fig. 6.2.4.3 Design strategy ‘Trias energetica’

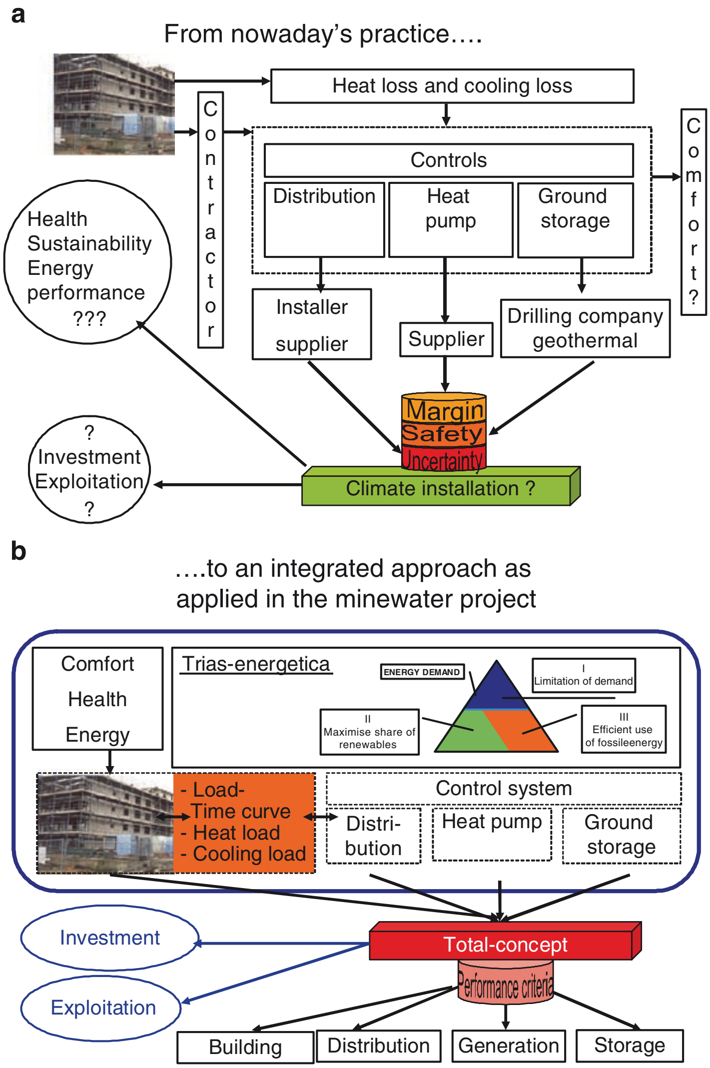


Fig. 6.2.4.4 From a traditional to an integrated design approach

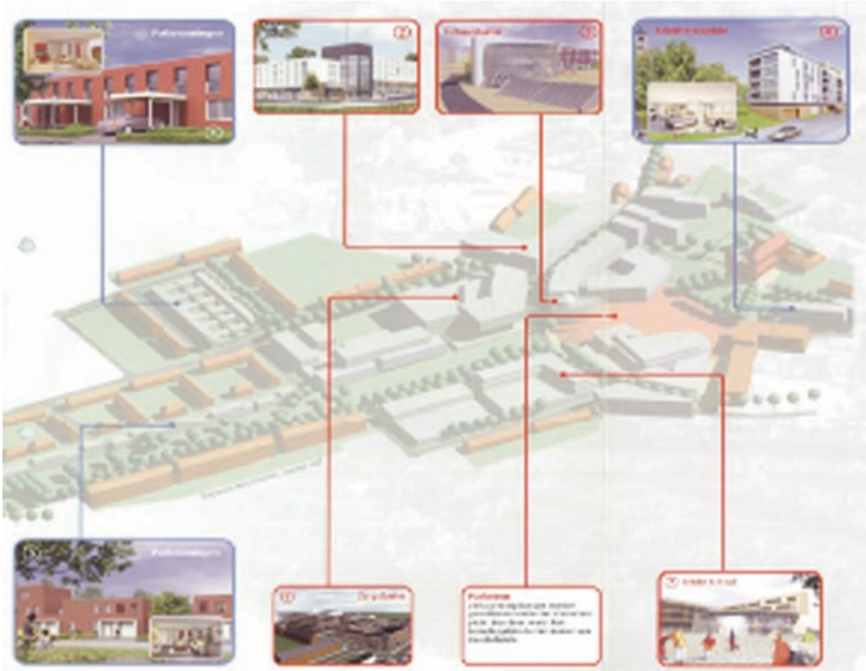


Fig. 6.2.4.5 Impression of location Heerlerheide (From Weller)

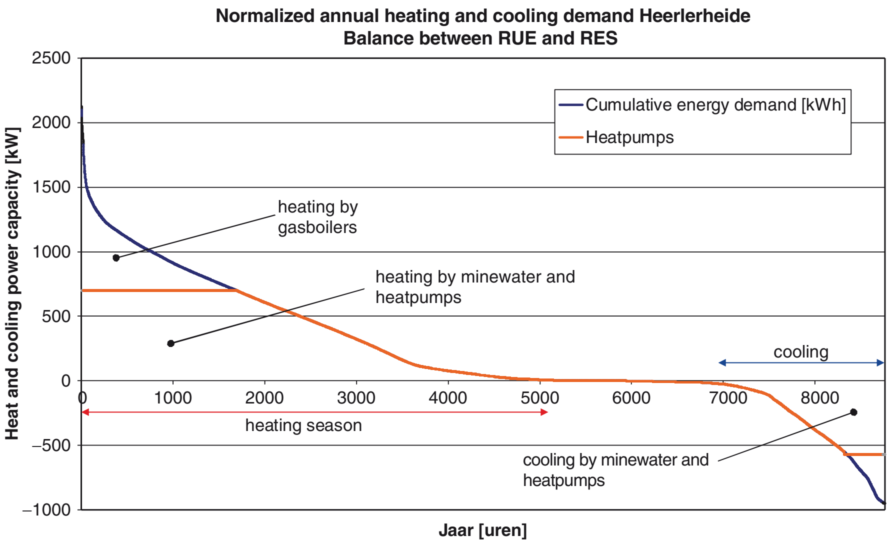


Fig. 6.2.4.6 Annual load-duration curve Heerlerheide

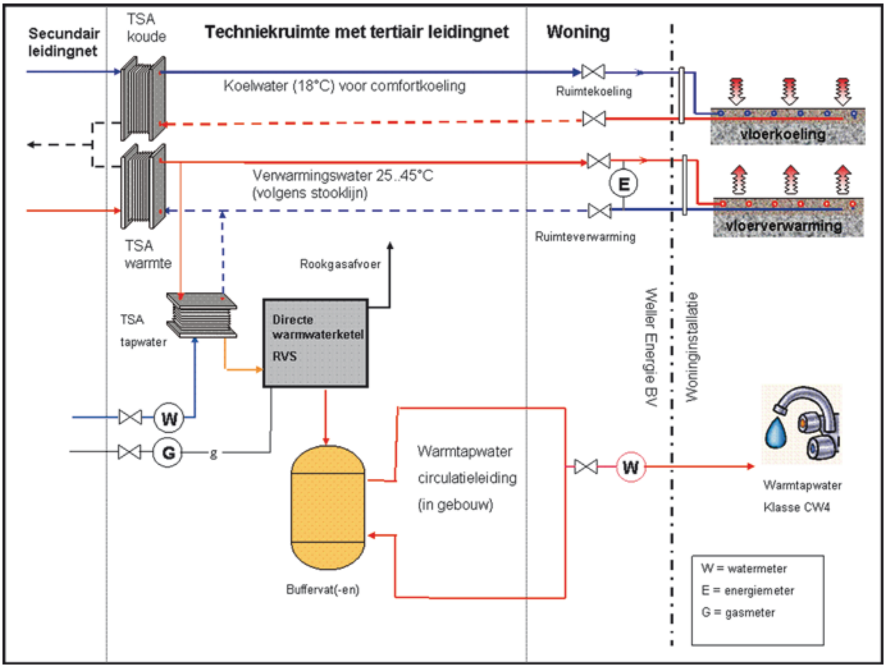


Fig. 6.2.4.7 Energy concept Heerlerheide

Fig. 6.2.5.1 Lighting on the bridge of the Po River

Fig. 6.2.5.2 Photovoltaic facade of the secondary school ITIS

Fig. 6.2.5.3 Photovoltaic facade of the Province of Rovigo office building

Fig. 6.3.1.1 Cartoon illustrating options to save energy

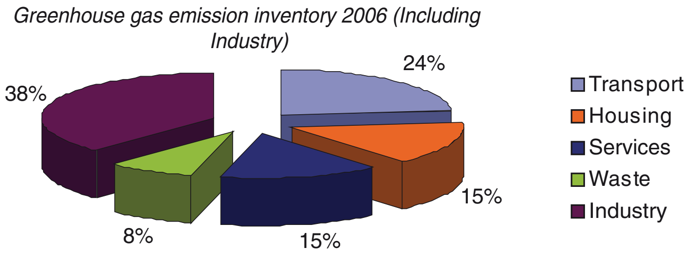


Fig. 6.3.2.1 Greenhouse gas emissions inventory results from 2006 (including industry)

Fig. 6.3.4.1 Climate and energy information for the public

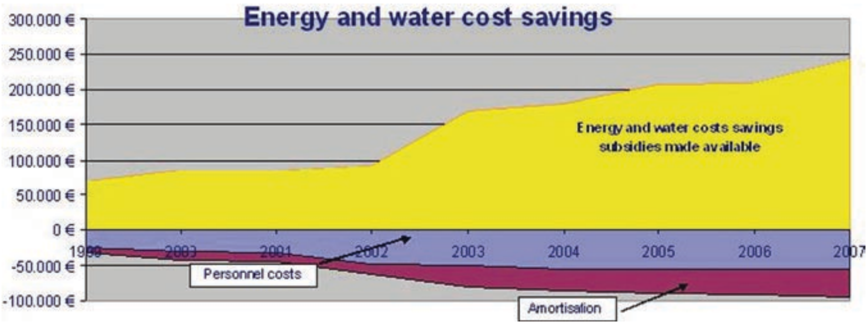


Fig. 6.3.4.4 Energy and water costs savings and amortisation period

Fig. 6.3.5.1 The Stockholm City hall

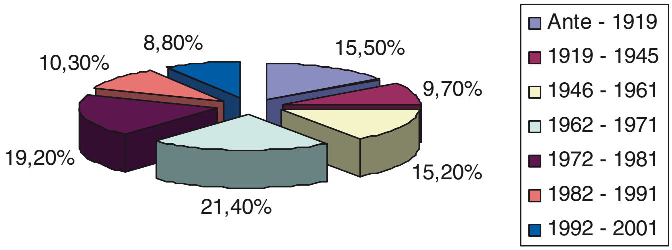


Fig. 6.3.6.1 Veneto region, buildings by construction period

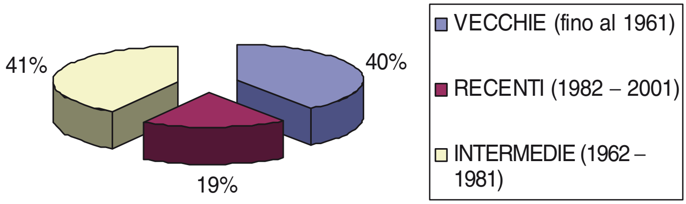
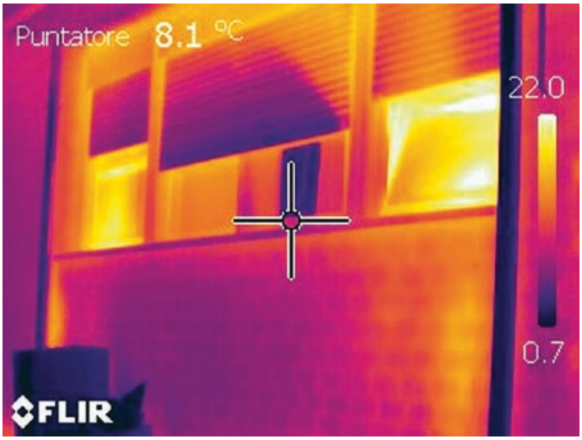


Fig. 6.3.6.2 Average surface of dwelling 110 m². Annual energy consumption 1.6 tep/around 170 kwh/m² per year (Veneto Region Sistar on National Institute of Statistics Data)

Figs. 6.3.6.3



6.3.6.4 Respectively showing photograph of school building and thermal image showing problem zones where heat escapes in winter

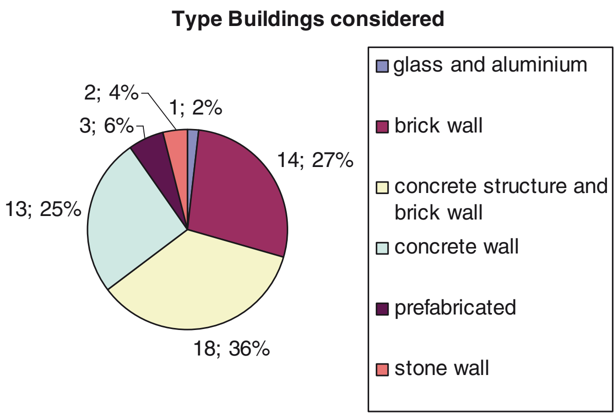


Fig. 6.3.6.5 Building typologies included in the project