FILIPPOS PROEDROU

ENERGY POLICY AND SECURITY UNDER CLIMATE CHANGE

Energy Policy and Security under Climate Change

Filippos Proedrou

Energy Policy and Security under Climate Change

palgrave
macmillan

Filippos Proedrou
University of South Wales
Cardiff, UK

ISBN 978-3-319-77163-2 ISBN 978-3-319-77164-9 (eBook)
https://doi.org/10.1007/978-3-319-77164-9

Library of Congress Control Number: 2018936607

Cover design: Akihiro Nakayama

Printed on acid-free paper

This Palgrave Macmillan imprint is published by the registered company Springer International Publishing AG part of Springer Nature.
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

To my little sunshine, Anastasia, and to Maria for all her love and support.

Contents

List of Abbreviations

AMI	Advanced Metering Infrastructure
CCS	Carbon Capture and Storage
COP21	2015 United Nations Climate Change Conference in Paris
ETS	Emissions Trading System
EU	European Union
FIPs	Feed-in Premiums
FITs	Feed-in Tariffs
GDP	Gross Domestic Product
GPI	Genuine Progress Indicator
IEA	International Energy Agency
IPCC	Intergovernmental Panel for Climate Change
ISEW	Index of Sustainable Economic Welfare
ISIS	The Islamic State in Iraq and Syria
NAFTA	North American Free Trade Agreement
OPEC	The Organization of Petroleum Exporting Countries
ppm	parts per million
ROCs	Renewables Obligation Certificates
UNFCCC	United Nations Framework Convention on Climate Change
UNSDGs	United Nations Sustainable Development Goals
WTO	World Trade Organization

List of Tables

CHAPTER 1

Introduction

Climate Change Comes of Age

Humanity finds itself at a critical crossroads. Based on the mainstream scientific consensus, humanity is faced with multiple existential threats. It is reaching critical planetary limits in domains such as global freshwater use and ocean acidification, rate of biodiversity loss, land-system change, stratospheric ozone depletion, and growth across all indices of starving resources (Zimmerer 2014: 268). The tip of the iceberg is climate change, meaning not just an uninterrupted upward trend of the average global temperature, but also—and not least importantly—interference with climatic conditions and cycles, which multiply and intensify extreme climatic phenomena. Contemporary available scientific data show that in 2014 the concentration of greenhouse gas emissions in the atmosphere had surpassed 400 parts per million (ppm) (Chesney et al. 2016: 5). Mainstream scientific estimations regard 450 ppm as the benchmark threshold. Beyond that, the increase of the global temperature is expected to surpass the 2 degrees Celsius with unbearable consequences on the climate and the human condition (King 2011; Falkner 2016: 1109).

Framing the issue macroscopically, humanity survived due to conducive conditions throughout the Holocene, the geological period dated to 11,000 years ago. We entered the most recent phase, Anthropocene, 250 years ago. Anthropocene is characterized by the reversal of a symbiotic relationship between humans and the ecosystem following the Industrial Revolution, and the end of the slow and peaceful utilization of the latter's

F. Proedrou, *Energy Policy and Security under Climate Change*,
https://doi.org/10.1007/978-3-319-77164-9_1

resources for the former's survival and welfare. The Intergovernmental Panel on Climate Change (1990, 1995, 2001, 2007, 2013) has issued five assessment reports, in which significant probability has given way to certainty regarding the anthropogenic nature of climate change.

At inception, climate change was viewed principally as a technical issue assigned to specialized institutions and framed in equally scientific terms. These initial formulations unraveled as the scope of threat presented by climate change came into focus. Given 'biophysical framings of climate impacts and ecosystems vulnerability, it is now recognized that vulnerability to climate change properly extends to the socioeconomic and political conditions that affect how communities cope with the impacts of climate-related hazards' (Mason 2011: 164).

As the initial speculation waned—along with overt denial and skepticism—the understanding of climate change graduated to widespread acquiescence of the bold fact that the climate has entered a phase of transformation that works to the detriment of human existence. There are three main reasons why this has happened in the course of the last two decades. Firstly, science itself has generated compelling evidence on the validity of the initial hypothesis. Accordingly, the burden of proof has moved to the opposite camp, which has failed to wage a persuasive campaign. Secondly, and related to the above, ecological transformations are producing powerful visible effects of climate change impact, now and into the future. Thirdly, there has been a significant—albeit far from universal—shift in entrepreneurial mood and concomitant growing acceptance of economic convergence with climate change. There is ample space for innovation and plenty corporate opportunities in 'green capitalism', which more and more economic actors are eager to seize upon, especially given tense competition in saturated economic sectors that drives the need for diversification of business portfolios. This economic convergence has facilitated a more favorable understanding of the challenge and enabled responses to it (Beck and Van Loon 2011: 117–21).

The main culprit behind climate change has been the extensive use of fossil fuels. Climate change mitigation has hence been 'cast largely as one of changing the energy systems of contemporary society away from fossil fuel-based systems towards low- or no-carbon systems' (Steffen 2011: 31). Given energy's centrality in the modern world, reversing climate change emerges as a fundamentally political project; it not only requires a large-scale transition in the global political economy, but also encompasses notions of social justice and issues of international governance. At the same time, it presents formidable challenges not only to traditional ideas of national sovereignty and market organization, but also to established trade patterns and policies in the context of globalization. As a bottom-line, climate change presents a challenge to humanity's capacity to organize efficient and equitable collective action, and to tackle inequalities resulting from climate change (Miliband 2011a: 193).

Although 'pressure for more comprehensive climate policy becomes critical for the future of energy globally' (Dubash and Florini 2011: 10), the discourse on and responses to climate change mitigation have been 'subject to international geopolitical scheming' (Goldthau 2013a: 2). Additionally, climate change policy and actions have been impacted by the uneven distribution of capabilities at the international level and the diverse economic development status of respective stakeholders. Treating climate change as a public policy issue emanating from 'market failure and ensuing externalities that call for public interventions' (Goldthau 2013a: 2)—to the contrary—has hardly caught on. In this context, the global governance of energy has been confined to long-term planning, identification of trends in the energy markets and buffering of price shocks, rather than focused on providing energy security as a public good and preventing further climate change as a public bad (Goldthau 2013a: 2–3).

Overall, responses to climate change—practical efforts to bring emissions down to sustainable levels—have been greatly conditioned by mainstream understandings of and workings within the global political economy, the global political system, and domestic political contours. After exploring these interactions in the next three sections, this introductory chapter moves on to expose the prevailing inconsistencies plaguing responses to climate change. The analysis then broaches the implicit trilemma between climate change mitigation, energy security and growth that drives the politics of climate change mitigation. Against this backdrop, the book sets out an alternative model of energy transition that breaks from the growth imperative tied to the traditional prisms of energy security, geopolitics and development.

The Market Orthodoxy and Its Discontents

A great cleavage in energy and climate policy is the division of labor between the state and the market. Market proponents see in climate change another problem—as all others—that can be solved via market mechanisms. Others blame the advent of climate change on the unfettered nature of global markets, and call for the state to recapture the competences it has yielded and organize economic activity in a climate-friendly and sustainable way (Giddens 2011).

Scholarly literature has focused lately on the ensuring-enabling state (Giddens 2011: 71–2). States can simply not afford to place all their faith in the invisible hand of the market. The magnitude of the problem of climate change calls for the state to marshal its vast resources and ensure market players can make profits if they play along with the new rules governments have engineered. From this perspective, states are entrusted to take pivotal decisions that will direct the key solutions to climate-related problems. This does not boil down to picking winners, but to picking games (Liu and Hanauer 2016). States emerge as editors of choices and determine the kind and range of measures to mitigate climate change.

Interestingly, this approach calls for state intervention so that specific direction is given to market players to follow suit and enforce state initiatives. Proponents prioritize the strategic role of the state to adjust incentives and regulations so that the market can be geared to yield climate-friendly results. While they consider the market unable to initiate the grand transition itself—it is essential to note—they refrain from market capitulation for the sake of state-run programs. Kuzemko et al. (2015: 17–18) have summarized governments' failures in the energy sector as consisting of bureaucratic expansionism and 'crowding out' effects that in practice create moral hazard, distortions of the price mechanism and 'white elephants' due to information failures. Arguments deriving from a critique of market performance, thus, fall short of recommending proposals for the introduction of heavily interventionist policies that would obscure market mechanisms. To the contrary, carbon markets, insurance companies, recycling enterprises and corporations developing smart technologies have a prevalent role in climate responses. This reflects a deeply ingrained mistrust of the state's management capabilities, as well as persistent faith in the benign impact of self-interest, understood as the most likely driver for positive change (Miliband 2011b: 199–200).

Other scholars, on the other hand, challenge this 'markets first' approach (Mazzucato 2015a, b; Stiglitz 2010). Mazzucato (2015a, b), for example, suggests that the state should focus on pioneering innovation. Mazzucato convincingly shows how the state has in many cases paved the way for innovative technologies and services, denouncing this way the myth that innovation can only originate in the market. In this context, she extends a call to states around the world to take a proactive stance and bring forward exactly those innovations that are necessary to drag the world out of the rising climate nightmare, like electricity storage, clean technologies and so on. In this understanding, the state can serve as a pioneer and creator of new markets—rather than a more modest corrective role (Mazzucato 2015a).

The distancing from the absolute faith in markets and their capacity to self-regulate reflects persistent energy market failures (e.g. information asymmetry, incomplete markets, monopolies, unaccounted for externalities and failure to provide public goods) (Kuzemko et al. 2015: 16–17). In particular, this distancing from a pure market approach is tied to two empirical fronts. Firstly, although knowledge and understanding of climate change has been with us for a few decades, the market has hardly addressed the challenge—opting for business as usual solutions (Dalby 2015). Secondly, the wave of market liberalization in the 1980s and 1990s has shown its limits and revealed its shortcomings (e.g. short-termism, corrosion of public institutions, lack of controls for system risk, infrastructure-related problems, and counter-productive institutional and material locks-in) (Giddens 2011: 111). Importantly, the aggravation of public good provision has gone hand in hand with corporate profitability. Elected governments have thus been accused of being complicit partners of the corporate world, and of failing to live up to their duty to protect and further common causes (Giddens 2011: 111; Dannreuther 2015: 479; Proedrou 2012: 62).

It is interesting to briefly explore why the market has failed to yield positive climate-related results. The cumulative corporate response can be summarized in terms of ecological modernization, this meaning a number of measures that were undertaken to secure capitalistic structures and agents from profit losses. In particular, the market responded to environmental hazards, and increased state regulations, with sophisticated technical fixes. A number of market tools, such as the cap and trade system for pollutants, investments on cleaner practices and fuel-switching have been utilized, all bringing substantial economic, but only partial ecological benefits (Dalby 2015: 434–6). In other words, corporate responses revolved around quick fixes to emissions-related problems, and failed to bring about a new economic architecture where sustainability and profitability would be matched in a harmonious way (Falkner 2016: 1118). In particular, corporations initially sought the most inexpensive emissions reductions and/or secured exemptions from regulation. Thereafter, markets pursued the management of projects designed to bring emissions down, new energy technologies and—most significantly—carbon markets. Indeed, markets have become so central to climate responses that one can talk of the marketization of climate change (Paterson 2011: 611, 617). To add insult to injury, offset schemes and market instruments designed to bring emissions down have persistently focused on fossil energy projects instead of mechanisms designed to promote investment in renewable energy generation. Economic fundamentals account for this tendency in the presence of low-cost, high-credit fossil projects that have effectively dislodged renewable energy investments. The economic orthodoxy of the World Bank has facilitated this approach by prioritizing the financial attractiveness of energy projects over holistic social and economic criteria (Zelli et al. 2013: 341–3, 352). Offset schemes are further limited by the inherent risk of carbon fraud and the criticism that carbon trading serves largely only to shift the location of pollution, not reduced carbon emissions. The presence of these limits within the construct of profitability maximization point to the parallel weakness of this approach to substantially contribute to climate change mitigation (Paterson 2011: 616; Young 2011: 628).

This is what Dalby (2015: 436–8) calls neoliberal security; the undertaken measures have facilitated the resilience of capitalist modes of operation and entrenched the understanding that the future can improve by means of private, rather than public, efforts. One of the first responses of the fossil industry to climate change mitigation, for example, has been the development of carbon capture and storage (CCS) systems. This would allow it to continue business as usual strategies with a relative stabilization of carbon emissions (Larkin et al. 2017). Nevertheless, this technology significantly reduces fossil fuel-fired power plant energy efficiencies. At the same time, it would only perpetuate other environmental problems, such as resource scarcity and environmental pollution. At a more profound level, CCS treats the symptoms, rather than the cause of carbon emissions. By enabling enhanced oil recovery, CCS only accentuates the very problem it is intended to deal with in the first place (Fuhr 2016; Brown and Sovacool 2011: 106).[1]

The idea that geo-engineering could be the ultimate solution—should climate disruptions proliferate and intensify amid an altogether failure of adaptation—speaks to the prevalence of the neoliberal security mindset (Dalby 2015: 439). At the same time, such policy proposals marginalize alternatives revolving around the reshaping of the contours of the political economy towards sustainable trajectories (Fuhr 2016). Both solar radiation management and marine cloud brightening, nevertheless, are vastly underexplored techniques. Not only can they just delay, rather than reduce, the concentration of emissions in the atmosphere, but they may also cause severe disruption of climatic phenomena around the world (Brown and Sovacool 2011: 129–31; Fuhr 2016). Interestingly, geoengineering also aims to create new markets in the longer term. While the public discourse is all about climate change mitigation, strong business sector interest lies underneath, not least from the military complex (Cairns and Stirling 2014: 26, 34).[2]

Based on the liberal axiom that Friedrich von Hayek (1944) set for determining whether the market or the state should be in charge of specific issue-areas, climate change stands out as the principal area where the market evidently underperforms, thus severely compromising the freedom and rights of global citizens (Giddens 2011: 120). Even if narrow economics' fundamentals do not dictate urgent and wide-ranging climate action, social reasons do (Bowen and Rydge 2011: 79); and it is only from the states that one can expect to take action on these grounds.

International Climate Diplomacy

The climate change battlefield is being waged on two fronts: the national, encompassing the local and extending to the regional, with states undertaking domestic climate measures and policies; and the global, with states coordinating global efforts in the understanding that climate change is reversible only with collective action. Not only do the risks emanating from climate change transcend national borders by nature, but climate change is also 'de-bounding' in the sense that it substantially transforms boundaries spatially (across nation-states), temporally (involving different timescales) and socially (reconfiguring accountability, responsibility and liability) (Beck and Van Loon 2011).

It is in this context that national interests and antagonisms co-exist with global cooperative endeavors in the make-up of climate politics. Starting with the Rio de Janeiro Earth summit and the ensuing United Nations Framework Convention on Climate Change (UNFCCC) in 1992, signed into force in 1994, states worldwide embarked on the titanic effort to respond to climate change. Progress, however, has since been sluggish at best, and far from linear. Ten years later, the Johannesburg summit in 2002 institutionalized public-private partnerships across the nexus of energy, sustainability and climate change, including the prominent Renewable Energy and Energy Efficiency Partnership (Zelli et al. 2013: 347–8). Climate change mitigation, though, remained on the margins of global politics.

Mainly club-like solutions short of global membership have been advanced thereafter. The European Union (EU)-led effort for an international cap-and-trade system and mandatory carbon emissions reductions was adopted in 1997 and put into force in 2005. While it marked the first mechanism and binding obligations scheme to bring emissions down, the Kyoto Protocol ultimately failed to create solid and enduring incentives for emissions reductions and decarbonization by setting a static emissions reduction target (Falkner 2016: 1110–11). The G8 Gleneagles summit in Britain in 2005 placed energy and climate issues at the core of the institution's deliberations for the first time. Moreover, it established the more inclusive G8+5 forum, to incorporate the most important emerging energy consumers (Brazil, China, India, Mexico and South Africa). The Heiligendamm summit in 2007, moreover, integrated these countries on a permanent basis in the G8 deliberations. While this has been a positive step, a number of other significant energy players, including Saudi Arabia and Turkey, remain outside. The remit of the G8+5 forum hence remains short of a truly global governance mechanism. Nevertheless, the extended form of the G8 has been instrumental in debating, articulating and setting, even if devoid of any binding commitments, pivotal benchmark goals. The Hokkaido summit in 2008 set for the first time the goal of halving global emissions by 2050; and, the G8 summit in L'Aquilla in 2009 officially endorsed the mainstream scientific opinion that the increase of the global temperature should not exceed 2 degrees Celsius. On top of this, it also recognized industrialized states' obligation to reduce greenhouse gas emissions by 80% in 2050 and set the year 1990 as the benchmark year for comparative reductions (Ebinger and Avasarala 2013: 193–4; Zelli et al. 2013: 346). As a result of the eruption of the global financial crisis and its management by the G20, the organization grew stronger and gradually took up discussions from G8 (Heywood 2011: 117). At the Pittsburgh summit in 2009, the G20 pledged to phase out fossil fuel subsidies in the run of the following decades, in an effort to rationalize and minimize fossil energy use (Zelli et al. 2013: 347).

The failure of the global Copenhagen summit in 2009 came as a disappointment as the global population had been awash with hopes for a full-fledged global deal to tackle climate change effectively. Efforts to reach to this goal, however, resumed thereafter with the Cancun summit in 2010 establishing a—even if modest—Green Capital Fund to assist climate change mitigation and adaptation. The Durban summit a year later put together a roadmap for a new agreement by 2015, while the Doha summit in 2012 saw an agreement by most signatories to the Kyoto Protocol to set new targets, albeit the decision by some members to walk out of the summit's second phase (Bradshaw 2014: 145, 190–1).

International climate diplomacy has established global climate stabilization policy as a norm and the principle of 'common but differentiated responsibilities' based on respective capabilities (Falkner et al. 2011: 205). These form the building blocks of the contemporary global climate architecture. In this diplomatic environment, hard power, in the form of force and coercion, is widely regarded as weak and an irrelevant instrument for promoting cooperative behavior by states. Economic leverage and ensuing carrots and sticks can in some cases provide anchor points for reaching consensus between advanced and emerging economies. Most importantly, however, deliberation, particular framings of issues and persuasion serves as the main instruments for climate diplomacy (Falkner et al. 2011: 209). The example of the EU as an institution that consolidated its responsibility for European collective action on climate change and role in international fora is instructive with the Kyoto Protocol being compatible with and building upon the EU's Emissions Trading System (ETS) (Helm 2014).

In general, all stakeholders in the climate negotiations have been interested in ensuring flexibility in meeting climate targets. This has been the case in order to both ensure that this effort would not overshadow other parallel goals, as well as to yield the maximum efficiency possible. Such discursive frames have been central in climate diplomacy and enabled market responses in a few distinct ways. Flexibility has been built-in the system through emissions trading, the Clean Development Mechanism and Joint Implementation schemes. The rationale behind emissions trading, enabled by the fact that the territorial source of emissions is insignificant for the sum of global emissions, has been to allow maximum efficiency for meeting climate targets for all players and, in doing so, also open up substantial market opportunities. Although we remain far from a global emissions trading regime, a patchwork of carbon markets has come into play with the increasing involvement of non-state actors, start-ups and banks. In additional to the European carbon market, a number of national and subnational carbon markets are being established, most crucially in the United States and China (Paterson 2011: 612–20).

While climate politics in the 1990s were underpinned by the EU's lead and the U.S. reluctance to join international climate agreements and mechanisms, from the 2000s the shifting ecological burden progressively tilted the locus of climate diplomacy. With the EU greenhouse gas emissions falling to single-digit numbers, and its international diplomatic power on the wane, the heart of climate diplomacy shifted eastwards. As reflected in the disappointing Copenhagen accord of 2009, American and Chinese national preoccupations and antagonisms eliminated the potential for a substantial agreement and legally binding international commitments to the cause. Divisions between the Global North and the Global South, personified in the U.S.-China clash, rest on who should shoulder the burden, and to what extent, for bringing down excessive carbon emissions—the developed Western polluters or the emerging economic powers (De Matteis 2012).

Developed nations are historically responsible for the overt concentration of emissions in the atmosphere, but were largely unaware during most of the industrial period of the climate repercussions from growing carbon emissions. At the same time, their emissions reduction efforts are insufficient to bring emissions down to numbers capable of stabilizing global temperatures. The criterion of population is brought to the table as a way to highlight that the very large populations of the emerging economies are driving global energy consumption, and hence action on their side is required. The emerging economies counter-argue that the foundation of any climate change discussion should be emissions per capita, this way returning the ball to the Global North's side (De Matteis 2012).

While climate change mitigation negotiations have placed an undue emphasis on population numbers and whether carbon emissions should be estimated on a state or per capita basis (Paterson 2011: 612), a more nuanced approach looks at the very composition and dynamics of the population. For one, the creation of a global middle class is tantamount to the increase of energy use and carbon emissions. Secondly, the global trend of increasing numbers of households (meaning that more people are proportionately living alone) serves as a further driver of increased energy consumption. The composition of the global population also impacts energy use, with different age groups manifesting different energy use patterns. For example, young adults consume more energy for mobility and the elderly for heating, albeit in general energy consumption decreases with ageing populations. While this, together with low fertility rates, may be good news for the Global North, the inverse image is reflected in the demographics of the Global South (Bradshaw 2014: 151–2).

Increasing urbanization trends represents another issue. Urbanization constitutes a driver of economic growth with the effect that energy consumption goes up. Although, these energy needs are met in a more efficient way than in rural areas, thus making for proportionately lower emissions, cities account for the generation of two thirds of the global emissions and for 70% of global energy consumption (World Bank 2016). This opens up significant leeway for alternative global energy and climate governance structures, with the C40 Cities Climate Leadership Group being a case in point (Bradshaw 2014: 47–8; Brown and Sovacool 2011: 119–20).

While the emerging economies undeniably account for an increasingly large share of emissions, a trend that is projected to continue in the mid-term, these countries on the other hand have hardly enjoyed the benefits of previous industrialization rounds that negatively impacted the atmosphere. At the same time, they need fossil energy to keep their economies developing in order to drag their people out of poverty and low welfare standards (Paterson 2011: 612). These major energy consumers perceive the Global North's stance on climate negotiations as a conspired effort to suppress their access to modern energy services (Dubash and Florini 2011: 15). These arguments have become more pronounced in line with the emerging economies' growing diplomatic clout, and tie in with their pledge for enhanced representation and influence within the established Western-dominated framework of international cooperation (Falkner et al. 2011: 211–12; Mahbubani 2013).

What the great representatives of the two rival blocks in climate diplomacy—China and the United States—have in common is, ostensibly, their reluctance to tie themselves down to binding agreements and this way compromise their sovereignty. This reinforces perceptions of international order as characterized by anarchic inefficiency with inadequate and sub-optimal representation (Held and Fane-Hervey 2011).

Climate change cleavages—last but not least—do not run across only the Global North-Global South axis, but also internally. The discrepancy between the EU top-down and the U.S. bottom-up approach to climate policy point to very different logics of climate action (Bradshaw 2014: 72–3, 82–3). Russia, for its part, has followed a rather passive and non-ambitious stand for two reasons. Firstly, it makes the case that the ecosystem services provided by Russia's vast forests should be factored in its contribution; secondly, the establishment of 1990 as the benchmark year coincides with the Soviet Union's disintegration period and ensuing low levels of economic activity and emissions, impacting Russia's ability to comfortably meet climate targets (Bradshaw 2014: 115). The position of China and a host of small and/or least developed countries in the Global South, moreover, has gradually diverged, with China increasingly shouldering more responsibilities in climate change mitigation (Wu 2016).

Overall, the elastic terms of the climate justice debate render it often futile given different perceptions of justice and referent objects, as well as differing historical pathways and personal values (O'Neill 2011). This categorical absence of a shared sense of fairness has been instrumental in perpetuating free-riding and blocking a full-fledged global agreement. At the same time, it has allowed the climate change discussion to be monopolized by—and remain hostage to—utility and competitiveness considerations (Young 2011: 627). Justice-related issues have also been emphatically overshadowed by power politics and geopolitical considerations. It is noteworthy that only six economies (China, the United States, EU, India, Russia, and Japan), and within them mostly their most affluent parts, account for 70% of global emissions (EPA). At the same time, coal consumption in the United States and China accounts for most of global coal consumption (Bradshaw 2014: 59). These two cases bring home the point that those who benefit from climate-damaging activities pay disproportional costs; those least able to bear the costs have to shoulder a disproportionate burden of climate deterioration; and that the least well-off receive services that dwarf their needs. Since energy production, trade and consumption patterns span key intertwined dimensions of markets, security, sustainability and development (Goldthau 2013a: 3), key equity issues such as distributive justice and maximization of social welfare remain marginalized (Brown and Sovacool 2011: 188–9). In the words of Michael Mason (2011: 166), the climate vulnerability of developing countries is

> inseparable from, and exacerbates, global disparities in wealth and relative power: the most disadvantaged face a disproportionate burden of climate-related risks even though they are least responsible for contributing to dangerous levels of greenhouse gases, and have received little or no benefit from the economic activities causing climate change.

In other words, we are more often than not left with sub-optimal distribution of costs and benefits to different groups of citizens 'across income, ethnic, and racial groups, across regions of a country, and across countries' (Brown and Sovacool 2011: 188–9).

Moreover, globalization has put into motion 'the underlying processes driving the geographies of energy demand and carbon emissions' and has substantially altered the contours of the global political economy in the sense that 'consumption in the developed economies is directly implicated in the rapid growth of energy demand and carbon emissions in the emerging economies' (Bradshaw 2014: 147). In this context, globalization highlights the intertwined nature of the contemporary global political economy that is 'confounding global agreement on climate-change policy' (Bradshaw 2014: 48).

Emissions outsourcing blurs the picture further and creates stark analytical problems. Transnational, global production networks now drive economic activity and global trade in the stead of national industries and corporate structures. A territorially based system of climate change diplomacy is perhaps convenient as a reflection of current geopolitics but may be ill equipped to fit with today's complex political and economic reality. This heightened and deep interdependence makes—to the contrary—a strong case for closer and more constructive cooperation between and within the Global North and the Global South (Bradshaw 2014: 45, 147).

From a more groundbreaking viewpoint—rather than looking at states and entrenched categories of states—it is the (upper) middle class, however unevenly and disproportionately distributed across the globe, which is the main culprit behind persistently high carbon emissions. Climate diplomacy affords different degrees of protection to citizens of the global middle class but hardly stimulates necessary change nor provides for equity and social welfare (Harris 2011: 643–4).

It is for these reasons that conceptions of international justice, the ethical and practical foundational unit of the nation-state, obscure the climate change debate. An international justice framing legitimizes national interests, traditional interstate politics and geopolitics, competitiveness concerns and 'you go first' mentalities. These figure prominently in international justice intellectual schemata and naturally lead to a fundamentally problematic global terrain for solutions of collective problems and the provision of global public goods. Cosmopolitan justice, on the other hand, recognizes nation-states' practical importance, but views them as an 'inadequate basis for deciding what is just climatewise' (Harris 2011: 642). In a world characterized by rising interdependencies, globalization, climate change, relationships of causal responsibility that transcend national borders, and overlapping communities of fate, states can be better theorized as the vehicles for climate change purposes, vice the units of reference (Held 2004; McGrew 2007; Frangonikolopoulos and Proedrou 2013: 9; Harris 2011: 640–50). A 'cosmopolitan corollary to the international governance of climate change' (Harris 2011: 644–5) therefore seems both more well-grounded and appropriate to address—in particular—interlinkages between two truly global in scope goals: climate change mitigation and access to energy for the least well-off.

For the time being, consistent with understandings of international justice, tension remains between the need, on the one hand, to bring emissions down and, on the other, to fuel development in the Global South. This tension can only be reconciled and resolved through cosmopolitan understandings and concerted action of all actors, including energy importers and global governance institutions (Bradshaw 2014: 146). The awareness of the consequences of climate change and the understanding of the atmosphere as a shared resource render the enormous ecological footprint of industrialized nations and their citizens as tantamount to human rights violations. Their immense ecological footprint curbs the ecological space of the Global South and creates a pressing obligation for the Global North to pursue a carbon neutral lifestyle (Held et al. 2011: 6; Singer 2011). Duties to assist the Global South in implementing adaptation measures also exist within this overarching obligation so as to advert adverse distributional consequences of climate change.

Domestic Constraints

The history of deadlock in international climate negotiations resulted in the delay of significant progress at the domestic level in many states due to entrenched fears that unilateral measures would weaken one's economy and enhance free-riders. A number of domestic political factors, however, have also contributed to stalled outcomes. Autocracies are by nature non-transparent, unaccountable and broadly immune from public pressures; the risk of underperformance or unenlightened decision-making is hence omnipresent, and naturally extends to climate change mitigation. While the Chinese political establishment has put forward a bold energy reform plan (Kuzemko et al. 2015: 116; Chen and Lees 2016; Mathews 2015), verification mechanisms are obscure and civil society drivers for more comprehensive climate action are missing. This latter factor may also account for the fact that China's climate policy seems driven by narrower air pollution problems and related dire effects on the health of Chinese citizens, rather than climate change itself and its wider ramifications (Haas 2017: 2; Eid et al. 2016: 13).

Democracies, on the other hand, albeit preferable to autocracies in responding to climate change, are far from optimal either. Although open democratic systems enjoy the support, know-how and political pressure of NGOs and businesses working to support the cause of climate change mitigation (Giddens 2011: 76, 123–6), the same is also true for the forces resisting political change (Paterson 2011: 614; Giddens 2011: 122). Moreover, short-termism, self-referring decision-making, interest group concentration and weak multilateralism also help explain the slow progress in both setting and achieving ambitious national climate goals as well as realizing effective international cooperation (Held and Fane-Hervey 2011). Climate change mitigation's medium- to long-term horizon, combined with the need for high upfront costs and unpopular measures in the short-term, clashes with the brevity of electoral cycles and governments' subsequent prioritization of other issues in the policy agenda (Falkner 2016: 1109). Moreover, intense lobbying by fossil industries, together with the increasing influence of money and vested interests across the political system, render climate-friendly policies harder to legislate and implement (Renner 2015: 12; Giddens 2011: 122; Paterson 2011: 614).[3]

The case of ExxonMobil is illuminating amid the firm's notorious tactics of hiding and manipulating evidence regarding the advent of climate change (Coll 2012). Other organizations, such as the Global Climate Coalition and the Climate Council, also gained notoriety for their role in both lobbying for the incumbent fossil industry in the United States, as well as for forging international alliances with climate change-denying states, such as Saudi Arabia and Kuwait. These countervailing forces have as of lately been increasingly balanced by an empowered renewable energy industry and insurance companies vying to hedge against rising and unpredictable future costs, as well as a plethora of various stakeholders in search of diversifying their investment portfolios (Paterson 2011: 614).

In the U.S. political setting, domestic politics also helps explain why a carbon tax remains elusive while emission trading schemes have proliferated. Different voting criteria (unanimity for a carbon tax but only qualified majority required for emissions trading schemes) have facilitated the latter scheme irrespective of benefits or disadvantages (Paterson 2011: 617). This is why Ebinger and Avasarala (2013: 195) conclude that 'the obstacle to international consensus is more often local as opposed to geopolitical. Given the importance of energy policy to the citizens, and therefore voters, in each member nation, consensus on such issues is normally derailed by domestic politics'. This naturally leads to constrained mandate and narrow leeway for global governance structures to make headways in climate change mitigation (Ebinger and Avasarala 2013: 196).

The Climate Regime and the New Paradigm of Domestically Driven Action

While a fully-fledged climate and energy regime has yet to emerge, the institutionalization of piecemeal agreements and governance mechanisms is giving rise to a nascent regime in an incremental fashion. For Keohane and Victor (2011), climate governance amounts to a regime complex with several institutional arrangements loosely coupled at variant levels of hierarchy pulling towards fragmentation and integration. Uncertainty, variable distribution of interests and sought after linkages with other sectors constitute inherent elements of this complex (Keohane and Victor 2011: 12–13). Zelli et al. (2013: 349) also adopt a similar approach, discerning institutional interactions and complexes. The fragmented character of the global climate governance architecture can thus be better understood as an amalgam of

> different institutional approaches to be situated along a continuum ranging from international and public, to public-private or private interventions. Some are related to international agreements and norms and thus fall under a shadow of hierarchy, while others are situated in the realm of non-hierarchical steering without any overarching authority. Its potential reaches up to becoming a global energy governance regime in case organized around concrete national caps on energy use. (Zelli et al. 2013: 340–2)

Among a number of successes, one can list the institutionalization of the Green Climate Fund and various financing instruments. Moreover, subtler effects and results are often unrecognized in assessments of the climate regime (e.g. the direction and progress of research, development and deployment (RD&D) and international cooperation on clean energy technologies) (Zelli et al. 2013: 341, 349). At the same time, global climate governance is 'gradually complemented by transnational—border-crossing and non-state-based—forms of governance' (Zelli et al. 2013: 347). As Falkner (2016: 1112) maintains,

> bottom-up initiatives have come together in transnational networks that coordinate their activities and promote diffusion of climate policies throughout the world. The trend towards transnationalization of climate initiatives, which gathered pace particularly from the early 2000s, has embedded climate policy more deeply in the domestic agenda of leading emitters, has helped spread low-carbon policy approaches and technologies around the world, and is stimulating a growing interest in innovative global solutions.

Crucially, transnational climate governance prioritizes and utilizes disclosure. In particular, transnational networks contribute to climate governance by providing information; enhancing transparency; creating benchmarking processes against which corporate practices are assessed environmentally-wise; institutionalizing novel norms at the transnational level; stimulating competition among corporate actors; and, fostering behavior change in the direction of more climate-friendly practices (Zelli et al. 2013: 349). Before COP21, one could foresee three possible scenarios regarding the evolution of the regime:

- A comprehensive agreement structured around national carbon caps. These would lead to a global emissions cap and be tantamount to a full-fledged global energy governance regime. The political cleavages evidently rendered this option highly unlikely.
- A 'bottom-up' climate regime, where climate change actions would lie in the hands of states with very loose scrutiny by formal global institutions.
- A hybrid model, with bottom-up actions following top-down established targets and embedded in a global system of political accountability (Dubash and Florini 2011: 14).

The Paris Agreement represented a milestone in international climate change mitigation by giving birth to the hybrid model and a new logic of domestically driven climate action. On the one hand, the agreement was of a traditional, classical internationalist kind where governments negotiated and agreed upon independent nationally determined contributions that are neither legally binding nor contemplate the creation of a post-national institution as the fiduciary-guarantor of the accord. Rather than satisfying calls for strong top-down governance and mandatory emissions reductions, the agreement explicitly affirmed the primacy of domestic politics, as well as states' strong aversion to get bogged down to legally binding commitments. This way, the Paris agreement downplays distributional conflicts and allows states to opt for their level of ambition and means of climate action (Falkner 2016: 1111–1119).

On the other hand, a number of international, formal and informal, mechanisms were put into place to monitor, guide and incentivize ambitious national climate change mitigation policies. Mitigation efforts are not left 'to an entirely bottom-up logic', but—to the contrary—are embedded 'in an international system of climate accountability and a "ratchet" mechanism'

(Falkner 2016: 1107–8). Negotiators then positioned international policy deliberation and coordination as a bridge between the climate-mandated emissions ceiling and the outcome of the sum of national pledges. In addition, two instruments were designed to scrutinize states' performance, and are expected to monitor compliance with submitted national pledges and push for more ambitious climate targets and agendas. The first is international review and peer pressure.The second the 'naming and shaming' by the global civil society of those states failing to reach their national goals. In this brave new world of climate politics and diplomacy, political leadership, financial assistance, moral suasion and soft reciprocity are expected to play a crucial role (Falkner 2016: 1120–4).

COP21 also set the benchmark goal of no more than 2 degrees Celsius increase of the global temperature. At the same time, it alleged for the first time that this may not be sufficient, and that a target of 1.5 degrees Celsius increase may be necessary to avert runaway climate change. The Paris summit also set forth the proposition for a mitigation strategy focused not only on minimizing emissions but the parallel need to enhance the absorption capacity of the Earth's carbon sinks (Haas 2017).

In many ways, the Paris Accord represents more of an evolutionary, rather than revolutionary, step approximating a case 'of global coordination through disclosure and scrutiny rather than explicit regulation' (Dubash and Florini 2011: 14). In a sense, it 'rationalizes an already emerging system of domestically driven climate policy', since 'a gap had been growing between the inertia and gridlock that characterized the multilateral negotiations and the increasingly active field of climate policy experimentation at national level' (Falkner 2016: 1119). In practice, in the run-up to COP21 in December 2015, at least 173 countries had already adopted renewable energy targets, while close to 150 had put in place renewable energy support policies (European Commission 2016: 5). The emergence of these policy amid a built up of pressure on the road to the summit was linked to the growing realization of states—and of an increasing number of domestic societal actors—of the potential costs of continued climate inaction.. The independent nationally determined contributions that countries agreed to in Paris reflect a shift in national priorities and raise hopes that the stakeholders will measure up to the task. In this context, the climate regime evolves into the orchestrator of country-level transitions (Goldthau 2013a: 9). The new paradigm is in tune with Dubash and Florini's (2011: 16) prediction that 'as the climate change regime emerges … global governance around energy will take the form of common procedures for reporting and dialogue around national policy actions, rather than around globally agreed substantive commitments.' The developments in Paris also seem to vindicate prior projections that 'multilateral negotiations will yield many energy policy prescriptions or mandate any energy or environmental policy reforms to national practices' (Ebinger and Avasarala 2013: 190).

This hybrid model means that climate change mitigation can benefit from both global and local action. In particular, on the one hand, global action brings uniformity and consistency; creates economies of scale; ensures equity; prevents spill-overs and a race to the bottom; and minimizes transaction costs associated with coordination and negotiation (Brown and Sovacool 2011: 224–33). Local action, on the other hand, facilitates experimentation and innovation; flexibility; accountability and participation; simplicity; and contagion, positive competition among local actors and a race to the top (Brown and Sovacool 2011: 233–6).

This path of evolutionary governance bears resemblance to the evolution of the global trade regime that developed by means of intergovernmental agreements and only recently adopted some supranational characteristics and mechanisms (Falkner et al. 2011: 218). Indeed, the evolution of the trade and climate regimes seem to conjoin each other in that a lucrative global carbon market, within which competition will play out in a carbon-constrained global economy, may soon become a building block of a more comprehensive global climate architecture (Falkner et al. 2011: 218). For this to materialize, the broadening of participation, the provision of financial incentives, and the enlightened action of states are essential prerequisites (Held et al. 2011: 5).

The Bold New Trilemma: Climate Change Mitigation, Energy Security and Growth

For the time being, a governance void lies at the roots of the haphazard transition that is currently under way, particularly manifest at the interface between energy security, climate change, globalization and trade (Bradshaw 2014: 191). Global governance, as a result, remains deeply fragmented, since

- The global climate change governance structure has been exhausted in a monolithic top-down approach to emissions reductions, which encounters severe distributional and free-rider problems, and epitomizes the Global North-Global South controversy. The developments in Paris have opened up a window of opportunity, which has yet to prove itself.

- The global energy governance structure remains both essentially divided in dichotomous blocks of exporters and importers, and absorbed with traditional energy security problems.
- The global trade structure remains trapped in the Global North-Global South divide and hence delivers neither on the economic and social, nor on the global sustainability front.
- The globalization governance structure remains committed to the goal of delivering further growth of international trade and economic activity, which lie at the heart of both ongoing climate change and energy insecurity (Bradshaw 2014: 191).

Since 'a global framework is missing to prevent carbon leakage, address equity issues, and ensure economic scales' (Brown and Sovacool 2011: 323), climate change efforts and the current scope and scale of the transition remain out of tune with the urgency of required climate action. The initial governance efforts aimed at setting benchmarks for climate change mitigation (the UNFCCC and the Kyoto Protocol)

> erred in addressing the issue of emissions in the margin, focusing on modest reductions from current levels on the part of major emitters rather than setting overall emissions levels and confronting the question of how to allocate emissions permits on a global scale (Young 2011: 628).

Carbon reduction percentages and degrees though are only arbitrary formulas that remain far off from target. There is now general acknowledgement that the carbon intensity of global energy use must decrease by a factor of 21 by 2050 (Goldthau 2013a: 4), and that no more than one third of the proven fossil reserves can be consumed if the 2 degrees Celsius temperature increase threshold is not to be surpassed prior to 2050. Business as usual scenarios, however, only perpetuate the crisis given projections for a further rise of emissions that will increase global temperature by more than 3 degrees Celsius (Bradshaw 2014: 192). While a 30–40 percent emissions decrease will be manageable with current efficiency, renewables and conservation schemes along with efficient forest sinks, we remain way far from approaching the 80 percent (and higher) drop in global emissions that is needed to stabilize the global temperature (Young 2011: 634). The national pledges submitted in the Paris Climate Summit are projected, if fully implemented, to result in global warming of 2.7 Celsius degrees above pre-industrial levels,[4] much higher than the benchmark goal of maximum

2 degrees—let alone the more ambitious 1.5 Celsius degree target (Falkner 2016: 1108, 1115). In fact, this more ambitious goal may be a more appropriate benchmark if one accounts for the much larger than initially estimated heat absorption by the oceans and the very slow pace of evaporation of trapped emissions (Falkner 2016: 1108).

Hence emerges the need to move to the idea of a strict, ecologically driven, carbon budget (Young 2011: 627). This entails setting a globally acceptable level of carbon equivalent greenhouse gases emissions annually (which lies at a total of 750 gigatones by 2050) (Zelli et al. 2013: 340–1), together with mechanisms to monitor progress (Young 2011: 629). For now, however, this idea remains elusive, rightly seen as too hazardous for the perpetuation of growth strategies. Ironically, the idea of a carbon budget has been contemplated by natural gas proponents, who argue that the energy needs of the world can be covered by existent natural gas reserves that will broadly substitute for coal and oil use.[5] The International Energy Agency's (IEA) golden age of gas scenario, however, estimates a catastrophic global temperature increase of 3.5 by 2035 (cited in Bradshaw 2014: 66–7). As a result, as long as firm caps on carbon emissions are not institutionalized and regulated, the speed, scope and scale of the transition to clean energy systems is bound to remain limited (Brown and Sovacool 2011: 179–80).

Reversing climate change in practice comes down to drastically fewer carbon equivalent emissions, lower fossil energy production and consumption and, effectively, a smaller ecological and carbon footprint. The global energy system, though, remains emphatically locked-in the proliferation of fossil energy production and consumption. Fossil energy fuels all economic sectors (e.g. industry, services, trade, etc.) in service of a premise upon the propensity of national economic systems and the global economy to grow (Mulligan 2010: 87). This growth imperative dominates economic thinking and results in exponential growth beyond biophysical limits in all sectors—most significantly for the purposes of this book in exponential growth in energy use and emissions. This is hardly what one would call prudent and sustainable housekeeping.

In this growth-dominated policy context, energy policy and security focus on security of energy supply, rather than on the reversal of climate change and sustainability. As a result, anti-climate policies, such as a return to coal, are consistently pursued despite the advent of climate change, while energy sector reforms reflect more of a motivation to increase energy efficiency for a mix of economic, geopolitical and security reasons, rather than a candid endeavor to combat climate change (Giddens 2011: 90–1, 109). This manifests itself most emblematically in the observation that the decline of energy intensity has been much greater than the drop in carbon intensity (Bradshaw 2014: 53). Not only does contemporary climate and energy policy hence remain full of contradictions (Compston and Bailey 2013), but energy policy remains an obstacle to an efficient climate policy, rather than effectively metamorphosing into one.

While a plethora of high caliber scholarly analysis has endeavored to integrate energy and climate perspectives, the work generally follows a rather mediocre, middle ground, conventional approach grounded to contemporary political realities reflecting the sluggish tilt of policy-making (Brown and Sovacool 2011; Bradshaw 2014; Giddens 2011). In the same context, energy security scholarship has incorporated the sustainability dimension and related concerns (Goldthau 2013a, b; Stang 2015), but has not effectively focused on how energy security can balance between its core priorities, including sustainability in its fullest sense and climate change mitigation. A few exceptions (see Cherp and Jewell 2014) critically discuss the goals, means and implications of mainstream energy policy—and question their foundations—without however delving into alternative pathways. As a result, energy policy and security analysis mirrors a conservative approach with adequate supplies on time and at reasonable prices still dominating the agenda (Goldthau 2013a; Dubash and Florini 2011: 11). A preference for reformative, business as usual policies is inherent to this approach in the sense that analysis does not stretch to question other policy priorities and fundamental assumptions. Energy security analysis takes the reform approach as a given, and endeavors within this framework to critically discuss energy challenges and dilemmas.

There has hence as of yet been no attempt to design a sustainable energy policy framework that will abide by a biophysically-set emissions ceiling. A holistic approach capable of addressing the synergies and linkages of traditional energy security concerns with climate change in a ground-breaking fashion is thus badly in need. The incompatibility of the growth and sustainability agendas (Daly 1996) accounts for this persistent gap. Intellectual difficulties in separating policy analysis and recommendations for a post-carbon future from the growth framework plague scholarship in the energy field, where the goals (deep decarbonization) and means (policy prescriptions for energy reforms) diverge emphatically (Kuzemko et al. 2015).

The Kaya identity modelling provides a valuable matrix that can offer insights into how contemporary analyses remain captive to long-held, unproblematized assumptions. Population, economic growth, energy intensity and carbon intensity together determine energy needs and ways of meeting them. In policy-making terms, though, population and economic growth go unproblematized as unquestioned parameters. The focus then naturally falls on economic, institutional and technological improvements of the energy and carbon intensity of the economy (Bradshaw 2014). The central assumption of this book is that a check on economic growth is fundamentally crucial, and can facilitate massive decreases in both energy and carbon intensity. The crucial population issue is not dealt with here, since this would require a totally different approach and significant additional space—although it is fully appreciated that it both impacts and is impacted upon by the other three factors.

With the orthodoxy of growth untouched, the emphasis inevitably lies at minimizing energy and carbon intensity, which evidence shows will fall short of fulfilling climate goals (Bradshaw 2014: 183). Ironically, renewable energy technology innovations are bolstering investor optimism in the successful transition to a low-carbon economy, part and parcel with their growth strategies (Falkner 2016: 1113). This is evident in all states' economic strategies and visions for green growth, including the Juncker Commission's dual goals of energy security and sustainable growth, the U.S. standard pro-growth economic policy and the Saudi Vision, to name only a few indicative examples. Political stakeholders thus remain far from rethinking growth and its constitutive role in producing adverse climatic conditions, and effectively arresting it. In the absence of limits, the effort to minimize energy intensity seems elusive; efforts to substantially reduce carbon intensity lack dynamism and effectiveness as they stumble against institutional and technological lock-in effects (Goldthau and Sovacool 2012: 234–5; Bradshaw 2014: 19–20).

Overwhelmingly conventional energy security analysis, the sluggish, partial and far from comprehensive integration of the energy and climate policy fields, and the mediocre advance of global energy and climate governance seem to be conjoined and hindered by the overarching economic priority of growth. Indeed, energy security literature takes growth for granted and assumes that energy policy and security should serve growth. Only Kuzemko et al. (2015) do not make the same reflective assumption and devote a few pages to discuss approaches that challenge growth. Nevertheless, they ultimately do not stray from the imperative of growth and hence do not delve into any anti-, de- or post-growth discussion of energy policy and security. This is despite their bold recognition that

> a massive increase in the worldwide effort is still required – some say of revolutionary proportions … energy and climate governance needs to become a great deal more reflexive, interactive, coordinated and visionary [as] any sustainable energy transition would be unprecedented, both in terms of the time frame envisaged, and because of the centrality of new scientific knowledge about humankind's relationship with the environment … change appears to be difficult, messy and uncertain (Kuzemko et al. 2015: 102–3, 120).

They also acknowledge that the goal of 2 degrees Celsius will not be achieved and that measures to mitigate climate change are nothing but 'post-hoc sticking plasters', suggesting that stricter carbon budgets are needed, and 'more profound policy measures are required to avoid the potentially devastating impacts of such temperature rises' (Kuzemko et al. 2015: 25, 105, 114). Nevertheless, the authors surprisingly conclude that reforms and restructuring will have to take place without upsetting growth (Kuzemko et al. 2015: 216). Not only is it hard to see how these proposals are compatible with growth, but they have also historically failed to prove themselves so. In all, the prospects for achieving climate change mitigation, energy security and growth within reformist, growth-based mindsets and policy frameworks remain obscure.

The Rationale, Aims and Plan of the Book

The logical implication of energy security literature's overarching conclusion that current energy policies fall short of climate goals would seem to be further research along alternative pathways. This book endeavours exactly that, and in doing so departs sharply from mainstream frameworks of energy policy and security, and their associated deadlocks and insurmountable contradictions. Its central argument is that the failure to provide the energy transition with the required scale, scope and speed lies at the heart of the antinomy between growth and the need for less necessitated by climate change. Designing an energy policy that will achieve 'an effective (emissions go down), efficient (cheap) and equitable (just and compensatory) global response to climate change' (Bowen and Rydge 2011: 78–9) bumps against the imperative of growth. If growth, climate change mitigation and energy security are not achievable together, a strategic choice lies ahead. The default option seems to be sticking to conventional, business as usual and reformative (at best) approaches to energy policy in line with the growth agenda to the detriment of climate change mitigation. This book, to the contrary, argues for disentangling from the imperative of growth and for prioritizing climate change mitigation.

The reversal of climate change calls for an energy policy of a very different kind. Appreciating that 'energy policy is in need of and linked to paradigms' (Goldthau 2013b: 525), de-constructing growth and approaching economic organization towards a new paradigm is the first indispensable step to devise an energy policy that lives up to the climate challenge. This is so for two reasons. Firstly, an alternative approach can guide the conception, organization and establishment of a suitable energy policy for a climate-strained world. Secondly, energy policy does not operate in a policy vacuum. It is essential to focus analytical attention on economic realms and policies that affect and are affected by energy, the function and reform of which carry significant implications for energy policy.

No wonder, institutionalizing a new paradigm is a titanic challenge. As Smith and Stirling (2010: 7, 9) underline,

> politically and economically, institutionalization is very difficult. It involves mobilizing serious selection pressures against the incumbent regime and redirecting vast institutional, economic, and political commitments into promising niches along desired pathways … with notions of sustainability displaying such malleability to strategic interpretation, how credible is it that a transition management process that begins within a vanguard of elite visionary forerunners can really overturn structurally embedded regimes? (Smith and Stirling 2010: 9)

The window of opportunity for change, however, has opened up significantly with the twin developments of progressive mobilization of social movements demanding greater sustainability and a number of ecological catastrophes compounded by the dredging austerity of the last decade that resulted from the financial crisis. These bestow 'greater credibility on radical arguments … the interdependencies that made the regime so enduring can become problematic because they constrain responses to these significant new pressures' (Smith and Stirling 2010: 9).

With the option of extensive nuclear power generation handicapped by exorbitant economic safeguards, we have to choose between two ideal-type strategies. Growth-driven strategies will perpetuate business as usual policies. This includes exploration of unconventional and extreme forms of energy, end-of-pipe and geo-engineering solutions, and harnessing technological innovations for energy conservation and efficiency. Contrary to solutions compatible with the dominant mindset, no-growth strategies prioritize sustainability and aim to reorganize the energy systems and the contours of the economy accordingly. While remaining on the margins of political thought and policy-making structures, no-growth strategies are both promising and historically realizable. Rather than anticipating a rapid, one-off mentality switch around the world, a de-growth process can be kick-started by a few dominant players that can effectively stem demand for fossil energy; this can bring sweeping effects in the energy system, foster chain reactions, and release significant transformational potential. The hope is that this book can contribute to the ongoing debate by clarifying the tangible benefits emanating from a steady-state energy policy in terms of climate change mitigation, energy security, development and more benevolent geopolitics. A proper explanation will this way help empower the resolve of political actors to move closer to this path.

This chapter sought to introduce the current state of play in climate politics and to underscore the deficient progress achieved thus far. It subsequently set forth the assumption that growth serves as a structural barrier to an effective energy policy that can mitigate climate change. In this context, Chap. 2 presents the theory of ecological and steady-state economics as an alternative and more pertinent lens for the study of the climate-energy nexus. Here, the focus is placed on the scale of economic activity, the economy-ecology nexus and the macro-economics of the biosphere, all of which lie at the heart of the climate change problem. Chapter 2 subsequently singles out and critically discusses the reforms put forward by current literature in ecological and steady-state economics for the monetary, trade and auditing policy realms as essential for returning economic activity and energy use closer to or within biophysical limits.

On this theoretical basis, Chap. 3 presents how a radical steady-state energy policy would look. It initially focuses on the implications steady-state monetary and trade policies carry for energy policy. This analysis is supplemented by the examination of ecological tax reform that can reshuffle patterns of energy use, and an investment policy inspired by steady-state principles and geared to accomplish steady-state energy policy goals. The chapter then moves on to discuss core aspects of energy policy. It sets out two different pathways of energy transition and the critical variables to success. In doing so, it juxtaposes contemporary low-carbon transitions to steady-state energy policies in terms of urgency, speed, scope and scale. The bottom line is that contemporary low-carbon transitions fail to legislate indispensable limits to energy use in fear of negatively affecting growth. In this context, climate measures remain modest, include only emissions reductions relative to the 1990 benchmark, and thus remain far from synchronized with ambitious climate goals and associated stringent carbon budgets. A steady-state energy policy, to the contrary, begins by imposing caps on energy use within biophysical limits, in effect imposing a carbon budget. It subsequently harnesses the large-scale generation of renewables in centralized and de-centralized modes with government support and favorable regulation, as well as systematically tapping into energy efficiency's vast potential.

Such a radical steady-state energy policy has to be assessed both against the merits of contemporary energy policy, and within the established energy security framework. Chapter 4 undertakes this task and reaches three principal conclusions. Firstly, while contemporary energy policy evidently fails to attain sustainability goals—more emphatically climate change mitigation—a steady-state energy policy is set on delivering sustainability by defining and sticking to stringent carbon budgets within the remaining biophysical capacity. Secondly, compared to the consistent geological, geopolitical and market-related risks faced by contemporary energy policy, a steady-state energy policy figures more favorably in terms of physical availability of and access to energy, the local ownership of energy, and the predictable renewable energy harvest as compared to unpredictable oil harvest cycles. Thirdly, putting renewables costs in perspective, not least by means of revealing fossil energy's full costs, the chapter unveils that conventional energy policy performs rather poorly on the affordability front vis-à-vis a steady-state energy policy; pulling out of an endogenously unstable global fossil energy market also constitutes a significant plus for the energy security of states undertaking steady-state energy policies.

Chapter 5 effectively extends the assessment of a steady-state energy policy, scrutinizing the impact it would have on geopolitics and development. This is necessary and valuable for two reasons. Firstly, energy plays a fundamental role in geopolitics and development; energy policy, hence, is critical for the achievement of high-order goals in the global system. Secondly, a more peaceful and equitable world is a prerequisite for sustainability. The expansion of zones of peace, good governance and development in this context becomes supportive of the wider cause of sustainability (Wackernagel et al. 2006: 248–9). Again, the findings are encouraging. For one, although it is hard to exaggerate the risks inherent in such a ground-breaking transition away from fossil fuels, a steady-state energy policy will lessen the entrenched link between fossil energy and conflict. Secondly, scholarly literature has very recently started to speculate on the future geopolitics of renewable energy. In doing so, it has more often than not reproduced the competitive understandings of fossil energy geopolitics and loaded them unto the geopolitics of renewable energy. A number of factors, however, speak to the less conflictive nature of the geopolitics of renewable energy. With regard to development, thirdly, local renewable energy systems constitute a promising solution to the Global South's persistent energy poverty and wider developmental problems. Breaking the link between oil and gas on the one hand, and authoritarianism and underdevelopment on the other, moreover, is the first indispensable step in opening up new developmental pathways. In this context, a steady-state energy policy—despite the very real caveats regarding the transition period—is supportive of the causes of peace, cooperation and development.

Chapter 6 summarizes the main argument of the book, the pillars of a radical, steady-state energy policy, and the policy's across the board merits. It subsequently discusses how issue cycling works to the detriment of effective energy and climate agendas, and, in line with ecological economics, extends a call for nexus thinking with climate change at the center. It concludes with underlining the importance of embracing plural understandings of sustainability, and accordingly envisioning and envisaging sustainable livelihoods in diverse, imaginative ways.

Notes

1. Failure to render this technology commercial at a wide scale, not least due to high storage and associated infrastructure investments costs, means that we remain some distance from its potential implementation (Brown and Sovacool 2011: 106). In a similar note, nuclear fusion has been on the table as a viable large-scale alternative due to its low carbon and security credentials, but remains so far prohibitively expensive and demonstrates no learning curve. High safety standards for nuclear reactors exponentially raise the cost of production of nuclear energy and decisively discourage further investments. What is more, nuclear energy can lead to toxic leaks, and calls for safe storage facilities operative well into the future. Finally yet importantly, decommissioning toxic waste remains an unresolved issue (Brown and Sovacool 2011: 100–2; Kuzemko et al. 2015: 53, 121–3).
2. Geo-engineering methods also feature enormous geopolitical disruption potential. For one, great powers may acquire control of the planetary

thermostat, and meddle with it for all sorts of geopolitical goals (Fuhr 2016). This stands for nothing less than ecological imperialism, since unilateral actions are certain to have global consequences. At a broader level, corporations, powerful institutions and even affluent individuals can also undertake such practices with unpredictable consequences. The spectre of such methods being used by terrorist groups speaks to the magnitude of the problem in its direst form (Brown and Sovacool 2011: 137–8).

3. As Noreng (2013: 172) indicatively asserts, a coalition of the automobile industry, oil, real estate, and construction interests has much leverage in the Congress to thwart any proposed measures on reduction of oil consumption in the US.
4. Peter Haas (2017: 2) estimates a range from 2.6 to 3.1 degrees Celsius by 2100.
5. Two caveats are crucial here. Firstly, such a scheme obscures more ambitious agendas, like fully renewable energy systems. Secondly, while gas is certainly cleaner than oil and coal, shale gas is not that cleaner and also brings other detrimental side-effects to the environment (Franca et al. 2016; van der Veen 2015; IFRI/CIEP 2015).

References

Beck, U. and Van Loon, J. 2011. Until the Last Tin of Fossil Fuel Has Burnt to Ashes: Climate Change, Global Inequalities and the Dilemma of Green Politics, in D. Held, A. Fane-Hervey and M. Theros (eds), *The Governance of Climate Change. Science, Economics, Politics & Ethics*. Cambridge: Polity Press, 111–134.

Bowen, A. and Rydge, J. 2011. The Economics of Climate Change, in D. Held, A. Fane-Hervey and M. Theros (eds), *The Governance of Climate Change. Science, Economics, Politics & Ethics*. Cambridge: Polity Press, 68–88.

Bradshaw, M. 2014. *Global Energy Dilemmas*. Cambridge: Polity Press.

Brown, M. and Sovacool, B. 2011. *Climate Change and Global Energy Security: Technology and Policy Options*: Cambridge, MA: MIT Press.

Cairns, R. and Stirling, A. 2014. 'Maintaining Planetary Systems' or 'Concentrating Global Power?' High Stakes in Contending Framings of Climate Geoengineering. *Global Environmental Change*, 28, 25–38.

Chen, G. and Lees, C. 2016. Growing China's Renewables Sector: A Developmental State Approach. *New Political Economy*, 21: 6, 574–586.

Cherp, A. and Jewell, J. 2014. The Concept of Energy Security: Beyond the Four As. *Energy Policy*, 75, 415–421.

Chesney, M. et al. 2016. The Issue of Climate Change, in M. Chesney et al. (eds), *Environmental Finance and Investments*. Heidelberg: Springer, 5–16.

Coll, S. 2012. *Private Empire: ExxonMobil and American Power*. London: Penguin.

Compston, H. and Bailey, I. 2013. Climate Policies and Anti-Climate Policies. *Open Journal of Political Science,* 3: 4, 146–157.
Dalby, S. 2015. Climate Geopolitics: Securing the Global Economy. *International Politics*, 52: 4, 426–444.
Daly, H. 1996. *Beyond Growth: The Economics of Sustainable Development*. Boston, MA: Beacon Press.
Dannreuther, R. 2015. Energy Security and Shifting Modes of Governance. *International Politics,* 52: 4, 466–483.
De Matteis, P. 2012. The EU's and China's Institutional Diplomacy in the Field of Climate Change. *European Union Institute for Security Studies Occasional Paper,* 96. Paris.
Dubash, N. and Florini, A. 2011. Mapping Global Energy Governance. *Global Policy,* 2: 1, 6–18.
Ebinger, C. and Avasarala, G. 2013. The "Gs" and the Future of Energy Governance in a Multipolar World, in A. Goldthau (ed.), *The Handbook of Global Energy Policy.* Chichester: Wiley-Blackwell, 190–204.
Eid, C., Hakvoort, R. and de Jong, M. 2016. Global Trends in the Political Economy of Smart Grids: A Tailored Perspective on 'Smart' for Grids in Transition. *UNU-WIDER Research Paper wp2016-022. World Institute for Development Economic Research*, 1–19.
European Commission. 2016. The Revised Renewable Energy Directive. *MEMO – Clean Energy for All,* 30 November, 1–6.
Falkner, R. 2016. The Paris Agreement and the New Logic of International Climate Politics. *International Affairs,* 92: 5, 1107–1125.
Falkner, R., Hannes, S. and Vogler, J. 2011. International Climate Policy after Copenhagen: Toward a 'Building Blocks' Approach, in D. Held, A. Fane-Hervey and M. Theros (eds), *The Governance of Climate Change. Science, Economics, Politics & Ethics.* Cambridge: Polity Press, 202–222.
Franca, L., de Jong, D. and van der Linde, C. 2016. The Future of Gas: The Transition Fuel?, in S. Colombo, M. El Harrak and N. Sartori (eds), *The Future of Natural Gas Markets and Geopolitics.* Netherlands: IAI/OCP, 25–40.
Frangonikolopoulos, C. and Proedrou, F. 2013. Global Governance and Cosmopolitan Democracy: Bridging the Gap between Proponents and Opponents. *Bridges: Conversations in Global Politics and Public Policy*, 2: 1, 1–26.
Fuhr, L. 2016. Radical Realism About Climate Change. *Project Syndicate* [Online]. Available: https://www.project-syndicate.org/commentary/paris-climate-agreement-and-geo-engineering-by-lili-fuhr-2016-11 [Accessed on 11 November 2016].
Giddens, A. 2011. *The Politics of Climate Change*. Cambridge: Polity Press.
Goldthau, A. 2013a. Introduction: Key Dimensions of Global Energy Policy, in A. Goldthau (ed.), *The Handbook of Global Energy Policy.* Chichester: Wiley-Blackwell, 1–12.

Goldthau, A. 2013b. Conclusion: Global Energy Policy: Findings and New Research Agendas, in A. Goldthau (ed.), *The Handbook of Global Energy Policy*. Chichester: Wiley-Blackwell, 521–525.
Goldthau, A. and Sovacool, B. 2012. The Uniqueness of the Energy Security, Justice, and Governance Problem. *Energy Policy*, 41, 232–240.
Haas, P. 2017. Parxit, the United States, and the World. *Chinese Journal of Population Resources and Environment* [First online], 1–3.
Harris, P. 2011. Reconceptualizing Global Governance, in J. Dryzek, R. Norgaard and D. Schlosberg (eds), *The Oxford Handbook of Climate Change and Society*. Oxford: Oxford University Press, 639–652.
Hayek, F. 1944. *The Road to Serfdom: With the Intellectuals and Socialism*. Chicago: Chicago University Press.
Held, D. 2004. *Global Covenant. The Social Democratic Alternative to the Washington Consensus*. Cambridge: Polity Press.
Held, D. and Fane-Hervey, A. 2011. Democracy, Climate Change and Global Governance: Democratic Agency and the Policy Menu Ahead, in D. Held, A. Fane-Hervey and M. Theros (eds), *The Governance of Climate Change. Science, Economics, Politics & Ethics*. Cambridge: Polity Press, 89–110.
Held, D., Fane-Hervey, A. and Theros, M. 2011. Editors' Introduction, in D. Held, A. Fane-Hervey and M. Theros (eds), *The Governance of Climate Change. Science, Economics, Politics & Ethics*. Cambridge: Polity Press, 1–10.
Helm, D. 2014. The European Framework for Energy and Climate Policies. *Energy Policy*, 64, 29–35.
Heywood, A. 2011. *Global Politics*. London: Palgrave Macmillan.
Institut français des relations internationales/Clingendael International Energy Programme. 2015. The New Dimensions of Geopolitics. *2012–2015 Triennium Work Reports*, 1–36.
Intergovernmental Panel for Climate Change. 1990. First Assessment Report: Climate Change 1990.
Intergovernmental Panel for Climate Change. 1995. Second Assessment Report: Climate Change 1995.
Intergovernmental Panel for Climate Change. 2001. Third Assessment Report: Climate Change 2001.
Intergovernmental Panel for Climate Change. 2007. Fourth Assessment Report: Climate Change 2007.
Intergovernmental Panel for Climate Change. 2013. Fifth Assessment Report: Climate Change 2013.
Keohane, R. and Victor, D. 2011. The Regime Complex for Climate Change. *Perspectives on Politics*, 9: 1, 7–23.
King, D. 2011. The Challenge of Climate Change, in D. Held, A. Fane-Hervey and M. Theros (eds), *The Governance of Climate Change. Science, Economics, Politics & Ethics*. Cambridge: Polity Press, 13–30.
Kuzemko, C., Keating, M. and Goldthau, A. 2015. *The Global Energy Challenge: Environment, Development and Security*. London: Palgrave Macmillan.

Larkin, A. et al. 2017. What if Negative Emission Technologies Fail at Scale? Implications of the Paris Agreement for Big Emitting Nations. *Climate Policy* [first online], 1–25.

Liu, E. and Hanauer, N. 2016. Economics Shows Us Why Laissez-Faire Economics Always Fails. *Evonomics* [Online]. Available: https://evonomics.com/complexity-economics-shows-us-that-laissez-faire-fail-nickhanauer/ [Accessed on 12 July 2017].

Mahbubani, K. 2013. *The Great Convergence: Asia, the West, and the Logic of One World*. New York: Public Affairs.

Mason, M. 2011. The Ends of Justice: Climate Vulnerability Beyond the Pale, in D. Held, A. Fane-Hervey and M. Theros (eds), *The Governance of Climate Change. Science, Economics, Politics & Ethics*. Cambridge: Polity Press, 162–182.

Mathews, J. 2015. The Renewable Energy Revolution. *Project Syndicate* [Online]. Available: https://www.project-syndicate.org/commentary/china-india-transition-to-renewable-energy-by-john-a--mathews-2015-12 [Accessed on 14 June 2017].

Mazzucato, M. 2015a. *The Entrepreneurial State: Debunking Public vs. Private Sector Myths*. New York: Anthem Press.

Mazzucato, M. 2015b. Toward a Green New Deal. *Project Syndicate* [Online]. Available: https://www.project-syndicate.org/commentary/clean-energy-billionaires-public-investment-by-mariana-mazzucato-2015-12?barrier=true [Accessed on 14 June 2017].

McGrew, A. 2007. Globalization and Global Politics, in J. Baylis, S. Smith and P. Owens (eds), *Globalization of World Politics: An Introduction to International Relations*. Oxford: Oxford University Press, 14–34.

Miliband, D. 2011a. Green Peace: Energy, Europe and the Global Order, in D. Held, A. Fane-Hervey and M. Theros (eds), *The Governance of Climate Change. Science, Economics, Politics & Ethics*. Cambridge: Polity Press, 185–193.

Miliband, E. 2011b. The Politics of Climate Change, in D. Held, A. Fane-Hervey and M. Theros (eds), *The Governance of Climate Change. Science, Economics, Politics & Ethics*. Cambridge: Polity Press, 194–201.

Mulligan, S. 2010. Energy, Environment, and Security: Critical Links in a Post-Peak World. *Global Environmental Politics*, 10: 4, 79–100.

Noreng, O. 2013. Global Resource Scramble and New Energy Frontiers, in A. Goldthau (ed.), *The Handbook of Global Energy Policy*. Chichester: Wiley-Blackwell, 159–175.

O'Neill, O. 2011. Social Justice and Sustainability: Elastic Terms of Debate, in D. Held, A. Fane-Hervey and M. Theros (eds), *The Governance of Climate Change. Science, Economics, Politics & Ethics*. Cambridge: Polity Press, 137–143.

Paterson, M. 2011. Selling Carbon: From International Climate Regime to Global Carbon Market, in J. Dryzek, R. Norgaard and D. Schlosberg (eds), *The Oxford*

Handbook of Climate Change and Society. Oxford: Oxford University Press, 611–624.

Proedrou, F. 2012. *EU Energy Security in the Gas Sector: Evolving Dynamics, Policy Dilemmas and Prospects*. Surrey: Ashgate.

Renner, M. 2015. The Seeds of Modern Threats, in World Watch Institute (ed.), *State of the World 2015: Confronting Hidden Threats to Sustainability*. London: Island Press, 3–17.

Singer, P. 2011. Changing Values for a Just and Sustainable World, in D. Held, A. Fane-Hervey and M. Theros (eds), *The Governance of Climate Change. Science, Economics, Politics & Ethics*. Cambridge: Polity Press, 144–161.

Smith, A. and Stirling, A. 2010. The Politics of Social-Ecological Resilience and Sustainable Socio-Technical Transitions. *Ecology and Society*, 15: 1, 1–13.

Stang, G. 2015. The Climate-Energy Nexus. *European Union Institute for Security Studies Issue Alert 54*, Paris.

Steffen, W. 2011. A Truly Complex and Diabolical Policy Problem, in J. Dryzek, R. Norgaard and D. Schlosberg (eds), *The Oxford Handbook of Climate Change and Society*. Oxford: Oxford University Press, 21–37.

Stiglitz, J. 2010. *Freefall: America, Free Markets, and the Sinking of the World Economy*. New York: Norton.

The World Bank. 2016. COP 22: Three New Ways to Help Cities Reach their Climate Goals. *Feature Story* [Online]. Available: http://www.worldbank.org/en/news/feature/2016/11/28/cop-22-three-new-ways-to-help-cities-reach-their-climate-goals [Accessed on 14 February 2017].

Van der Veen, E. 2015. Why Energy Per Carbon Matters. The Relevance of Fossil Fuel Properties for Climate Change and Energy Transition Discussions and Policy-Making. *The Clingedael Institute Energy Programme Paper*, 2, 1–20.

Wackernagel, M. et al. 2006. Ecological Footprint Accounts for Advancing Sustainability: Measuring Human Demands on Nature, in P. Lawn (ed.), *Sustainable Development Indicators in Ecological Economics*. Cheltenham: Edward Elgar, 246–267.

Wu, F. 2016. Shaping China's Climate Diplomacy: Wealth, Status, and Asymmetric Interdependence. *Journal of Chinese Political Science*, 21: 2, 199–215.

Young, O. 2011. Improving the Performance of the Climate Regime: Insights from Regime Analysis, in J. Dryzek, R. Norgaard and D. Schlosberg (eds), *The Oxford Handbook of Climate Change and Society*. Oxford: Oxford University Press, 625–638.

Zelli, F. et al. 2013. Global Climate Governance and Energy Choices, in A. Goldthau (ed.), *The Handbook of Global Energy Policy*. Chichester: Wiley-Blackwell, 340–357.

Zimmerer, J. 2014. Climate Change, Environmental Violence and Genocide. *The International Journal of Human Rights*, 18: 3, 265–280.

CHAPTER 2

Ecological and Steady-State Economics: Principles and Policies

Unpacking Ecological and Steady-State Economics

Ecological economics responds to the call made by many scholars for coming to terms with the consequences of the economy's metabolic rift, revisiting dominant mindsets that ignore the limitations presented by the ecosystem, and for bringing nature back into geopolitical, economic and energy thinking (Dalby 2015: 440–1; Deudney and Matthew 1999). In doing so, it theorizes the economy based on its coexistence, synergies, and dependence on the ecological system. The central theme underwriting this approach is the opposition to growth, defined as the perpetual proliferation and expansion of economic activity and understood as inputs from and outputs back into the biosphere (Daly 1996). Growth is synonymous with modernity, guiding the vector of the global economy since modernity's advent. In doing so, it has produced substantial ecological and economic liabilities, as well as concomitant political and social problems. The unwarranted commitment to growth, from this perspective, constitutes nothing but a hidden threat to sustainability (World Watch Institute 2015).

This is true for two reasons. Firstly, growth creates enormous risks and damages to the global ecological system that translates into evidence of massive and tangible natural, material, and monetary costs (UNEP and Stockholm Environment Institute 1999; WRI, UNDP, UNEP and World Bank 2000; Wackernagel et al. 2006: 246; Stern 2006; Jowit and Wintour 2008; Lesage et al. 2010; Heinberg 2011: 33). Secondly, according to the

F. Proedrou, *Energy Policy and Security under Climate Change*,
https://doi.org/10.1007/978-3-319-77164-9_2

fundamental economic law of diminishing returns, returns on investments at some point reach their peak and then start to decline. For a significant number of types and sectors of economic activity, including crucially the energy sector, the presence of this limiting factor creates serious repercussions for the potential of further growth; growth *per se* cannot be infinitely profitable (Daly 1996: 43).

The changing climatic conditions charge humanity with the responsibility to reflect critically on a paradigm that will ensure subsistence and to designate a 'fully consistent ecological macroeconomics' (Victor and Jackson 2016: 5). The shift from a narrow economics-centered perspective to a broader interdisciplinary perspective is key to this intellectual endeavor. Inherent in this shift is the constructive coming together of the natural and the social sciences; and the designation of a holistic, interdisciplinary framework as a coherent whole within which climate challenges, political verdicts and economic dilemmas can be effectively treated synergistically (Dietz and O'Neill 2012; Jackson 1996, 2009; Ayres and Warr 2009; Wackernagel et al. 2006: 246–7). The de-bounding global issue of climate change cannot help but rest at the center of such an enterprise, carrying the key notion of limits and the juxtaposition of development to growth (Daly 1996). What is at stake is nothing less than a political paradigm shift, a 'cosmopolitan realpolitik' (Held et al. 2011: 8).

Ecological economics theorizes the economic system as a sub-system of the broader ecological system—the biosphere—since the former's function depends on the health of the latter. As all systems, the economy has inputs, in the form of natural resources flowing into the economy, and outputs, in the form of emissions and waste returned to the environment. The economy, therefore, can only function as long as the natural environment is able to keep providing natural resources that serve as its material basis, and absorbing the byproducts of economic activity (Daly and Farley 2004).[1] For capitalism to continue to operate smoothly, the sustenance of an essential material basis is indispensable, as is a minimum of ecological services. Capitalism has evaded a dramatic downfall in the first decades of environmental awakening by means of a combination of ecological modernization adjustments and further extension of biophysical limits. With the repercussions of climate change evident and growing, however, capitalism's continue survival hangs on solving this catch-22 problem (Blauhof 2012: 257). The development of a macro-economy capable of internalizing ecological costs that extent beyond the biophysical limits of the environment is thus badly needed (Daly 1996).

Contrary to the academic orthodoxy that addresses paramount issues separately, and policy-making which 'breaks down the issue into separate parts, each tackling a defined problem as part of a comprehensive and cohesive solution' (Hallsworth 2012: 41–2), ecological economics adopts a holistic approach. In particular, it examines complex natural phenomena and utilizes fundamental tools of the economic discipline to suggest optimal economic solutions within the biosphere's capacity (Georgescu-Roegen 1971; Daly and Farley 2004; Lawn 2007; Costanza and Daly 1992). In this context, the economic discipline shifts towards different research questions that pertain mostly to the sustenance of the welfare level, the conservation of goods and services, and adaptation to biophysical limits (Daly 1996: 167), rather than the increase of productivity. Economics subsequently lends itself towards the study of the improvement, rather than the maximization, of economic activity. In contrast, the ecological economics examines questions from the following integrated framework:

- the throughput flows that link the real economy to the biosphere
- the real economy, where resources are allocated and goods and services are produced and distributed
- the financial system, where money is created, credit is advanced, and interest paid (Victor and Jackson 2015).

The idea that the economic cycle requires harmonization with the limits of the ecosystem is hardly surprising or obscure given mounting ecological problems (Wackernagel et al. 2006: 247–8). John Stuart Mill (1909 [1848]) had rather prematurely emphasized the finitude of growth itself, suggesting the eventual need to create a stationary state. The pillars of a steady-state economy are, given a relatively stable population, a stable flow of material and energy that will not exceed the Earth's carrying capacity (Daly 1991: 17; Dietz and O'Neill 2012). Accordingly, what is at stake is the designation of economic institutions and processes that will prevent the sinking of the biosphere under the weight of the economic sphere, without at the same time substantially sacrificing people's needs and amenities (Daly 1996: 50). This seems like going back to the future since very low- and no-growth economies have been the norm before the advent of the Industrial Revolution; the growth economy of the last 250 years is in this sense a historical aberration (Victor and Jackson 2015: 38).

Steady-state economics takes the strong sustainability thesis and naturally theorizes income as sustainable insofar it does not lead to loss of capital which is critical for the sustenance of this income in the future (Fisher 1935; Daly 1996: 99–100). To achieve this, the organization of economic activity requires the premise of five principles:

- The maintenance of natural capital to such an extent that economic activity can be sustained and, where possible, its efficiency can be increased. This includes energy production with the lowest entropy and the absorption of waste with the highest entropy.
- The minimization of the loss of ecological services, so that the indispensable material and energy basis of the economy is sustained.
- The accumulation of man-made capital up to this point where further growth will lead to greater losses, rather than benefits.
- The minimization of the throughput of matter and energy necessary for the sustenance of the accumulated man-made capital.
- The maximization of the returns of the accumulated man-made capital (Lawn 2007: 202).

Steady-state economics thus envisages the transition to circular natural capitalism (Hawken et al. 2013). In this system, all ecosystems are assessed, and all matter and energy returns either to the ecosystem as nutrients, or back into the manufacturing process. Contrary to a growth-driven, throwaway economy with boom and bust cycles, steady-state economies revolve around the exploitation of the Earth's goods and services within biophysical limits, and circular economic processes.

A de-growth movement has emerged over the last the last decades, emphasizing the growth paradigm's shortcomings and calling for action along the lines of ecological and steady-state economics. One of the movement's central pledges is the voluntary decrease of consumption in the Global North, so that both natural and manufactured resources are opened up for the Global South (O'Neill 2012). The de-growth movement is important in that it adopts and communicates an alternative theoretical approach to the organization of the global society in the twenty-first century. It testifies to the societal dynamics of a new paradigm of economic, social and political organization that rejects the growth paradigm and underscores that the latter lacks universal consent. These bottom-up dynamics work synergistically with the theoretically and empirically grounded holistic approach of ecological economics, and some top-down initiatives to decrease the throughput of matter and energy, creating conducive ground for economies operating within biophysical limits (Kerschner 2010: 549; Kallis et al. 2012). Such an ambitious political scheme may sound radical and utopian at first. As Herman Daly (1973: 163) writes, however, contrasted to the utopia—and dystopia—of an ever-growing global economy that continues to disregard ecological limits, it makes more sense to opt for the political, rather than the biophysical, utopia.

Putting Steady-State Economics to Work

Establishing the desirability of a steady-state economy is one thing. Setting out how it would look like in practice is another. A steady-state economy is one in which the quality and quantity of resources used in economic processes do not encumber upon the biosphere and do not surpass biophysical limits. Its institutionalization is premised upon the control of economic demand/consumption. Going back to Keynes (1936) and his seminal work on how effective demand works up the economic sphere, steady-state economics revolves around demand and consumption control within the biophysical limits, with an eye to decelerate resource scarcity, enhance the substitutability of resources in the economic process, and adjust economic processes to nature's and materials' properties, and to ecological services.

While piecemeal efforts of this sort take place around the world, they do so within the growth framework. Rather than to return economic activity within biophysical limits, they aim to stimulate growth by saving resources and materials as part of economic and energy efficiency. The lack of green auditing and the continued presence of dominant policy priorities that run counter to ecological economics—organized not only without due consideration to ecological limits but in fundamental contrast—attests to this reality. Monetary and trade policies stand out as illuminating cases in point, reviewed in this chapter (together with accounting standards) following a preview of the principles underlying a steady-state economy. Tax policy is also pivotal for shaping the types and patterns of economic activity, but we address it head-on in the next chapter head-on due to its direct impact on energy policy (rather than the more indirect impacts of trade and monetary policy).

At the onset, moving towards a sustainable circular economy is premised upon two principles: service and maintenance efficiency; and growth and ecosystem service efficiency (Odum 2007: 391; Daly 1996). According to the former, the economy has to be oriented towards services that make as restricted and efficient use of matter and energy as possible. This lies in, firstly, removing all materials that have a serious impact on human health and the environment,[2] and, secondly, turning to the use of materials and to productive processes that create minimal and manageable wastes. In the same context, it is essential to re-focus technology so that it contributes to both the maintenance of human-created capital, and to the production of robust, resilient, repairable, and recyclable goods and services (Jackson 1996: 45–56).[3]

In conformity with the latter principle, the economy has to adjust to ecosystems' properties. This takes two forms. Firstly, resources that can grow rapidly must drive and from the base of future economic activity. Technologies, applications and consumption patterns, in the same context, must also be designed to utilize resources that reproduce themselves, develop at a fast pace, and are relatively robust. While fossil-based strategies, for example, are bound to fail, solar- and wind-fired economies can prosper. Secondly, ecological services need to be comprised of a rational order based on a common economic assumption of marginal costs. Climate change attests to the emphatic absence of this dimension from the designation of the economic sphere, and the resultant compromise of the most vital ecological services (Daly 1996: 84–7; Odum 2007: 364, 391; Sager 2015). Insufficient emphasis on forests protection provides another illustrative case in point. Deforestation constitutes a critical source of emissions at the same time that it brings the Earth's absorptive capacity down (Brown and Sovacool 2011: 40). An ecologically mandated forest policy, on the contrary, would result in the preservation of forests and extensive reforestation; this way maximizing the invaluable ecological services provided by forests provide as both sources and sinks.

Under today's climate strains, moreover, it is essential to repack the logic of profitability and embed it in broader ecological goals. The first indispensable step in this process is gearing the economy away from the production of goods, which use ample matter and energy, to the delivery of commensurable services (Jackson 1996: 144–5). This involves significant initial costs, as corporate profitability rests primarily in selling goods, which in many cases are pollutants. The rationale of profitability, in addition, conflicts with the recommendation for products' sustained life cycle since it means, all else being equal, fewer sales and lower profits (Jackson 1996: 124–5). To the extent that the conventional economy aims to replace and expand the stock of assets, it effectively revolves around 'the creation and re-creation of new markets for new products [and] the continual throwing over of the old in favor of the new' (Victor and Jackson 2016: 26). In light of these structurally unsustainable economic modes, the ecology of investment needs a significant overhaul. This lies in making investments that sustain the indispensable assets for future services, and the provision of these services that sustain and improve welfare (Victor and Jackson 2016: 26; Odum 2007: 364). A new ecology of investment extends, significantly, to the reinvestment of profits in green schemes across the value chain, to a significant extent locally and to the benefit of local communities. It also includes community banking as an institution intrinsically responsive to local ecological and social needs (Victor and Jackson 2016: 28, 39).

That said, changes of production and consumption processes and practices along these lines could in many cases be profitable (Giddens 2011). To reap the benefits, corporations need to embrace a radical shake-up of their operations, and accordingly redesign production in line with ecological limitations and fundamentals. The business sector usually focuses on the adverse effects demand reduction will have on its profits. In doing so, however, companies miss on the enormous gains that can be achieved through energy efficiency across the business chain, like reduced material consumption, lower maintenance needs, waste reduction and management, and improved product quality (LaBelle and Horwitch 2013: 119). A number of companies in Europe have already taken this path; their profitability has been enhanced not hurt from the switch from the sale of energy products to the sale of energy-saving appliances and devices (Buchan and Keay 2016: 6). Taking such a pathway affords forward-looking, flexible, bold and innovative corporations a competitive advantage vis-à-vis companies that continue to follow traditional corporate models (Jackson 1996: 89).[4]

Green Macro-Economic Accounting

The radical economic overhaul described above is unlikely to materialize within the paradigm of Gross Domestic Product (GDP) indices and associated mindsets. In fact, such reforms are designed to lead to a fall in or the stabilization of GDP levels, a development that is always alarming for growth-driven economies.

The main failing of the GDP index is that it measures both costs and benefits without distinction. This is because growth is premised upon higher productivity and the perpetual increase of GDP, irrespective of its impact on the ecosystem. Deforestation, exploitation of natural resources and overtly intensive land cultivation, for example, are all counted as additions to the GDP, while they in fact constitute losses (Daly 1996: 11, 60, 115). Aiming to increase the GDP as a goal *per se* hence is distorted and at times destructive, in that it amounts to accelerating both natural resources depletion and ecological degradation (Daly 1996: 113). It is therefore imperative to move beyond the prevalence of the GDP mindset and the subsequent ecological distortions it creates, and to broaden the scope of economic indexes. Daly (1996: 108–55) has suggested three separate accounts:

- A benefits account, which is identical to what comes today under GDP (goods, services, and infrastructure).
- A costs account (Gross National Costs) or gross national throughput index, which measures all losses inherent in economic activity, such as carbon emissions, deforestation, depletion of natural resources and so on.
- A capital account, which measures natural capital, such as forest areas, aquifers, remaining natural resources, and ecological services.

The first account measures the output of economic activity, while the second monetizes the costs and consequences of economic activity. Since these are nothing but the outcome of the transformation of matter and energy into goods and services, not measuring them would constitute a major omission and fallacy. Creating this type of index allows us to count natural resources depletion as a negative factor since it reduces the indispensable basis for future economic activity, and hence its very sustainability (Daly 1996: 196–7). This costs accounting is of critical importance since it serves as an automatic advocate on the proper scale of economic activity. In all cases, the second index (costs) should not surpass the first (benefits). States with overt economic activity and great ecological losses have to scale back economic activity to achieve sustainability. In contrast, states whose economic activity does not create excessive costs may have the space to scale up economic activity proportionately. The third account provides the necessary benchmark for such an expansion, so that natural capital is not allowed to dwindle beyond certain levels. Substituting the anachronistic and misleading GDP index with three separate accounts, in sum, serves to remedy GDP's obliviousness to fundamental ecological parameters.

Interestingly, the fact is that many states have witnessed an exponential increase of their GDP over the last decades while experiencing stagnant welfare levels along with the rise of serious ecological threats and social challenges (Lawn 2007: 114–15). This renders an integrated measurement of economic, social and ecological parameters imperative. The Index of Sustainable Economic Welfare (ISEW) and the Index of Genuine Progress Indicator (GPI) (Daly and Cobb 1989), however, remain marginalized in comparison to GDP, despite their marked advantages. On top of these, there is broad consensus among ecological economists that we need to move to a nexus of indices comprising:

- A sustainability index that will measure the ecological footprint of societies.
- A complex index that will measure systematically natural resources reserves as well as the environment's ability to absorb the wastes of economic activity.
- A progress index that will monetize the economic, social and environmental dimensions of sustainable development.
- An index that will integrate the above and categorize states based on their sustainability, progress and welfare (Patterson 2006: 443–4; Daly and Farley 2004; Daly 1996; Lintott 2006: 84–6; Lawn 2006, 2007; Dietz and Neumayer 2006: 188).

Substituting the GDP index for these indices naturally leads to starkly different policy recommendations and developmental strategies, embodying the urgently needed redefinition of 'progress as adaptation to earth restoration' (Odum 2007: 391). Countries that remain fixated on growth and do not adopt broader indices will only end up disregarding the crucial ecological, social and associated economic costs, and subsequently severely compromising their sustainability. As Brown and Sovacool (2011: 156) forcefully write, 'masking the true cost of goods and services is the stuff of which historians write epitaphs for entire civilizations, and it deludes us into thinking that we are much richer than we are'. To the contrary, countries who choose to adopt broad indices and subsequently designate sustainable developmental policies will be in position to avert, or at least minimize the impact of, ecological crises.

A Steady Monetary Policy and the 'Gold Standard' of the Twenty-first Century

Two broader economic policies are fundamentally important for the establishment of a steady-state economy. The first concerns monetary policy, and boils down to keeping money supply more or less constant (Odum 2007: 389).

Monetary growth precipitates economic growth as a function of credit (Hubbert 1969; Brown and Sovacool 2011: 319; Heinberg 2005; Daly and Farley 2004: 255–8). Commercial banks are authorized by their central bank to operate in the financial sector by committing only a small percentage of the value of their business cycle as guarantee in various forms of assets (capital, property titles and so on). Banks, however, profit from their ability to give out interest-based loans, this way increasing the quantity of money in the market. On top of that, the deregulation of the banking sector has allowed extensive hazardous leverage, hidden thoroughly in a number of financialized, often obscure, schemes that effectively create an exponential increase of money supply (Stiglitz 2010; Moyo 2011, Morin 2013). What is more, in many cases banks issue the loans outside the territory in which the money ends up (e.g. via exports-induced foreign exchange, global derivatives markets or international lending). Hefty funding by China of the U.S. deficit since the 2000s constitutes an indicative example (Sager 2015: 102, 104).

Two banking system reforms in particular carry the potential to provide an effective check on monetary growth. Firstly, full (or nearly full) reserve banking disciplines would encourage lending institutions to use more responsible lending schemes since issuance of money presupposes the commitment of increased assets (Daly 1996). Secondly, reinstating the stringent distinction between commercial and investment banks with strict, transparent rules of the game for investment banking (Stiglitz 2010; Mutterperl 2011) would significantly curtail lending activity in a steady-state world amid decreasing leverage opportunities. These moves would result in stronger monetary control and a substantial reduction of arbitrarily created money, thus facilitating a progressive state of equilibrium between the over-expanded financial sector and the lagging real economy (Daly and Farley 2004; Douthwaite 2006; Gunningham 2013: 312; Kerschner 2010: 545; Loehr 2012; Victor and Jackson 2016: 35).[5]

While keeping money supply more or less constant can halt economic growth, it does not define whether this stagnated level of economic growth is sustainable or not. To achieve this, linking money with a biophysical unit that can serve as benchmark for sustainability is essential. Since the most critical and limiting economic factor is undoubtedly carbon equivalent emissions (King 2011: 26), linking emissions to the value of money can place states' economies in a sustainable trajectory (Browne and Fell 1994). The Contraction and Convergence scheme of the London-based Global Commons Institute has introduced calculation mechanisms of carbon emissions' ceilings. These bands can form the biophysical range of states' monetary capacity (Douthwaite 2006), and by extension determine the size of their economies. Economic, fiscal and monetary growth thus align with the biophysical metabolic rift.

Revisiting Trade Policy

Like an expansive monetary policy, trade provides a flexibility that obscures boundaries with foreign purchases of raw materials and final products, boosting consumption in importing states and ecological deficits in exporting states. Such outcomes contribute to global ecological deficits, resource scarcity, and increased emissions. Ensuring that international trade results not in a global ecological deficit but remains within the global carrying capacity necessitates a different understanding of the role and implications of international trade, and a commensurate trade policy.

International trade is problematic on three fronts. Firstly, it is an inherent part of an overshot global economy, designed in such a way to increase GDP growth and the scale of economic activity (Compston and Bailey 2013). It is highly energy-intensive with a premise upon a wide global transportation network that consumes substantial energy. Its heavy subsidization means not only the effective waste of valuable resources, but also the conveyance by distorted market mechanisms of wrong economic signals of persistent abundance of natural resources (Daly 1996). Any proper pricing mechanism would have to factor-in trade-induced ecological and subsidies costs. In such a case, domestic goods would more often than not be more affordable than imported ones. The current state of play, thus, constitutes nothing but a grave misallocation of resources. Free trade also results in all countries operating within one increasingly saturated global energy market. Lowering the scale of global trade would allow countries to face resource scarcity problems at different timings, and hence be in position to address the challenge more efficiently (Daly 1996: 149).

The dogma of free trade, secondly, is premised upon the logic of the comparative advantage and structures of the global political economy for the last two centuries. This type of economic organization is preferable to an international economy composed of more or less autarkic states that hardly trade with each other, since it leads to a positive sum game, in which everybody tends to be better-off than before (albeit some better-off than others). This logic is valid but premised upon assumptions of capital immobility. Different countries have enjoyed comparative advantages in the past given the domestic characteristic of capital, not globalized. One of the principal pillars of contemporary economic globalization, nevertheless, is the liberalization of financial transactions and the unimpeded movement of capital. This undermines the very essence of the concept of the comparative advantage and in practice generates a level playing field where capital can instantly convert one country's comparative advantage or disadvantage into an absolute one (Daly and Farley 2004). This turns free trade from a win-win to a zero-sum game, where the benefits of the one are the losses of the other. This is so because capital will naturally move to locations where profit margins seem most attractive, linked in many cases to the presence of cheap, hardly regulated labor, abundant natural resources, and deficient (if any) environmental regulation (Lawn 2007; Costanza 1991; Heinberg 2011; Daly 1996; Daly and Farley 2004). The globalized economy, in this context, generates winners and losers in the short term, and only losers in the long-term (Odum 2007: 273; Daly 1996).

The logic of comparative advantage and its application under distortive conditions, thirdly, carries crucial repercussions for the welfare of states and local communities. Free trade leads states to specialize in specific sectors, meaning a move away—at least to an extent—in different areas of land farming and agriculture. As a result, states progressively become dependent on cheap imports of primary resources. This economic strategy has rendered the less and least developed states much more vulnerable to the fluctuations and vagaries of the global market (Daly and Farley 2004; Lawn 2007: 330).[6] In general terms, trade surpluses broadly equal trade deficits at a global level. The accentuation of economic destitution and hardship in the Global South directly implicate the accumulation of high trade surpluses by countries of the Global North (and increasingly by emerging Asian economies). Global economic stability, to the contrary, is best sustained when trade surpluses and deficits are limited and manageable, allowing sufficient purchasing power on all sides so that they can continue participating in international trade for efficiency reasons (Victor and Jackson 2016: 34).

It thus makes sense to re-consider the prevalence of exports in the designation of economic policy and focus more on local economic activity. Firstly, the local and national level is more conducive to sustainable economic activity (Victor and Jackson 2016). Secondly, in many cases, a focus on local economic activity carries the potential to yield significant economic, ecological and social benefits. Local economic activity brings the added benefit of convergence between corporate profitability and the citizens' purchasing power. Since it targets foreign and not domestic consumers, outsourced and export-oriented corporate activity frequently overrides local ecological and labor standards without bearing any associated costs. This, however, is a sub-optimal option for firms selling locally since it undermines both the environment and their consumers, thus jeopardizing profitability in the mid-term. In this context, higher ecological standards, labor standards, and increased employment rates are also to the benefit of local companies (Lawn 2007: 309–10).

The other side of the distortive trade regime is its flamboyant antinomies. While it emphasizes unimpeded flow of capital and goods, it retains critical barriers to the free mobility of ideas. This is underpinned by the excessive protection of intellectual property rights, which in practice make up a non-free trade regime in the field of ideas. Ideas, however, rather than matter and energy should circulate freely. Free trade in ideas carries hardly any expenses, serves social goals around the globe, is consistent with the needs of a world characterized by resource scarcity. Moreover, this freedom sits well both with the free trade rationale that has prevailed in the post-1945 world order and with the Global North's developmental rhetoric. The free flow of ideas can not only lead to significant savings in matter and energy, but also help engineer optimal economic and technological practices all while contributing to the rise of welfare levels (Odum 2007: 389). Knowledge constitutes a social product and its evolution marks a profoundly social process, premised upon the enabling role of ecological services. There is no doubt that specific individuals, corporations, and organizations have played a leading role, deserving of merit (and remuneration). The contemporary intellectual property rights regime, nevertheless, secures patents for way too long. This works to establish monopolistic and non-competitive market structures, and blocking (rather than further facilitating) the evolution of knowledge and innovation (Daly 1996: 150). High costs for filing for patent applications, patent enforcement and patent protection—let alone for litigation—constitute critical barriers that benefit the established and dominant market players, while disincentivizing new entrants, and small and medium-sized business.[7]

At a more profound level, the aim should not be to trickle the wealth of the rich down to the poorest; a nobler goal would be to enhance citizens all around the world to have a fair chance to generate themselves innovation, new ideas and novel applications of existing ideas (Sen 1999; Liu and Hanauer 2016: 9). In contrast to the established principle that innovations should be generously rewarded and afforded extended protection to incentivize further creativity by stakeholders, broad accessibility of knowledge and collaborative efforts for common causes presents an alternative (Lent and Fisher 2012). According to this logic, people around the globe warrant the opportunity to access and further advance knowledge without intellectual property restrictions. Linux, for example, is an open software program currently preferred by many information technology experts that benefits from continuous improvement by users. Secured patents, moreover, have not sprung out of nowhere. People have built on and furthered previous knowledge and innovation which (or once this) had been widely accessible. Absent this pivotal prerequisite, numerous innovations would not have taken place. Counterfactually, our world may as we speak be deprived of a number of innovations exactly due to the protected nature of the most perplexing and advanced elements of contemporary knowledge.

Conclusion

To wrap up, expansive monetary policies that proliferate money circulation drive contemporary economic systems as part of a selectively free and highly distortive trade regime that stimulates demand for a vast array of globally traded commodities. Economic activity, in sum, takes place with neither reference to resources and ecosystems' properties and processes, nor due consideration of biophysical limits that may act as limiting factors. GDP metrics both reflect and reproduce the drive towards the perpetual expansion of economic activity and highlight the prominence of growth in economic deliberations.

It is hence no surprise that there has been a dearth of critical attention in scholarly circles paid to the scale aspect of economic activity. Climate change, however, rings alarm bells on the critical significance of economic scale for the future of the planet, bringing attention to the urgent need to integrate this critical issue into the heart of economic study. By challenging the imperative of growth, ecological and steady-state economists inform the much-needed debate on the macro-economy of the environment, and zoom in on the gap between the overshooting global economy and the much narrower biophysical limits.

This discussion carries a broad array of policy implications. The first regards the need to revisit the very principles that guide economic activity, and revolves around the adjustment of economic resources and processes to ecosystems' properties and fundamentals. This also sets in motion an industrial ecology, and the concomitant process of revisiting and repacking the profitability rationale around ecologically benevolent and energy-frugal services. Ecological and steady-state economics also question the validity of the anachronistic GDP index, point to its counterproductive policy relevance, and suggest alternative indices that incorporate crucial ecological parameters.

The importance of monetary and trade policy in perpetuating and sustaining growth is hard to exaggerate. Circumscribing monetary growth and linking monetary policy to a strict carbon budget is thus essential for arresting growth and for placing economic activity within biophysical limits. Revisiting trade policy, on the other hand, carries enormous potential for increasing economic efficiency and facilitating resource allocation; for supporting economic activity at the local/national level; and for promoting the sharing of knowledge as a means to confront humanity's ecological and technological challenges.

What such policy reforms have in common is that they respond to the need, and serve the goal, to return economic activity within biophysical limits. Crucially, they also feature significant linkages. For example, a restrictive monetary policy is bound to impact importing capacity; a restrictive trade policy will boost economic activity at the national/local level where economic activity can be more sustainable; and tighter monetary and trade policies will reshuffle economic processes, opening up windows of opportunities for more eco-friendly and services-oriented corporations to emerge. Approaching the issue from the reverse angle, pursuing some but not all of these policies will provide contradictory signals and hinder the restructuring of the economy towards more sustainable modes of production and consumption.

Crucially, these reform proposals have profound implications for energy policy design. These implications—however underexplored at this point—together with an ecological tax reform and an investment regime tailored to climate needs, are essential for a transformative change in energy policy.

It is to these issues that the analysis turns in the next chapter, together with a discussion on core aspects of energy policy with the aim to set out a steady-state energy policy framework.

Notes

1. According to James Lovelock's (1995, 2000, 2006) Gaia hypothesis, the Earth (Gaia) can be better understood in terms of a living body and a self-regulated system that obeys specific natural laws and responds to external forces in such a way that it can survive. Human interference has generated significant imbalances to which the Earth will adjust in particular ways that may not suit human existence. Humanity's prospects, subsequently, are dependent upon compliance with natural laws and the sustenance of the global ecosystem.
2. In general, the combined application of the precautionary principle (according to which proof that a product or service is broadly harmless throughout its lifecycle lies with the enterprise, not the claimant) and the principle the polluter pays would internalize associated costs and minimize the use of hazardous materials (Giddens 2011: 66–7). With regard to the use of materials the effects of which remain uncertain, Giddens' percentage principle shows significant merits, albeit caution has to be taken that 'lack of data is not misconstrued as evidence of safety' (Brown and Sovacool 2011: 182). In general, the companies' responsibility should span all stages of the materials' lifecycle, disciplining corporate actors to ecologically prudent decision-making. In order to hedge against imprudent corporate policies, a sound idea is to utilize assurance bonds. These will be paid from the beginning by high-risk industries for defined periods of time (say decade or more). This sum will reflect a worst-case scenario analysis and would be refunded in full in case of zero pollution, or only partially in case some pollution has been caused. Such suggestions transfer the responsibility to industries, providing them at the same time with ample incentive to prevent, or at least significantly limit, pollution on time (Lawn 2007: 210–11).
3. The Swedish car industry has turned the last decades to this direction, producing more robust cars that both enjoy a longer lifecycle and comply with greener standards (Jackson 1996: 45–56, 131–4).
4. In this light, for example, retail computer companies can focus their profitability on providing software services, rather than the hardware itself. Personal computers, tablets and so on can be contracted under leasing terms, with the retail companies undertaking the management, repair, recycling and eventual dismantling of the equipment into its components in an eco-friendly and entrepreneurial way. Not only will proper e-waste manage-

ment ensue and overall waste decrease, but also the contemporary practices of shipping waste to Asia and dismantling it under abysmal ecological and labor conditions will be eclipsed (Brown and Sovacool 2011: 47). This will accomplish reduction of matter and energy use, at the same time that it will not compromise valuable services delivered to customers (Jackson 1996: 134–5).

5. A broader role for community banking and the provision of soft loans would afford critical access to capital to those in need and for the implementation of projects with ecological and social benefits.
6. The food crisis of 2008 is an indicative example that reveals how the deficient global division of labor impacts on and threatens the subsistence of the poorest regions of the world (Vanhaute 2011; Daly 1996).
7. In particular, prevalent market players are notorious for three patent manipulation practices that effectively block innovation and technology diffusion. Firstly, they may own a patent for an innovative technology, but not work towards its development (patent warehousing). Secondly, they may refuse to file for a patent with the aim and the effect that innovative technologies and/or products do not make it to the market (patent suppression). Thirdly, they may make use of patents to block other firms from acquiring them, for example by demanding extravagant licensing fees (patent blocking) (Brown and Sovacool 2011: 166).

References

Ayres, R. and Warr, B. 2009. *The Economic Growth Engine: How Energy and Work Drive Material Prosperity.* Cheltenham: Edward Elgar.

Blauhof, F. 2012. Overcoming Accumulation: Is a Capitalist Steady-State Economy Possible? *Ecological Economics,* 84, 254–261.

Brown, M. and Sovacool, B. 2011. *Climate Change and Global Energy Security: Technology and Policy Options.* Cambridge, MA: MIT Press.

Browne, F. and Fell, J. 1994. Inflation—Dormant, Dying or Dead? Central Bank of Ireland Technical Paper No. 6/RT/94.

Buchan, D. and Keay, M. 2016. EU Energy Policy – 4th Time Lucky? *Oxford Energy Comment, The Oxford Institute of Energy Studies*, 1–9.

Compston, H. and Bailey, I. 2013. Climate Policies and Anti-Climate Policies. *Open Journal of Political Science,* 3: 4, 146–157.

Costanza, R. (ed.). 1991. *Ecological Economics: The Science and Management of Sustainability.* New York: Columbia University Press.

Costanza, R. and Daly, H. 1992. Natural Capital and Sustainable Development. *Conservation Biology*, 6: 1, 37–46.

Dalby, S. 2015. Climate Geopolitics: Securing the Global Economy. *International Politics*, 52: 4, 426–444.

Daly, H. 1973. *Toward a Steady-State Economy*. San Francisco: W. H. Freeman.
Daly, H. 1991. *Steady-State Economics*. Washington, DC: Island Press.
Daly, H. 1996. *Beyond Growth: The Economics of Sustainable Development*. Boston, MA: Beacon Press.
Daly, H. and Cobb, J. 1989. *For the Common Good: Redirecting the Economy toward Community, the Environment and a Sustainable Future*. Boston, MA: Beacon Press.
Daly, H. and Farley, J. 2004. *Ecological Economics. Principles and Applications*. Washington, DC: Island Press.
Deudney, D. and Matthew, A. 1999. *Contested Grounds: Security and Conflict in the New Environmental Politics*. New York: State University of New York Press.
Dietz, R. and O'Neill, D. 2012. Enough is Enough: Building a Sustainable Economy in a World of Finite Resources. London: Earthscan.
Dietz, S. and Neumayer, E. 2006. Some Constructive Criticisms of the Index of Sustainable Economic Welfare, in P. Lawn (ed.), *Sustainable Development Indicators in Ecological Economics*. Cheltenham: Edward Elgar, 186–205.
Douthwaite, R. 2006. *The Ecology of Money*. Ireland: The Foundation for the Economics of Sustainability.
Fisher, I. 1935. *100% Money*. New York: Author.
Georgescu-Roegen, N. 1971. *The Entropy Law and the Economic Process*. Cambridge: Harvard University Press.
Giddens, A. 2011. *The Politics of Climate Change*. Cambridge: Polity Press.
Gunningham, N. 2013. Regulation, Economic Instruments, and Sustainable Energy, in A. Goldthau (ed.), *The Handbook of Global Energy Policy*. Chichester: Wiley-Blackwell, 305–321.
Hallsworth, M. 2012. How Complexity Economics Can Improve Government: Rethinking Policy Actors, Institutions and Structures, in T. Dolphin and D. Nash (eds), *Complex New World: Translating New Economic Thinking into Public Policy*. London: Institute for Public Policy Research, 39–49.
Hawken, P., Lovins, A. and Lovins, H. 2013. *Natural Capitalism: The Next Industrial Revolution*. London: Routledge.
Heinberg, R. 2005. *The Party's Over. Oil, War and the Fate of Industrial Societies*. Canada: New Society Publishers.
Heinberg, R. 2011. *The End of Growth: Adapting to our New Economic Reality*. Canada: New Society Publishers.
Held, D., Fane-Hervey, A. and Theros, M. 2011. Editors' Introduction, in D. Held, A. Fane-Hervey and M. Theros (eds), *The Governance of Climate Change. Science, Economics, Politics & Ethics*. Cambridge: Polity Press, 1–10.
Hubbert, M. King. 1969. *Resources and Man*. Washington, DC: National Academy of Sciences and National Research Council.

Jackson, T. 1996. *Material Concerns: Pollution, Profit, and Quality of Life*. London: Routledge.

Jackson, T. 2009. *Prosperity Without Growth? The Transition to a Sustainable Economy*. London: Sustainable Development Commission.

Jowit, W. and Wintour, P. 2008. Cost of Tackling Global Climate Change Has Doubled, Warns Stern. *The Guardian*. 25 June.

Kallis, G. et al. 2012. The Economics of Degrowth. *Ecological Economics*, 84, 172–180.

Kerschner, C. 2010. Economic De-growth vs. Steady-State Economy. *Journal of Cleaner Production*, 18, 544–551.

Keynes, J. M. 1936. *General Theory of Employment, Interest and Money*. Amherst: Prometheus Books.

King, D. 2011. The Challenge of Climate Change, in D. Held, A. Fane-Hervey and M. Theros (eds), *The Governance of Climate Change. Science, Economics, Politics & Ethics*. Cambridge: Polity Press, 13–30.

LaBelle, M. and Horwitch, M. 2013. The Breakout of Energy Innovation: Accelerating to a New Low Carbon Energy System, in A. Goldthau (ed.), *The Handbook of Global Energy Policy*. Chichester: Wiley-Blackwell, 113–126.

Lawn, P. 2006. An Assessment of Alternative Measures of Sustainable Economic Welfare, in P. Lawn (ed.), *Sustainable Development Indicators in Ecological Economics*. Cheltenham: Edward Elgar, 139–165.

Lawn, P. 2007. *Frontier Issues in Ecological Economics*. Cheltenham: Edward Elgar.

Lent, A. and Fisher, G. 2012. A Complex Approach to Economic Policy, in T. Dolphin and D. Nash (eds), *Complex New World: Translating New Economic Thinking into Public Policy*. London: Institute for Public Policy Research, 161–168.

Lesage, D., van der Graaf, T. and Westphal, K. 2010. *Global Energy Governance in a Multipolar World*. Surrey: Ashgate.

Lintott, J. 2006. Environmental Accounting and Policy Making, in P. Lawn (ed.), *Sustainable Development Indicators in Ecological Economics*. Cheltenham: Edward Elgar, 78–95.

Liu, E. and Hanauer, N. 2016. Complexity Economics Shows Us Why Laissez-Faire Economics Always Fails. *Evonomics* [Online]. Available: https://evonomics.com/complexity-economics-shows-us-that-laissez-faire-fail-nickhanauer/ [Accessed on 12 July 2017].

Loehr, D. 2012. The Euthanasia of the Rentier – A Way Toward a Steady-State Economy?. *Ecological Economics*, 84, 232–239.

Lovelock, J. 1995 [1988]. *Ages of Gaia*. Oxford: Oxford University Press.

Lovelock, J. 2000 [1979]. *Gaia: A New Look at Life on Earth*. Oxford: Oxford University Press.

Lovelock, J. 2006. *The Revenge of Gaia: Why the Earth is Fighting Back and How We Can Still Save Humanity*. London: Allen Lane.
Mill, J. S. 1909 [1848]. Principles of Political Economy with Some of their Applications to Social Philosophy, in W. Ashley (ed.), *Library of Economics and Liberty* [Online]. Available: http://www.econlib.org/library/Mill/mlP61.html [Accessed on 3 July 2016].
Morin, F. 2013. *A World Without Wall Street?*. Chicago: University of Chicago Press.
Moyo, D. 2011. *How the West Was Lost: Fifty Years of Economic Folly – and the Stark Choices Ahead*. London: Palgrave Macmillan.
Mutterperl, W. 2011. From Glass-Steagall to "Too Big to Fail". *Banking and Finance. Bloomberg Law Reports.*
O'Neill, D. 2012. Measuring Progress in the Degrowth Transition to a Steady State Economy. *Ecological Economics,* 84, 221–231.
Odum, H. 2007. *Environment, Power and Society for the Twenty-First Century. The Hierarchy of Energy*. New York: Columbia University Press.
Patterson, M. 2006. Selecting Headline Indicators for Tracking Progress to Sustainability in a Nation State, in P. Lawn (ed.), *Sustainable Development Indicators in Ecological Economics*. Cheltenham: Edward Elgar, 421–448.
Sager, J. 2015. *The Ecological Keynesian: Energy, Money, and Oil Cycles in the Global System* [A Dissertation Submitted in Partial Satisfaction of the Requirements for the Degree of Doctor of Philosophy in Energy and Resources in the Graduate Division of the University of California, Berkeley].
Sen, A. 1999. *Development as Freedom*. Oxford: Oxford University Press.
Stern, N. 2006. *Stern Review on the Economics of Climate Change*. London: HM Treasury.
Stiglitz, J. 2010. *Freefall: America, Free Markets, and the Sinking of the World Economy*. New York: Norton.
United Nations Environment Program and Stockholm Environment Institute. 1999. *Global Environment Outlook 2000*. New York: Oxford University Press.
Vanhaute, E. 2011. From Famine to Food Crisis: What History Can Teach Us about Local and Global Subsistence Crises. *The Journal of Peasant Studies,* 38: 1, 47–65.
Victor, P. and Jackson, T. 2015. The Trouble with Growth, in World Watch Institute (ed), *State of the World 2015: Confronting Hidden Threats to Sustainability*. London: Island Press, 37–50.
Victor, P. and Jackson, T. 2016. Towards a New Green Economy. Sustainable and Just – At Community Scale. *The Next System Project,* 1–52.
Wackernagel, M. et al. 2006. Ecological Footprint Accounts for Advancing Sustainability: Measuring Human Demands on Nature, in P. Lawn (ed.), *Sustainable Development Indicators in Ecological Economics*. Cheltenham: Edward Elgar, 246–267.

World Resources Institute, United Nations Development Program, United Nations Environment Program and World Bank. 2000. *World Resources 2000–2001. People and Ecosystems: The Fraying Web of Life*. New York: Oxford University Press.

World Watch Institute (ed.). 2015. *State of the World 2015: Confronting Hidden Threats to Sustainability*. London: Island Press.

CHAPTER 3

Designing a Steady-State Energy Policy

Introduction

Energy policy determines the governance and regulation of energy supply and demand. At the core of energy policy lie strategic choices regarding the fuel mix and energy infrastructure, the regulation of the energy sector, and mechanisms to establish, guide, and monitor the energy market (Armstrong et al. 2016). Energy policy, moreover, features linkages with an array of economic policies, including tax, investment, monetary, and trade policies—insofar as they affect the supply, demand and final consumption of energy.

Despite all the technological progress and advances in climate change mitigation efforts, the energy sector is still largely based on the production, trade and consumption of fossil energy (oil, natural gas and coal combined making up around 80% of the global fuel mix) (BP 2016: 42). Due to the uneven distribution of these resources accross the planet, most of this energy is traded internationally, creating a vast global energy market and a tangled web between importers and exporters (Yergin 2011). The external aspect of energy policy is hence critical. Importers and exporters invest in energy diplomacy, and prioritize the conclusion of contracts and the formation of energy, corporate and political alliances with third countries, as well as military control and/or surveillance of critical energy areas (Pascual 2015; Jaffe and Soligo 2008). In this context, geopolitics, diplomacy and broader political relations also form crucial elements of energy policy.

F. Proedrou, *Energy Policy and Security under Climate Change*,
https://doi.org/10.1007/978-3-319-77164-9_3

The undercutting theme of contemporary energy policy is the governance of oil and gas flows and markets (coal features lower volumes of trade due to a more even distribution across the world), despite their pivotal role in climate change as carbon intensive fuels. An energy policy that aims to circumscribe energy use within biophysical limits and at the same time respond to citizens' energy needs, to the contrary, must strictly conform to the following three principles:

- greenhouse gases from energy consumption must not surpass the atmosphere's absorptive capacity
- the rate of depletion of non-renewable resources must not exceed the rate of renewable energy generation, and
- energy produced by renewable sources must not exceed their regeneration rates (Daly 1996; Sovacool and Brown 2010: 84).

Rising emissions, persistent peak oil and resource scarcity concerns (see Chap. 4), and a substantially smaller and inferior renewable energy industry—compared to the fossil fuel industry—speak to contemporary energy policy's failure to adjust to climate imperatives. While decarbonization policies have been put in place the last decade, they are solidly embedded in 'green growth' agendas (The Green Growth Group 2013). They are hence taken up within a growth mindset and in the hope to bolster growth; they consequently, and quite naturally, lack the indispensable check on energy consumption for fear of interfering with and negatively impacting growth. The fact that renewable energy has covered the increase in global energy demand (in lieu of reduced oil and gas trade volumes and overall consumption) illustrates this point exemplarily (Sovacool 2016: 203). In this growth-driven context, decarbonization policies are anchored around goals regarding greenhouse gas emissions reductions and renewable energy and energy efficiency increases relative to 1990 standards (Larkin et al. 2017b), rather than benchmarked against strict carbon budgets.

A steady-state energy policy, on the other hand, would operate within a strict carbon budget that prioritizes a drastic arrest of energy demand and consumption in tandem with a large-scale substitution of fossil fuels for renewable energy (Hargreaves et al. 2013: 133). Such a radical energy policy turn resonates with the International Energy Agency's (IEA) (2008: 37) pledge for an energy revolution. This can only be premised upon a reprioritization of energy objectives and subsequent far-reaching technological and institutional change (Dubash and Florini 2011: 11).

While fossil-based and demand-driven energy policy overwhelms and marginalizes demand-side energy measures—and their socio-technical, cultural, technological, management and ecological impacts—demand side management carries the potential to reshape the energy sector. Since energy demand is fundamentally linked to sociological and behavioral patterns, dependent on consumer utility, altering energy structures bears significant potential for altering consumer behavior (Noreng 2013: 164–5). Reshaping energy policy along these lines can discourage and control energy usage; alter consumption patterns; actively encourage energy efficiency; substantially reduce fossil energy imports; boost renewable energy generation; and minimize greenhouse gas emissions (Sovacool and Brown 2010: 103; Bradshaw 2014: 148). Such self-help energy approaches (Buchan and Keay 2016b) can lead to energy delivery in efficient and responsible ways, but remain emphatically marginalized mainly because they run against dominant mindsets, intellectual, technological and institutional inertia, as well as prevalent societal and corporate forces (LaBelle and Horwitch 2013: 115).

Importantly, a downscaling of energy consumption mandated by a steady-state mindset may be disruptive to dominant modes of economic activity and energy use, but needs not amount to economic and welfare descent. Odum (2007: 225–7) makes a convincing case for a prosperous reduction. This, he argues, can be the case because renewable energy generation can biophysically maintain the knowledge and information structure that is essential for high standard economic performance, prosperity, and welfare. While energy use will have to be adjusted to climatic and biophysical limitations, an economy within biophysical limits needs not sacrifice human welfare (Odum 2007: 385).

Ceding due attention to the modest decarbonization steps taken the last two decades, this chapter draws from a number of developments currently unfolding in the energy sector, discusses their inevitable pitfalls within the growth-driven paradigm, and suggests how they can cascade into a full-fledged energy transition proportionate to the scope, scale and speed needed. The redesign of the electricity sector, the roll-out of smart grids, the increasing utilization of demand response management, the emergence of prosumers' markets and the proliferation of community energy, among others, carry significant potential. The key issue for the envisaged successful energy transition, it is argued, is whether the enacted policy tools are geared to serve and underpinned by growth or steady-state mindsets, goals and economies. The analysis also sets out the hard and soft pathways of energy transition, and scrutinizes the different implications they have for a successful energy policy. Different policy choices thus emerge, from which different political entities can choose to meet and scale-up their nationally determined contributions.

The onus for establishing steady-state energy policies in time to halt climate change lies with the importing world. Beyond the rational of historical responsibility—which applies to most energy importers—the majority of importing states dispose of the resources to implement such a radical overhaul, while all of them have profound interests in doing so. On the one hand, importers create demand for oil and gas and thus constitute a principal pillar of the energy market (Sharples 2013). A strategic decision to reduce fossil energy use to sustainable levels and substitute it with clean energy systems would effectively dilute demand for oil and gas (Sager 2015: 44, 83), paving the way for the divestment of the fossil industry. Deep decarbonization, falling emissions and a more balanced economy-environment nexus should be realizable under this path (Kuzemko et al. 2015: 220).

On the other hand, it is to the importers' enlightened (ecological, geopolitical and economic) self-interest to eradicate dependence on fossil imports and lead the divestment of the fossil sector (Proedrou 2017b). A blend of geopolitical, economic and climate considerations has indeed motivated the institutionalization of decarbonization policies (Leal-Arcas et al. 2017: 5–11). While these are profoundly different in character from the steady-state energy policy outlined in this chapter, similar strong interests lie behind each and can stimulate the institutionalization of a steady-state-driven energy transition as well.

An alternative, radical, steady-state energy policy, to sum up, would be inward-looking. It would utilize numerous demand-side tools and provide energy solutions within a wider steady-state policy context. This latter issue is fundamental given that the transition to clean energy systems needs a much more favorable political, economic, and business environment to enable deep decarbonization to start setting in. It is to these issues we now turn, before exploring the core aspects of a steady-state energy policy.

Steady-State Economics' Implications for Energy Policy

The implications of a radically different monetary and trade policy for energy policy are crucial, as discussed in Chap. 2, but remain largely underexplored by ecological economists. For one, a more or less stable money supply will translate into effective control of energy demand. While national economies import fossil energy at the price of mounting deficits, growing debts and rising inflation, a steady-state monetary policy would curb disposable income for energy expenses, thus stimulating recourse to alternative energy sources and policies. In such a stringent context, there would be good reasons for policy-makers and communities to accelerate and scale-up the hesitant energy transition under way.

The impact on exporting states would be decisive. To begin with, diminishing demand for fossil fuels would lead exporters to halt further exploration schemes, and would send powerful signals for downscaling the activities of the fossil industry globally. In a more far-reaching scenario, the progressive divestment from fossil energy sources could make room for the development of less energy-intensive economic sectors (i.e. booming renewable energy sources and technologies across the supply chain). In the remote scenario that exporters would follow a steady-state monetary policy themselves (perhaps inspired by successful examples elsewhere), this would translate in moratoria on fossil exploration and self-imposed plateaus on production of fossil fuels. Such measures are certain to lead to compensatory policies that would boost renewable energy sources and technologies. All these would effectively lower fossil energy production and consumption, and displace emissions proportionately. While such scenarios may sound utopian, attention should be paid to the fact that exporters will have to respond, eventually, to biophysical limits as a post-carbon reality amid evolving energy policies in importing countries (Wackernagel et al. 2006; Odum 2007; Sharples 2013).

Adopting a green accounting system, moreover, would reveal the costs associated with fossil energy production and consumption reflected in newly-found costs account. In this context, for those states whose costs account surpasses the benefits account, and/or which feature a depreciated capital account, displacing such costs can be viewed as investments. In effect, these investments can replace fossil production, infrastructure, and consumption schemes—as well as future fossil-fired plans—with cleaner forms of energy, emissions rights and/or energy efficiency schemes, and in this way provide positive outcomes across the three accounts (Bowen and Rydge 2011: 79).

In parallel, adopting a restrictive trade policy will reshuffle energy use patterns. A number of trade measures can decrease energy use, bring emissions down, and promote trade in renewable resources, as well as climate change mitigation technology and know-how. This can notably serve to bolster local economies, where a steady-state energy policy is easier to establish (Odum 2007; Daly 1996; Victor and Jackson 2015; Cowell et al. 2017b: 171).

The first such policy tool is compensatory tariffs to militate against ecological dumping that accentuates shrinking sources and sinks. This policy tool is solidly grounded, in stark contrast to the unwarranted import tariffs the Global North maintains against the Global South in some sectors such as textiles and agriculture—in contradiction of the Global North's fervent liberalization rhetoric for the sake of its least competitive industries. These tariffs, moreover, may also serve as levers of pressure to third countries to adopt higher ecological standards in order to retain their market share (Daly 1996: 18, 147).

Congruent with the approach of compensatory tariffs is also the legislation of low-carbon fuel standards for imports by countries of the Global North, responsible for the majority of imports. This constitutes a defensive tool that would allow exporters around the world time and leeway to adopt to the new ecologically mandated and ambitious standards (Bradshaw 2014: 70). Regulation concerning performance and technology standards (which can also extend to requirements for specified renewable technologies) can significantly accelerate the roll-out of clean technologies at scale, taking into account the ripple effects that access to new lucrative markets can generate (Gunningham 2013: 313–6).

In case such measures do not materialize or succeed, the imposition of tariffs on all carbon-based imports seems the unavoidable next step. This policy has been sponsored in the main by voices in the United States, is compatible with the World Trade Organization (WTO), and would amount to nothing less than a global shadow carbon price. While this measure could be interpreted as carrying imperialistic and protectionist connotations, it would lead to a number of positive outcomes such as reduced greenhouse gas emissions and increased trade costs (Overland 2015: 3533; Egenhofer 2013: 369). Rationalizing and internalizing the energy costs of trade—explicit in any of the above mentioned ways—may have two effects:

- eradicate the most carbon-intensive and energy-consuming forms of trade, and this way render global trade less energy- and carbon-intensive, or
- discourage trade substantially, this way leading to more local economic activity and local patterns of energy use.

Both outcomes (or, more likely, a combination of each) are desirable for climate goals, which resonate with low-carbon projections that portend a decrease in trade volumes (Jewell et al. 2014: 754). Such measures, however, also necessitate that time, funding, and advice are generously provided to the Global South to avoid economic hardship, but effectively re-adjust to cater to pressing ecological needs. Utilizing the revenues emanating from these trade measures in a global fund designed to further diffuse clean energy technologies and disseminate associated know-how to the Global South—upscaling existing initiatives—would remove the political friction accompanying these measures while at the same time advancing the global cause of emissions stabilization. To the contrary, import tariffs on clean energy materials do not make any sense in light of the overarching goal of climate change mitigation and should thus be strongly discouraged, although caution should be taken that they do not disincentivize the creation of local firms and stem further innovation in this sector (Brown and Sovacool 2011: 154).

This brings us to a broader issue, namely how revisiting trade can stimulate alternative forms of trade. Theorizing climate change as the most emphatic market failure (Held et al. 2011; Miliband 2011) drives home the dual point that competition and market dynamics cannot address all issues. Further, more intellectual space should be opened up to accommodate a cooperative logic and rationale, as well as collaborative approaches and policies. Trade in non-material economic factors, such as ideas, and the establishment of cooperative platforms with a global scope focused particularly on global public goods (read climate change mitigation) has significant potential to spur the deployment of clean energy technologies on a massive scale (Morin 2013). There is hardly any point in securing patents on such schemes, and thus preventing the transmittance of relevant know-how, since this constitutes the most desirable global public good.

That said, a restrictive trade policy also effectively leads to the general bolstering of local and national economies. This bears important implications on the organization of the energy sector, its focus on indigenous renewable resources and its recourse to shared societal modes of energy production and consumption (Overland 2015: 3533; Egenhofer 2013: 369). The end-result may well be an emphasis on more sophisticated and effective energy demand management, inward-looking energy policies and utilization of domestic energy potential (see below).

To sum up, a steady-state monetary policy would rest on constant money supply defined by the space available for carbon equivalent emissions. Choosing this path would result in proportional decreases in the quantities of fossil energy explored, produced, traded, and consumed. A green accounting index would alert states to critical conditions, and encourage them to trade away fossil energy for cleaner schemes in diverse ways. A steady-state trade policy would rest on compensatory tariffs, low-carbon fuel standards and/or tariffs on all carbon-based imports, and support an open trade regime in ideas that would promote collaborative platforms and the sharing of knowledge. Such a policy would lead to a substantial decrease in the volume of energy-intensive trade; minimize fossil fuels extraction, production, trade, import, and consumption; and strengthen the case for indigenous renewable energy sources and clean energy processes within more local/national economies.

Instigating an Investment Policy for Clean Energy

While the proposed monetary and trade policies are restrictive (of fossil energy and carbon intensity), investment policy should be expansive in most needed areas, namely renewable energy to compensate for the ecologically mandated large-scale decrease in fossil energy use. Indeed, the timing for undertaking such large-scale investments on renewable sources of energy is optimal since both exploration and infrastructure modernization needs (e.g. power networks, pipelines, storage facilities, refineries, etc.) are high, estimated in the trillions of dollars (Goldthau 2013: 5; Umbach 2010: 1232; Goldthau and Sovacool 2012: 235).[1] This cost factor, along with climate, low carbon security, and import reliability considerations (see Chap. 4), should provide ample rationale for a switch away from fossil energy (Proedrou 2015). Moreover, investing further in fossil energy assets now would render a decisive shift to renewable infrastructure later on far less affordable. This lock-in danger has already been highlighted with regard to the EU's 'gas first policy', and applies to the opening of new coal-fired power plants as well.

While the required investments for the energy system are enormous, it is important to bear in mind that this represents only one percent of the global GDP and just five percent of the assets held by the global fund management industry. At the same time, in a world with very low—even negative—interest rates, bank savings represent neither a profit-maximizing, nor a prudent option for global capital which ubiquitously seeks profitable investment outlets (Wüstenhagen and Menichetti 2013: 376). Paradoxically, though, public finance remains emphatically idle. Rather than invested in innovative technologies, it remains held in deposits (Mazzucato 2015; 2016). Most of the profits realized in the private sector, moreover, return to shareholders rather than re-invested into promising ventures in the real economy (Stiglitz 2010; Morin 2013).

In this financial environment of artificial scarcity of capital (Sager 2015: 54), the role of policy for attracting capital for specific kinds of investment is instrumental. In this context, a successful energy policy becomes contingent upon the guidance of investment strategies, and the increase of the social acceptance of renewable energy by the financial community. The key issue is risk, since its variation (or perceptions thereof) is critical for the investment decisions taken. For now, pension funds and insurance companies, rather than utilities, have been more active in renewable energy investments. This has mainly been the case due to diversification goals for their investment portfolios and as a hedge against associated risks. In general, however, investments in renewable energy constitute inferior investment options vis-à-vis conventional energy under the current paradigm. This is so for a number of reasons. First of all, the unaccounted for ecological externalities privilege investments on fossil energy. Secondly, investments in renewable energy technologies are capital-intensive, and hence a sub-optimal option for investors from a purely financial angle. Thirdly, renewable energy investors are in some cases small, new market entrants with limited leverage and circumscribed support from the banking sector. These investors must also operate, fourthly, in a market dominated not only physically by fossil energy but institutionally with entrenched vested interests naturally influencing heavily the policy agenda with contemporary rules and regulation. These new market players, fifthly, face high transaction costs and substantial market risks (Lehmann and Gawel 2013: 602). Risk-aversion, inertia, business-as-usual strategies, and entrenched perceptions based on previous experience, sixthly, point towards replicating—rather than revolutionizing—investment strategies. The proclivity by states to provide a level playing field for all companies, sources of energy and technologies is sub-optimal in this context since it deprives new technologies of the stimulus needed to compete directly with mainstream investments and technologies. While feed-in tariffs (FITs) have significantly boosted the prospects for investments in renewable energies by lowering the associated risks associated with the cost of capital (Gunningham 2013: 312; Wüstenhagen and Menichetti 2013: 376–8), a wider policy context needs to be put in place so that investments in renewable energy technologies and clean energy systems proliferate exponentially.

Energy policy should therefore aim at correcting these structural faults, and this way encourage and prioritize such investments. Different, and long term rules of the game should be put in place to build solid investor expectations; incorporate investor perspectives in evaluating the effectiveness of applied energy policy; and prepare targeted policies for different kinds of investors. There are a number of different ways to highlight and put in effect this policy change. For one, green public procurement strategies provide strong blueprints and convey clear messages (Gunningham 2013: 312). Educating and training financial decision-makers in this transitory era, moreover, can also shape their decisions towards greener directions. Cooperation with opinion leaders in the financial community, further, is of central importance if cognitive barriers are to be surpassed and critical information passed over to stakeholders. Targeted policies also hold much promise. Effectively communicating, for example, the idea that the reduction of greenhouse gas emissions translates into improved health and an associated lower expense for health funds could spearhead investments from the health sector in this direction. Stressing important co-benefits can shift risk perceptions by investors and push investment decisions in desirable directions (Wüstenhagen and Menichetti 2013: 376–81).

In general terms, private capital can be expected to move to the clean energy sector in the presence of profitable investment opportunities. A shift in regulation that will render contemporary profitable activities non-profitable, moreover, can also proliferate investments in renewable energy projects. One can hardly anticipate, however, that the market will implement the transition to clean energy systems in time and at the scale needed on its own. The state thus must intervene either autonomously or via public-private ventures (Kuzemko et al. 2015: 120) to scale-up investments in ventures where private capital is unwilling to step-in. These investments can cascade into effective demand for particular clean energy technologies. Such investments may still generate financial profits in the mid-term. However, the fundamental feature of these investments is a yield in terms of lower emissions, boosted employability, and increased aggregate demand (as well as other social benefits in areas such as improved air quality and health standards). While this shift in investment strategy carries significant (and difficult to calculate) indirect economic gains, the benefits are primarily social and should be embraced as such (Proedrou 2017b). Ultimately, this resonates with the understanding of energy and climate policy as public policy to hedge against the imperiled public good of climate conservation (Goldthau 2013: 2).

The particularly carbon-intensive transportation sector features prominently here. Market initiatives have introduced electric and hybrid cars but market penetration remains low, not least due to relatively high prices. As a result, their impact on emissions has been marginal. For countries in which car use and ownership is culturally embedded—absent a realistic hope for a move away from car dependence in the short term—the imperative is for the fast, massive introduction and circulation of affordable electric or hybrid vehicles. Powered by renewable energy generation, serving as batteries when grid connected, and meeting green standards in all aspects (e.g. lightweight, near-zero fossil energy consumption, and grid connectivity for other electricity uses), these next generation cars will constitute fundamental breakthroughs and substantially displace emissions in the transportation sector (Giddens 2011: 143–4). At a time when global demand for cars is still increasing, remaining high in the Global North and booming in China and India, only state initiatives can deliver these goals. Massive public investments must thus be made in this direction.

Car use, nevertheless, is only one mode of transportation and other sustainable forms must be encouraged as well. While the large-scale production of renewable energy powered vehicles will boost demand for this medium of transportation, an equivalent policy should be put in place with regard to green public transportation. The end-goal is to achieve a mix of fully sustainable modes of transportation for citizens. Clean energy-fueled means of public transportation can have an even greater contribution to the decrease of greenhouse gases, while covering humanity's mobility needs in a less energy-intensive mode (Brown 2009). At a more profound level, discouraging energy use should be a central energy and climate policy goal. This is due to the fact that even clean energy fueled transportation is subject to limits, and may hence lead to economic activity and energy use beyond the Earth's regenerative and absorptive capacity. These limits concern the intermittence of renewable energy, limitations of today's battery technology, and resource demands of vehicle manufacturing.. They also extend to the fundamentally controversial issues surrounding the socio-ecological impact of biofuel production, most prominently in relation to food security and land use change (Di Lucia 2017: 265–6). Building human-, not car-centered, smart cities is thus a goal of high-order.

Special mention should be made to aviation and shipping (amounting to close to five percent of total global emissions) where related emissions remain no country's responsibility. Given shipping's dominant role in trade (Larkin et al. 2017a), a restrictive trade policy could yield substantial emissions reduction. Aviation, on the other hand, has as of late flourished, especially since the emergence of low-cost companies. Low prices provide utterly misleading signals on the availability of fossil energy and encourage unprecedented air travel with the adverse effect of increased carbon emissions in the atmosphere. International efforts to regulate emissions in the aviation sector, however, remain far too modest. Timetables have been set for later dates with low targets compared to the urgency of climate change (see ICAO n.d.). Industry goals to gradually bring down energy consumption and green its fuel mix—rather than revolutionize it—speak to the sector's huge financial interests but hardly resonate neither with the urgent nature of climate change nor with state mandates to enforce more ambitious energy and climate policies (Larkin et al. 2016).

Limiting air traffic on ecological grounds, nonetheless, leads to no satisfactory solution since this would compromise and undercut people's mobility as a deprivation of the opportunity to explore different histories, places, ways of life and ideas towards wider intellectual horizons—as well as the thrill that comes with this liberty. Liberal International Relations theory (and especially its social and interdependent variants) also causally links extensive travel and international social exchanges with the establishment and consolidation of international peace (Deutsch 1957). This is of critical importance, as peace is a prerequisite for sustainability, while war ventures undermine climate change mitigation efforts (Wackernagel et al. 2006: 248–9). Air travel circumscription will also damage the tourist industry inflicting grave economic damage to the numerous local communities and states that earn their livelihoods through tourism-induced revenues, as well as to the global economy in sum as a multi-billion global industry.

In this context, it makes sense for governments to exponentially subsidize research into innovative technology that will have the wherewithal to fuel aviation in a clean way. Subsidization can take the form of either huge grants for the deployment of clean aviation fuels or public-private partnerships for promising R&D proposals. International cooperation through open, cooperative global platforms will be a substantial amplifier in this process, and thus states should extend their efforts to form international consortia that will target innovation in the aviation sector. Again, securing patents for such breakthroughs is counter-productive as it will stem the diffusion of clean technologies and undermine full potential.

Enforcing an Ecological Tax Reform

Tax policy is central to all economic activity as it effectively encourages some sectors and types of economic activity while discouraging others. In resource-rich states, for example, the fossil industry enjoys substantial tax breaks; in these cases, taxation serves as a policy tool for the primary energy goal of maintaining oil and gas production (and thus economic growth) (Kryukov and Moe 2013). Governments in the importing world, on the other hand, actively and systematically subsidize the use of natural resources through a number of tax relief schemes due to energy's centrality in delivering growth. A universal feature of contemporary tax systems around the world thus appears to be that they underprice natural resources, despite their progressive scarcity (Daly 1996: 89–90). At the same time, tax systems imprudently overprice both income (this way creating incentives for tax fraud and evasion) and employment (this way discouraging hiring and blocking a drastic fall in unemployment rates) (Jackson 1996: 155–8).

An ecological tax reform effectively reverses the tax base, tilting it from employment and income to natural resources. Overall, ecological tax reform is premised upon the 'tax bads, not goods' principle. Since we need to fight shrinking sources and sinks, it makes sense to tax energy use as a way to encourage more rationalized use and management of resources, lower pace of resource exhaustion, and decreasing emissions (Daly 1996: 89–90; Giddens 2011: 148). In the same logic and to a proportional extent, taxes on employment and income should be reduced as a positive feature of socio-economic life desirable of increase (Lawn 2007; Daly 1996: 15).[2]

Such ground-breaking reform has the potential to fundamentally reduce energy use. First, tax reform would gear enterprises to turn from commodity producers to services suppliers along the lines illustrated in Chap. 2. Subsidized training in new corporate models, designed in conjunction with the granting of incentives to adopt greener technologies, could contribute to such a transition. The companies that would adjust more quickly and efficiently to new regulations would acquire a significant comparative advantage by means of lower energy-induced costs vis-à-vis competitors at both the national and the international level. Groups that would stand to lose from such measures, such as pensioners and low-income workers (whose low income is not taxed anyway), would require compensation (Giddens 2011: 96; Proedrou 2017a). Part of the energy-born tax revenues would be recycled back to the more vulnerable groups, strengthening their purchasing power and encouraging savings on expensive energy. The net result would be a far cleaner and more energy efficient economy.[3]

The advent of climate change put energy taxation onto the political agenda beginning in the 1990s. Carbon taxes were proposed as a means of discouraging energy use and providing early responses to climate change. Nevertheless, such proposals enjoyed little support within policymaking circles. This has been so largely because carbon taxes harm entrenched interests in the fossil industry and pose a threat to economic growth. In this context, such proposals were effectively blocked by several member-states at the EU level (Solorio and Bocquillon 2017: 25; Solorio and Fairbrass 2017: 104). Carbon taxes failed to enjoy a better fate in the United States where the Congress has repeatedly declined to pass relevant legislation (Paterson 2011: 617). A few states, nevertheless, have gone along with carbon taxes. Denmark, as an indicative example, levies taxes on energy fuels, electricity, and carbon (Dyrhauge 2017: 99–100). These taxes, however, have failed to circumscribe energy use within biophysical limits, as they have been quite modest and do not operate within a strict, biophysically set carbon budget.

This empirical finding resonates with the point ecological economists theoretically established even before the implementation of carbon taxes, namely that while an ecological tax reform creates significant incentives for more prudent and efficient use of energy,[4] it does not ensure that the scale of energy use remains within biophysical limits. This is because taxes on energy could in principle be affordable; some societies would therefore be in position to pay high taxes, retain increased energy use, and maintain a sub-optimal scale of energy use. This possibility constitutes the great weakness of current efforts on ecological tax reform (Lawn 2007: 59; Norgaard 1990; Bishop 1993).

In this light, the need for a system that will fulfill the central goal of energy use within biophysical limits persists (Gunningham 2013: 307–309). Therefore, setting caps—the height of which will be contingent upon the level of success by eco-taxes—is essential and has to be supplemented by a system of tradable use permits. This system will be managed at the national level by an independent regulatory authority. This authority will be responsible for defining the ceiling of natural resource use based on the ecosystem's capacity, and for conducting use permits auctions annually. Such permits will be tradable with prices defined by limited supply, on ecological grounds, and demand dynamics. It is essential, both in initial auctions as well as in further trading of permits, to set upper limits in the number of licenses each person or legal entity can possess so that monopolization and cartelization are averted (Daly 1996: 52–7; Lawn 2007: 207–13).

Cap-and-trade systems have been put in place the last two decades, but with many shortcomings. For one, they have been institutionalized in the place of, rather than in parallel with, carbon taxes. Secondly, they feature very high caps that effectively retain substantial space for growth rather than a design to return energy use within biophysical limits. As a result, cap-and-trade systems like limited carbon taxes remain policy tools within the growth-driven policy framework instead of instruments that serve steady-state policies. Drawing from the lessons of the problematic EU trading scheme, a cap-and-trade price floor built into the system is pivotal as a competitiveness benchmark for renewable energy generation, along with the means for a gradual increase of carbon prices in order to discourage fossil energy use, enhance progression to a mostly renewable energy mix, and yield climate stabilization (Brown and Sovacool 2011: 196).

That said, eco-taxes and a cap-and-trade system can postponeof the extinction of natural resources to a later date, but they cannot avert it altogether. Salah El Serafy (1989) has developed a method to define the price that current generations will have to pay to compensate the next generations for the fact that they will have reduced or no opportunity whatsoever to take advantage of fossil energy. This may lead to over-taxation for current generations but is only fair, though, in light of the jeopardized rights and entitlements of the next generations. It is also prudent since fossil energy is an increasingly scarce good that should as such be properly priced (Lawn 2007: 210).

In all, an effective ecological tax reform lies in the parallel levying of taxes on fossil energy, the establishment of a cap-and-trade system, and an intergenerational compensation scheme. Elements of this program have emerged over the last two decades but have invariably failed to address the climate challenge. This is because, firstly, benchmarks lack in boldness. Secondly, the ecological tax reform's pillars have been implemented in a stand-alone rather than joint and synergistic fashion. Current carbon tax measures aim for greener growth and in doing so miss important climate targets. Conversely an ecological tax reform aims to stem growth and (mostly) green the energy mix in line with ecological imperatives.

Designing a Steady-State Energy Policy

A steady-state monetary policy, restrictive trade policy, and the institutionalization of an ecological tax reform and a green investment policy all create conducive ground for the application of a radical, steady-state energy policy. This policy will be mostly renewable energy centric and will provide for humanity's needs without irreversibly changing the climate. The goal of the remaining of the chapter is to set out how such an energy policy would look like and how it can live up to its goals. The natural question that emerges is how energy needs will be met given the implementation of a program to purposefully decrease fossil energy consumption within the biophysical limits. Indeed, the implicit assumption of contemporary energy policy worldwide is that the unsustainability path is taken out of pure necessity. In this logic, in the absence of alternatives that would avoid the severe compromise of humanity's living standards, maintaining the current rate of fossil energy consumption is inescapable despite destructive consequences on the future of the planet (Proedrou 2015, 2017a).

Stirling (2014: 86) refutes such claims by highlighting the central role of choice in the decision-making process. As he puts it,

> the obstacles to an entirely renewable global energy system are not … about intrinsic limits on resources, technologies or economics. Repeated detailed assessments show that the energy service needs of a more heavily populated and equitable world enjoying radically higher levels of wellbeing, can be cost-effectively met … entirely and solely through diverse currently available technological and organisational innovations around wind, solar, biomass, hydro, ocean and geothermal power. (Stirling 2014: 86)

Hence, he concludes, 'transformations in global energy services based entirely around renewables are at least realistic in the sense that these trajectories are in principle technically practicable, economically feasible, socially viable – and so potentially historically realisable' (Stirling 2014: 87).

The empirical evidence stemming from previous transitions (Sovacool 2016), as well as from the evolution of the fossil industry, seems to ironically to reinforce such a statement. Seen macroscopically, innovation in unconventional fossil energy exploration has been at times slow but nonetheless an impressive process, especially if one thinks that research on shale oil and gas began in the 1970s. A mix of governmental support and persistent individual initiative eventually set the shale revolution in motion a decade ago (Bressand 2013: 28). There is no reason to believe that the same result is not achievable for renewable energy generation, as long as countries steer investments, research, and appropriate policy initiatives to their large-scale development. In light of the adverse ecological effects of unconventional energy exploration, and the scores of geological and technological challenges surrounding it, this seems like a clearly preferential direction.

The full-fledged transition to clean energy systems, though, is hindered practically by the structural characteristics of the energy sector. These characteristics boil down to 'stickiness', lock-in effects and the strong mutual feedback loop between individual energy choices and the system's organizational principles and characteristics. In the words of Goldthau and Sovacool (2012: 234–5),

> power systems … exhibit strong path dependencies due to the large investments made into grids and plants, perpetuating a mostly fossil fuel based system of electricity production and consumption … a 'carbon lock-in' of industrial economies arising from a long term systemic interaction and positive feedback loops between fossil fuel-based energy and transportation systems and the societal and economic actors creating and using them … alternative or new technological options, even if coming with higher performance or lower costs, remain 'locked out', notably due to vested interests.

Deep decarbonization, in this context, is feasible but progresses only very slowly due to institutional, cultural, epistemic, and normative obstacles. Green transformations at this point are more about societal change and decision-making than material factors, and call for a strategic resolve to ensure that significant fossil fuel resources remain under the ground (Victor and Jackson 2015). This is indispensable in case current—let alone future—plans for new coal-fired power plants go forward and operate over their full life cycle of 40 years. Proposals for these investments by themselves exceed the remaining carbon budget (Franca et al. 2016; van der Veen 2015; Fuhr 2016). Legislated caps on fossil energy use and of moratoria on fossil exploration are hence mandatory. Exploration of extreme energy, including oil and gas reserves in the Arctic and unconventional oil and gas, is also automatically out of the question as it leads to higher emissions than conventional oil and gas production (Victor and Jackson 2015: 14–15). These realities represent indispensable starting points to respond to climate change mitigation needs but do not resolve the energy base problem faced by communities. A steady-state energy policy aims to compensate for these losses by means of energy services delivered within biophysical limits in a short time frame through the exponential increase of renewable sources, the deployment of clean energy systems, and realizing the vast potential of energy efficiency.

Rather than acceding to unsustainable energy policy as a necessity in the lack of alternatives, one can discern two ideal-type policy options for decarbonized, renewable energy powered economies. Both of these solutions are in fact underway and will benefit substantially from the digital revolution that is challenging predominant, business as usual economic patterns, and corporate models in various ways. While, pragmatically speaking, the most plausible scenario is that states will follow a combination of the two options, it is useful to set them out separately to discuss their respective strengths, weaknesses, and implications. The first model amounts to a 'bulk power' hard energy pathway in which large-scale renewable capacity feeds the electricity network, initially supplementing and then progressively substituting for conventional energy sources. This utility mode of energy markets development is dominant in many countries, including among others China, the UK and Spain. The second model is decentralized in nature and aims to reshape the energy architecture. In this second soft energy pathway, energy is produced by smaller players at the household, corporate (small and medium-size), and community level. Local ownership, distributed energy sources, microgeneration, and self-consumption are central features of this model. Germany, Denmark, and Belgium figure prominently among the states that have undertaken this option for energy transition.

The next two sections discuss the hard and soft pathways to renewable systems in more detail (Lovins 1977). The analysis that follows focuses on the limitations of both pathways as currently pursued. It sets forth the argument that these shortcomings can be attributed to adherence to the growth-based paradigm that dictates the setting of goals, the designation of specific policy tools, and related regulatory provisions. Subsequently, both sections show how, by adopting a steady-state approach, the two pathways can be scaled-up to meet the climate challenge. The third section approaches energy efficiency as an energy source, and scrutinizes how energy efficiency can essentially ease pressure on the energy generation front and contribute to bringing overall emissions down within biophysical limits.

Centralized Renewable Energy Systems

Decarbonization policies have been principally carried out in the power sector. In particular, renewable energy (primarily wind and solar installation but also bioenergy, hydroelectric, geothermal, and tidal sources of energy) has been fed into power networks at the expense of coal and gas (Cowell 2010; Cowell et al. 2017a: 483–4). This proliferation of renewable energy technolgies has gone hand in hand with an expansion of final end usage, rendering power systems the core pillars of the decarbonization agenda. Despite these breakthroughs, the evolving greening of the electricity sector remains for the time being circumscribed and is facing a number of hurdles.

The first barrier is state ambivalent and, in several cases, declining support for renewable energy. This regards both regulation and subsidies. In the European case, for example, renewables have been promoted by the priority dispatch mechanism and FIT systems. The former has granted renewable sources priority access to the grid; preferential treatment that has played a catalytic role in stimulating investments in renewable energy generation. Nevertheless, evidence points to considerations of policy reversals that will result in the loss of this privileged status for renewable generation in power markets (The Guardian n.d.).

FITs as fixed remuneration schemes proportional to the capacity installed, on the other hand, created solid expectations for generous returns on investments, paving the way for the first wave of large-scale renewable energy deployment (Gunningham 2013: 312; Wüstenhagen and Menichetti 2013: 376–8). The German example is an excellent case in point (Vogelpohl et al. 2017). Nevertheless, EU Member States and the European Commission have incrementally rolled back support for investments on renewables over the last decade. This shift can be attributed to a number of reasons. Firstly, the financial crisis plaguing the EU swung the pendulum from sustainable aspirations back to business as usual competitiveness and economic preoccupations (Escribano 2017: 248; Helm 2014). Secondly, lower than expected energy returns from renewable projects compared to the level of public investments—along with the parallel rise in electricity bills linked primarily to the subsidy schemes—led to a public outcry and rendered FITs unpopular (Solorio and Bocquillon 2017: 34; Lesser and Su 2008).

In this context, both EU Member States and the European Commission have reassessed the policy toolkit in support of renewable energy generation, and significantly lowered levels of support. In many cases, FITs have been replaced by feed-in premiums (FIPs), a compensatory scheme that adjusts payments to market prices, thus diluting guaranteed profitability and blurring incentives for further renewable energy investments (Jansen and Van der Welle 2013: 325–6; Solorio and Bocquillon 2017: 36). In the UK, the level of overall support provided in renewable energy support systems has been substantially decreased (Bere et al. 2017: 357); in Spain, a policy reversal effectively took place in 2008 with declining support for new schemes (Solorio and Fernandez 2017). Germany, for its part, has partially dismantled the successful FITs scheme (Vogelpohl et al. 2017). A critical decision by the European Commission to rule out FITs as unacceptable state aid effectively stems options for generous state support to incentivize further renewable energy generation projects (Solorio and Bocquillon 2017: 36).

Within the EU in general, the trend is towards cost awareness and more cautious support for clean energy. In line with the progressive marketization of renewable energy, tendering systems seem to be occupying an increasingly prominent position within European policy-making contours, crucially including the European Commission and Germany (Hinrichs-Rahlwes 2017: xiv). While the tendering system may facilitate some renewable projects in the most cost-effective way (Escribano 2017: 260), the shift to tenders will ultimately undercut the dynamics of Europe's energy transition, applying the brakes to full-fledged promotion of renewable energy projects across regions and sectors to the scale necessary to meet climate goals (Jörgens et al. 2017: 294). The sum of these shifts, to conclude, belittles incentives for renewable energy projects, and puts their further proliferation in jeopardy (Hinrichs-Rahlwes 2017: xiv).

Secondly, due to their intermittent character, as well as the need for constant balancing between electricity supply and demand, renewable energy generation creates further load management challenges with added expenses for the power sector (Walker 2008: 4402). This is a crucial issue for the deployment of renewable energy because regulation and grid capacity must go hand in hand; otherwise barriers to electricity systems balance can lead to a vicious cycle of sub-optimal deployment of clean energy systems (Jörgens et al. 2017: 298). The sector's response to this changing landscape has been the gradual deployment of smart grids, defined as intelligent power networks that utilize digital technology to integrate various units of (renewable) electricity generation, and maximize the efficiency of electricity transmission (Varaiya et al. 2011; Eid et al. 2016). In the traditional grid system, a restricted number of electricity generation utilities provide electricity to households, corporate and government premises, and public spaces. The smart grid will see a proliferation of sources for power generation and the concomitant need to balance electricity flows. The traditional grid, as a result, is shifting towards a web-like power network with multiple sources of energy production, virtual power plants, and flexibility built-in the system (Varaiya et al. 2011).

Interestingly, smart grids are designed to expand electricity provision to plug-in hybrid vehicles at various charging points. On the one hand, this constitutes a pivotal spill-over effect of decarbonization with enormous implications for transportation as one of the most carbon-intensive economic sectors. On the other hand, grid-connected vehicles can serve as batteries that can add to the flexibility and resilience of the grid (Ruester et al. 2014: 31). While a number of obstacles remain, and battery technologies remain in some ways away from a mature stage technology (Steinhilber et al. 2013), the electrification of transportation carries the potential to effectively enable clean sources to cascade into further uses (Brown and Sovacool 2011: 22).

Effectively, this new architecture creates 'yet another layer of market design challenges that may lead to qualitatively different market structures, organization, and outcomes' (Bressand 2013: 25). The formidable challenge is then how to achieve ubiquitous response to energy demand without the requirement of constant expansion of supply. Rather than incorporating the dogma of limits and frugality, centralized electricity systems currently require extensive spare capacity (Kuzemko et al. 2015: 154), a design inconsistent with conceptions for electricity systems powered predominantly by variable renewable energy. This, as Bridge et al. (2013: 338) insightfully point out, emanates from the centralized governance of energy and the consequent preference for supply-side solutions. In this context, most countries around the globe (plan to) invest in further coal-fired, natural gas, or nuclear capacity to meet increasing demand (Greece, Poland, and the UK respectively are indicative examples). Rather than fully leveraging the grid management potential, contingencies are dealt with via capacity mechanisms generally consisting of remuneration for fossil-fired plants or other baseload sources that can supply the grid in case of an emergency. Not only are capacity mechanisms rightly considered a backdoor to the perpetuation of fossil energy but the bill increases substantially, thereby delaying the transition to truly clean energy systems (Buchan and Keay 2016a: 3).

Thirdly, market logic remains dominant in this model of power markets development. Power generation is approached as a market product subject to the deliverance of market forces rather than a public good. The central actors are major industrial players that invest in and establish large-scale industrial facilities. Contemporary renewable energy governance and concomitant regulation not only reflect this understanding but have played a crucial role in replicating this model from the beginning of the energy transition. The UK provides an excellent case in point. Utilities have been mandated to green their mix by taking up Renewables Obligation Certificates (ROCs) which favor utility-scale supply of renewable energy. ROCs have been substituted for by Contracts for Difference, which again necessitated large-scale renewable energy supply. Both schemes are far too complex for the entry of small market players and require significant resources, capital and 'soft skills'—all of which favor big, established industrial players (Cowell et al. 2017a: 490–1). In other countries such as Spain and Greece, government prioritization of large-scale renewable parks that necessitate high upfront costs, liquidity and/or capacity for loans loans at low interest rates. Generous FITs yielding returns many times above market prices have been granted to big corporate players to incentivize them to invest in renewable solar and wind parks (Leal-Arcas et al. 2017: 27). Regulation, in this context, served the interest of big industrial players, attuned to modest renewables and emissions governmental goals, but has failed to provide the dynamics for the exponential displacement of oil, gas, and coal from the energy mix. One reason for this has been that 'transnational energy companies are very unlikely to be the best at, for example, securing support from local communities for wind farms … the centralisation of policy arguably therefore results in ineffective policy' (Bridge et al. 2013: 338).

More broadly, however, limited results in terms of renewable energy generation and displaced emissions along a 'hard' energy transition pathway derive from modesty of scope, scale, and speed. The imposition of annual limits on installed solar capacity and the establishment of quotas systems for renewable sources speak to the deficient and contradictory policy framework guiding the deployment of clean energy (Jörgens et al. 2017: 296). Governments have only incentivized industrial-scale renewable investments to an extent commensurate with modest domestic goals in emissions reduction and renewable energy generation. The example of Bulgaria is instructive. Strong top-down Europeanization efforts provided a clear initial boost to the renewables' industry; however, the modest targets for renewable energy deployment quickly levelled off. In the absence of strong resolve and associated bold climate targets, the energy transition seems stalled with support effectively frozen for clean energy systems (Hiteva and Maltby 2017: 238). It comes as no surprise then that the success of the transition has only gone as far as central planning and concomitant regulation allows it to go (Hinrichs-Rahlwes 2017: xiv–xv). Such an assessment may also reflect the current state of play in the EU as a whole since 'the spread of transformation has slowed down considerably and instances of policy dismantling are becoming more frequent' (Jörgens et al. 2017: 289). Deployment of clean energy sources in general seems to suffer from loose targets and regulation, soft coordination, superficial implementation, and shallow institutionalization of ecological norms and policy priorities (Solorio and Bocquillon 2017; Jörgens et al. 2017). As long as centralized energy transitions are embedded in growth agendas and subsequently attuned to only sluggish regulatory goals, only low-hanging fruits will be reaped; the hard pathway of energy transition will yield only marginal fruits with regard to climate change mitigation.

As Bressand (2013: 25) rightly notes, however, electricity markets are at the heart of the energy transition and, as such, lend themselves to 'the innovators' and designers' imagination producing market designs and outcomes better aligned with their political and value preferences'. In this context, the transformation of the electricity sector provides ample space for a breach with past practices and for experimentation with bold, novel devices. Adopting a steady-state approach for energy policy that adheres to a strict carbon budget would put upper limits on the supply of fossil-generated electricity. Simplification of subsidy schemes for renewable energy, the removal of subsidies for fossil fuels, and dispensing with capacity mechanisms constitute reasonable next steps. Accounting for a diminishing energy basis, a steady-state energy policy would alter the investment landscape for economic actors and provide a much needed stable regulatory framework with strategic guidance to enable massive-scale deployment of renewable energy technologies. Within this regulatory framework, priority access to the grid and FITs constitute central policy tools as they provide concrete expectations on returns that can attract further investments and lead to increased renewable energy generation. By means of shifting subsidies on fossil fuels to renewable energy, a steady-state energy policy would also ensure and strengthen the financial basis for new investments in renewable energy projects.

While subsidies for renewable energy projects come into question under growth-driven transition paradigms as the upkeep of investments becomes contingent upon competitiveness merits, a steady-state energy policy would prioritize and financially support these investments primarily for ecological vice economic reasons. This reversal in the subsidies arena—itself of pivotal importance not least since it effectively defines levels of support for different fuels and subsequently affects the fuel mix itself—is grounded in a number of rationales. First, despite the public outcry against the costs implicated in subsidies for renewables, it is essential to put them into context. Subsidies of renewables remain significantly inferior to those afforded to the fossil industry by a ratio of one to three or one to four, depending on method of estimation (The Guardian 2016). Moreover, the fossil fuel subsidies do not encompass the high externalized ecological (as well as social, diplomatic, and military) costs implicated in energy production and use (see Chap. 4).[5] Thirdly, there is hardly any sound rationale for supporting and subsidizing fossil energy in a highly burdened global ecosystem. On the other hand, renewable energy is a perfect fit for a world under climate strains.

Subsidies on renewables, furthermore, contribute to the increase of efficiency and competitiveness of renewable energy technologies in the mid-term. Renewable energy technologies have in many cases achieved grid parity and outcompeted other fuels directly due to prior subsidies. In particular, China's massive investments in renewable technology the last few years have brought solar energy costs down startlingly, this way greatly enhancing solar energy's competitiveness (Kazakov 2016; Hinrichs-Rahlwes 2017: xiii–xiv; Kuzemko et al. 2015: 122; Solorio and Bocquillon 2017: 34).

Lehmann and Gawel (2013: 601), furthermore, have shown how the effective subsidization of renewable energy has had additional impact on efficient climate change mitigation. Subsidies have increased availability of overall energy, allowing countries like Germany to tighten caps on fossil energy power generation. This is an illuminating example of how increased renewable energy generation and climate change mitigation can go hand in hand and reinforce each other, strengthening the case for generous support schemes.

In line with and building upon the above policy measures, a steady-state energy policy would help effectuate the transition from a supply- to a demand-side energy paradigm through:

- increased focus on the efficient function of demand response management (see below)
- the establishment of functional interconnections with neighboring power networks where appropriate, and
- the establishment of large-scale, reliable and resilient storage capacity, when the relevant technology becomes mature (Eid et al. 2016; Varaiya et al. 2011; Boscán and Poudineh 2016: 2).[6]

To sum up, a steady-state energy policy would feature the resolve to return energy consumption within biophysical limits; set high renewable energy generation and carbon emissions reduction goals proportional to climate needs; and put in place corresponding policy tools commensurate to the challenge. Within the current state of play, a few startling cases can serve as blueprints for accelerating and scaling-up ambition, resolve, regulation, and attendant policy tools. Scotland provides an excellent case in point; it has consistently delivered renewable energy well above UK-wide targets andlegislated in 2014 the goal to achieve a 100 percent renewable energy system by 2020. Concomitant policy instruments, both regulatory and financial, have been institutionalized towards this goal within a permissive culture, highlighting the feasibility of radical energy policies to take roots and deliver (Cowell et al. 2017a: 488).

Decentralizing Energy Architecture[7]

In technical terms, the centralized model of energy transition revolves around the substitution of superior fossil energy resources for inferior renewable ones. This reality also foments criticism of renewables while rendering the full-fledged transition to fully renewable systems harder to achieve. While the resource substitution discourse remains trapped in discussions regarding what will replace the most efficient energy resources, it makes more sense to adjust to the properties of fuels. In particular, the fact that renewable energy is much more efficient when consumed at the location of production represents a critical distinguishing feature of these technologies from fossil fuels (Proedrou 2017b).

This raises the broader issue of the prevailing energy architecture and a critical conversation on the utility of dominant energy structures shaped by industrialization and concentration dynamics (Proedrou 2012: 135–7; James and Patomaki 2008). Kuzemko et al. (2015: 32), in this context, call for reforming the dominant energy regime concentrated in the nexus of in fossil energy-politics and urbanized social patterns. Indeed, significant measures towards this goal have taken place in Germany, Denmark, Belgium, some U.S. states, and several Chinese and Indian regions (Kuzemko et al. 2015; Dyrhauge 2017).

Contrary to profit-targeting, large-scale renewable parks designed to supply the central grid, localized patterns of energy generation revolve around the key notions of micro-generation, self-consumption and community energy that feature a central distinction between on-grid (connected to the grid) and off-grid (stand-alone, not connected to the grid) renewable energy units. Micro-generation refers to small-scale production of electricity by households and small business to cater for their own needs. Self-consumption refers to their (legally enforced) right to satisfy (part of) their energy needs with the energy they themselves produce (Jones and Zoppo 2014; Brown and Sovacool 2011; Lehmann and Gawel 2013: 603; European Commision 2017). In scenarios of a positive balance between self-generation and consumption, facilitated by in-house smart appliances, small-scale energy producers may opt to transition off-grid, thus nullifying inefficiencies and associated costs implicated in electricity transmission (either born by themselvesor utilities, transmission and distribution companies). This may represent the most efficient pathway in many cases, particularly for special geographical areas like islands and isolated mountainous regions.

Community energy refers to locally-based, collective renewable energy generation schemes designed to cater to a local community's energy needs. Independent, stand-alone grids (which can still be connected to the central grid in case of need) are created and operate with the aim to cater to local energy (and broader local developmental) needs. As Walker (2008: 4402) writes,

> the deployment of large-scale renewables is creating various problems for the electricity network. Smaller-scale projects avoid some of these issues. If they closely match the existing load in an area they can defer expensive upgrades and extensions of the network, create islands of security during grid outages, and contribute to voltage stability.

As of lately, moreover, a handful of integrative systems have emerged. They

> combine technologies, concepts, and disciplines, and sometimes engage multiple sectors of the economy in ways that can offer unprecedented opportunities to mitigate GHG emissions and enhance energy security. They involve bundling concepts into more efficiently functioning systems and merging suites of technologies into more holistic approaches in which the technologies can be jointly optimized … [and] require paradigm shifts in how we generate and use energy and land today as well as acceptance of entirely new, transformational concepts. (Brown and Sovacool 2011: 116–7, 124)

For example, some communities combine systems engineering, comprehensive urban planning and co-location of activities with shared energy, water, and other requirements to achieve satisfactory energy supply and low carbon emissions. Hybrid renewable systems, in another example, integrate different renewable energy technologies and sources, manage the load flexibly and efficiency, and create resilient energy supply systems with very low or zero emissions (Brown and Sovacool 2011: 112, 117).

Taking into account that many developing countries lack a central grid, reproducing the centralizing dynamics that were a fit for a previous era hardly makes sense. This is even more so givenexpensive investments required to connect the locations of energy generation with metropolitan consumption centers (Brown and Sovacool 2011: 22). The empirical record on efforts to connect many remote areas in the Global South with the central grid, moreover, shows that these often fail for a mix of political, social, and economic reasons (Kuzemko et al. 2015: 139–40; O'Sullivan et al. 2017: 2).

The challenge for the Global South, to the contrary, lies in achieving access to modern energy services and rendering them sustainable through investments in local energy capacity generation (Bhattacharyya 2013: 236; Bradshaw 2014: 148, 179). In this context, leapfrogging and moving ahead with stand-alone household renewable schemes, local micro-grids, and flexible energy architecture seems well-placed. Such schemes can particularly cater to the populations' main energy needs (e.g. cooking, heating and lighting) in rural areas (Bhattacharyya 2013: 236; LaBelle and Horwitch 2013: 119). In fact, a number of local communities in the Global South have ensured their energy needs off-grid or through community mini-grids not connected to the central grid (Sovacool and Drupady 2016; O'Sullivan et al. 2017: 2).

In the Global North, self-consumption becomes an option in most cases in a broader prosumers' market. Prosumers can cover some of their needs through self-consumption, receive the rest of their needs through the central grid, and sell to utilities the extra capacity they generate at times. The intermittent nature of renewable energy (time/day, summer/winter) creates significant variations in energy supply and demand, and hence a strong case for ever-shifting deliveries to and from the grid at different times of the day/year (Parag and Sovacool 2016).

As Douthwaite (1996: 39) was writing twenty years ago,

> The electricity production and supply system … is one in which consumers will use the national or international grid not so much as a source of supply but as a battery. Many households will produce their own electricity with a combination of solar panels on their roofs and biogas-powered generating sets and, whenever they have more than they need, they will 'bank' the surplus by feeding it into the grid. Equally, whenever they need more power than they are producing, they will take the shortfall from the mains: their meter will run both ways, buying power from them at rates which vary according to the time of day and the season and charging it out on several rates as well.

A ground-breaking transition is thus very slowly taking place towards a prosumers' market (Fischer 2016). As Goldthau and Sovacool (2012: 236–7) succintly argue:

> energy systems need to be fundamentally overhauled … 'smart networks' are the key to such an overhaul. Such networks would make participants both producers and consumers of energy; enable a highly efficient use of available energy; communicate individual energy choices to all other participants, allowing them to respond timely and intelligently; and make variable energy sources compete against each other. This would require transforming centralized energy systems, characterized by bulky converters and energy flowing one-way from producer to consumer, into highly decentralized arrangements … Decentralizing energy systems is largely viewed as being a key to achieving a low carbon future, empowering individuals to make smart energy choices by at the same time embedding end-users in an 'intelligent' network of energy production, consumption, and use.

A particular type of intermediate actor can play a significant role in the evolution of the soft energy pathway, both in terms of practical input as well as of governance by example. Institutions offering distinctively public goods, even if in corporate business models (e.g. universities, schools and hospitals), as well as government agencies and courts, can become active stakeholders in the energy transition, invest in micro-generation, and act as its most emphatic sponsors. By embracing such reforms, these institutions can provide their energy needs autonomously, thus releasing pressure off the central grid and bringing overall fossil consumption down. This sets a bright example for the rest of the society to follow suit. A step further, these institutions can up-scale their renewable investments, also drawing from their newly gained related expertise, and become a significant pillar in the rising prosumers' market. The end-result will again be the proliferation of renewable energy generation.

The energy landscape can thus changes substantially if one conceives of most residential, corporate, and public buildings producing electricity on a diffuse basis close to demand centers with smart grid technology effectively integrating these small units into the electricity system. A prosumers' market thus comes into view, whereby consumers also become producers, shipping their energy to the grid. Germany, through its *Energiewende* (energy transition policy) and Belgium feature as prominent examples of developing prosumer markets (Hinrichs-Rahlwes 2017: xii; Leal-Arcas et al. 2017: 27–8).

Side by side with individual and small- or medium-level business initiatives, community energy, shared collaborative efforts across designated spatial areas to promote self-sufficiency and clean energy, have mushroomed in various regions of Europe, the United States and Canada, and across south and southeast Asia. While goals, priorities, modes of organization, and fuel mix vary significantly, what these efforts have in common is that the aim to harness the power of renewable energy to the benefit of local societies while simultaneously enhancing decarbonization (van der Schoor and Scholtens 2015: 666–7; Sovacool and Drupady 2016). In all, it is fair to conclude that with prosumers emerging as significant stakeholders in energy delivery amid a proliferation of community based generation, ownership structures begin to reshuffle, gradually gravitating away from the hands of a few dominant enterprises towards the people (Kuzemko et al. 2015: 117; van der Schoor and Scholtens 2015).

This remains, however, very much a work in progress; the combination of local community resolve to self-organize, enactment of governance structures, and evolving energy regulation will play a pivotal role as to how the transition unfolds. As far as the soft pathway is undertaken within a growth-based paradigm, it suffers from the supply-side bias identified above, persistently and opaquely centralized energy governance patterns and mindsets, and concomitantly insufficient regulation to boost distributed energy sources exponentially. What these factors have in common is that they are rooted in the growth paradigm, and subsequently pay lip service to (traditional understandings of) growth.

The centralized nature of energy governance constitutes a significant barrier to the proliferation of community energy (Bridge et al. 2013: 338). In particular, local governments in many cases remain marginalized with regard to energy policy, and thus lack the competencies to orchestrate and organize community renewable schemes. Even in those cases where they gain more formal powers, however, there is no certainty that local governments will act to boost decentralized energy paths, rather than pursue business as usual models and practices to bolster their own political remit. The case of the UK and the low impact devolution has had on the character of the energy transition features prominently here (Cowell et al. 2017b: 178–80). As Sovacool (2016: 205) argues, ‘the neo-liberal ideology has further entrenched capitalism into our social and political spaces so that alternatives are rarely imagined let alone implemented’. In this context, the stickiness of centralized energy governance results in the perpetuation of centralized energy patterns, obscuring the potential of fundamentally decentralizing the energy architecture. Decentralized actors are in this context often seen as 'as remote, unpredictable or even capricious, especially when they "fail" to behave in accordance with the preferred models of national decision-makers' (Bridge et al. 2013: 338).

Regulation naturally reflects the prevalent mindset within national and regional policy communities and guides the scale and speed of transition (Walker and Devine-Wright 2008: 500). Belgium, Germany, and Denmark stand out as positive examples of countries that have promoted bottom-up energy generation, not least by putting into place bold FIT subsidy schemes to encourage renewable energy investments at the household level. Prosumers' obligation to pay fees to gain the right to ship (part of) the electricity they generate to the central grid has acted as brake to the proliferation of micro-generation investments in Belgium. This example also speaks to governments' dilemmas involving carbon emissions reduction and affordability concerns (as these fees cover layers of costs associated with interconnections and load management). In the Netherlands, on the other hand, regulation in many cases prohibits regional renewable energy generation initiatives (van der Schoor and Scholtens 2015: 673). In the UK (including its devolved regions), community energy has been effectively circumscribed and relegated to the inferior status of an adjunct of the hard pathway (Cowell et al. 2017a: 496). In Spain and Greece, legislation allowing micro-generation and self-consumption has only very recently been put in place. In Spain, the obligation of prosumers to pay taxes on these investments, at the same time that they receive no remuneration for the quantities they ship to the grid, act as grave disincentives to supplement and accelerate the centralized-driven Spanish energy transition with a boost of micro-generation and distributed energy resources (Leal-Arcas et al. 2017: 27–8). To add insult to injury, the soft pathway stands to suffer significant setbacks in the broader European context in light of the roll back of FITs, and even more so if priority dispatch mechanisms are also revoked. Removing incentives for renewable energy generation and changing the opportunities structures for small-scale investors and prosumers seems to put its evolution in jeopardy altogether.

In all, the undercutting theme of decentralized energy architecture is local ownership, the diffusion of energy generation in a bottom-up fashion, and the empowerment of individuals, households, small corporations, and local communities to become energy stakeholders. A significant caveat to the decentralizing of energy architecture is that, in line with the prevalence of for-profit mindsets, it creates the potential for the subversion of small-scale energy stakeholders attentive to personal or local energy needs into corporate actors targeting profitability. At a micro level, rather than consuming the energy they produce as the most efficient technical option to minimize transmission leaks, releasing pressure off the grid and averting associated costs, prosumers may opt to trade their power generation capacity. This includes both selling electricity in premium markets (to aggregators and utilities in peak times or otherwise or purchasing electricity at lower prices both through customized contracts with utilities and by means of the possibilities that demand response management and real-time pricing conveys (see below) (European Commission 2017). At the community and intermediate actor level, generating revenues rather than yielding renewable energy to one's members, employees, and service recipients may become the prevailing goal for local generators. In Europe, for example, the twin developments of deregulation and digital technology revolution create ample space for local generators and energy co-operatives to become pillars of the grid, selling and purchasing energy within the local system. In such an increasingly corporatized energy landscape, the underlying rationale will be profitability, rather than self-sufficiency, and a focus on local needs. A potential outcome hence may be the establishment of a hybrid market in which market consolidation and concentration dynamics will be ascendant.

With this caveat in mind, micro-generation and community energy entertain substantial potential to mushroom. This, nonetheless, has been hardly tapped into. A steady-state energy policy, to the contrary, would naturally commit itself to the exponential proliferation of distributed energy sources and the deep institutionalization of the decentralized energy architecture. This is because these schemes tie in with steady-state economics' preference for economic activity at the local level. A steady-state approach also eludes the supply-side bias, focusing on meeting energy needs rather than producing large amounts of supply and generating surpluses. Micro-generation, self-consumption, and community energy respond exactly to these needs, and hence are preferable to (but far from sidelining and excluding) bulky power generation solutions in a steady-state policy framework. In this context, a steady-state energy policy would legally enforce self-consumption and off-grid systems, incentivize micro-generation, and encourage local communities' initiative to develop renewable energy generation capacity. Far from oscillating among competing policy priorities such as sustainability and affordability, a steady-state energy policy would unambiguously prioritize the former and regulate the energy market accordingly. FITs for renewable energy schemes and priority access to the grid would naturally form building blocks in this energy landscape.

A steady-state energy policy would also reward prosumption (by lifting charges for and remunerating shipments to the central grid) within a broader price structure that favors self-consumption. Public procurement policy would focus on rendering public institutions into test beds for raw models of clean energy generation and management. Last but not least, prestigious intermediate actors would be particularly targeted and incentivized to procure high amounts of clean energy, achieve (close to) energy self-sufficiency and/or evolve into significant prosumer actors. Governance by example is critical in empowering the soft pathway of transition.

Institutionalized within a broader favorable policy context, such provisions can engage local communities, intermediate actors, neighborhoods, and individuals to become active stakeholders in renewable energy generation and climate change mitigation. While the centralized model of decarbonization is more likely to partially green, rather than make-shift, the energy system, decentralized modes of energy generation offer significant potential to accelerate and scale-up the transition underway. This is because decentralized systems 'work on the "hearts and minds" of local people and have wider catalytic effects in promoting positive beliefs and actions about renewable energy' (Walker and Devine-Wright 2008: 499). While centralized modes of renewable energy production have to combat local opposition to the establishment of solar, wind, and tidal parks, local renewable energy schemes integrate and embed the local society in the process and benefits of the schemes, this way facilitating clean energy supply (Cowell et al. 2017b: 178). Local renewable energy schemes thus carry the potential to boost citizens' participation in community projects and lead to the wider adoption of renewable generating devices at the household and business levels. At a more profound level, decentralized energy systems can unlock dynamic and rich pluralities in imaging and designing sustainable modes of energy generation and management (Stirling 2016); the process of participating in renewable energy generation schemes itself carries pivotal learning effects that open up further potential for a sustainable energy landscape (Walker and Devine-Wright 2008: 500) (Table 3.1).

Boosting Energy Efficiency

Energy efficiency must be seen as a source of energy, in that it allows societies to cover their energy needs with lower energy inputs. Energy efficiency, hence, like renewables, constitutes in essence a substitute of what needs phase out: fossil energy. In fact, this hidden fuel (OECD/IEA 2014) has outdone the contribution of any single source of energy in the global fuel

Table 3.1 Centralized versus decentralized energy systems

	Centralized	*Decentralized*
Business models	Business as usual, top-down energy generation	Bottom-up mode of energy generation
State support	• Priority dispatch mechanism • Feed-in tariffs/premiums • Renewable Obligation Certificates • Contracts for Difference • Tendering systems	• Priority dispatch mechanism • Feed-in tariffs • Contradictory regulation • Adjunct, inferior status • Scarce funding
Features	• Intermittency and flexibility • Load management • Capacity mechanism • Smart grids and Advanced Metering Infrastructure • Demand response management • Plague-in electric vehicles	• Micro-generation • Self-consumption • Community energy • Local ownership • Stand-alone, mini-grids and connected to the grid systems • Distributed energy • Prosumers markets • Public procurement • The role of intermediate actors • Learning effects • Capacity to actively engage citizens

mix the last decades; in this context, it makes sense to gear further resources to harnessing, and increasing, the yields of energy efficiency.

Energy efficiency has a central place in the deployment of smart grids. While the supply-side dimension of smart grids boils down to integrating renewable sources of energy to the network, their demand-side dimension regards the control, rationalization, and prudent management of energy end-use. This amounts to a paradigm shift from supply- to demand-driven power networks and markets. While power markets remain for now supply-driven, in that spare capacity (expensive, fossil) is prioritized, smart grids are designed to manage existing electricity supply in optimal ways. Rather than boosting supply to meet ever-growing demand, smart grids can adjust consumption within certain supply bands, rationalizing and optimizing energy use to meet system demand (Varaiya et al. 2011; Kuzemko et al. 2015: 154). Smart grids can achieve this by employing a wide array of instruments, summed up as demand response management that allows for a plethora of individual, customized energy consumption options and patterns (Clastres 2011; Buchan and Keay 2016a: 3). These instruments include transmitting signals to consumers; notifying them of grid capacity and real-time pricing at any moment; suggesting instant measures to be taken; and, intervening automatically to reduce consumption (Varaiya et al. 2011; Eid et al. 2016). Smart meters and other Advanced Metering Infrastructure (AMI) devices (e.g. in-home displays, in-home automation and remote control apps) are the essential tools that enable the transmission of supply, demand, and real-time consumption information that can guide end-users to efficient energy management (Wissner 2011; Depuru et al. 2011; Eid et al. 2016: 3). Smart grids hence evolve into a valuable instrument in the hands of energy consumers 'rendering houses and buildings functionally smart and this way substantially boosting energy management, conservation and efficiency' (Proedrou 2017b: 451).

Smart grids and demand response management are expected to yield significant energy efficiency gains, and hence appear to be powerful tools in the battle against climate change. How far they contribute to climate change mitigation, however, largely depends on the mindset guiding their function. In fact, demand response management and smart grids are currently deployed within the dominant growth mindsets both in the Global North and the Global South, the expanding middle class of which emulates consumerist socio-cultural blueprints, disregarding any meaningful notion of biophysical limits that pose critical constrains on energy consumption (Elkind 2010; Lesage et al. 2010). Low energy use per activity may well incentivize higher energy usage in total as an important caveat. As Hargreaves et al. (2013: 133) suggest, once entering general routine, AMI will serve mostly to manage discretionary energy use but not profoundly alter the overall level of energy usage. The rebound effect hence will sacrifice whatever energy savings are achieved (Lawn 2007: 59); smart grids in this case will fail to bring overall energy use down. Instead of 'leaving the complex dynamics of energy consumption unquestioned and thus tacitly supporting and sustaining "normal" patterns of consumption that are known to be unsustainable' (Hargreaves et al. 2013: 133), it is essential to utilize niches offered by technological achievements to arrest growth in energy consumption (Hargreaves et al. 2013: 133). In the absence of such an overarching shift, and unless the energy mix becomes fully green, smart grids will only facilitate the climate change mitigation agenda on the margins (Jackson 2009; Brown and Sovacool 2011: 323).

In a broader political, economic, and energy steady-state mindset, to the contrary, smart grids will become the essential technological instruments that enable energy use within biophysical limits. Smart grids will rationalize and optimize energy use within given supply bands determined by biophysical limits. Constraints and limits to energy use will to an extent be lessened, providing space for more amenities than it would have been the case otherwise. In other words, smart grids will facilitate and *ceteris paribus* increase the utility of consumed energy, but without accommodating excessive energy capacity beyond biophysical limits, as is the case within the supply-driven energy paradigm. A steady-state energy policy would as a rule cede added emphasis on energy savings and efficiency. This is so not only because energy efficiency resonates with steady-state economics' focus on frugality, demand control, and energy use minimization, but also because biophysical energy supply ceilings render energy efficiency and savings indispensable for meeting energy needs.

Such savings, on the other hand, while also constituting significant gains, are not instrumental to growth-based energy policies' success. Contemporary growth-driven energy policies, moreover, invest in energy efficiency for economic rather than ecological reasons. Therefore, and taking into account the rebound effect, the impact of energy efficiency on climate change mitigation remains circumscribed and inferior compared to its full potential. Nevertheless, the establishment of energy efficiency standards has facilitated the penetration of energy efficient devices and domestic appliances; the building of passive houses; and the substitution of less efficient, more energy-intensive natural resources for more efficient and less energy-intensive ones (Gunningham 2013: 310, 313; Buchan and Keay 2016a: 6; European Commission 2016b: 4; von Weizsäcker 2014: 21–2).

A steady-state energy policy would significantly build on the progress accomplished by growth-driven policies with regard to energy efficiency over the span of the last decades. Firstly, a steady-state energy policy would invest the sums deriving from energy savings in further renewable energy generation and energy efficiency schemes. This move would ensure a strong financial basis for the deployment of clean, smart, and efficient energy systems, and would effectively kick-start a virtuous cycle in which initial energy savings produce further energy savings, this way enhancing both affordability and abundance of energy supply.

Secondly, energy efficiency standards and measures would be supplemented, and facilitated by, comprehensive green audits. The results of these audits will have to be mandatorily published together with corporations' financial balance sheets (Giddens 2011: 124), and would reveal the remaining gap between the positive effects of these innovations and the macro-level (i.e. the desirable scale of energy use within biophysical limits). While growth-driven strategies omit this step, this is indispensable to become aware of the scale of further energy savings needed.

Rendering this gap crystal clear is an indispensable step towards organizing public policy interventions that will bridge the remaining gaps and monitor full convergence of energy use with biophysical limits. In fact, growth-driven strategies retain by and large significant inefficiencies, which a steady-state energy policy would address by steering public policy resources in that direction. The discussion that follows does not aim to be exhaustive, as this would stretch analysis beyond the space available in this monograph, but is indicative of the space for further energy efficiency improvements.

To begin with, end-users in many cases retain unnecessarily high consumption levels because they remain locked in outdated, energy inefficient appliances (e.g. personal computers, ovens, washing machines, and TV sets). While energy saving appliances are widely available in the market, it is reasonable that not all end-consumers (including corporations) either afford, or will choose to invest in, the substitution of old appliances. As a result, consumers pay higher bills and overall energy consumption is higher compared to what it could have otherwise been.

This state of play is exacerbated by the amply documented principal/agent problem. The energy expenses of hospitals, for example, are covered from the public coffers, while the hospitals themselves or local authorities cover infrastructure investments. There is, as a result, an incongruence between those agents paying the bills, and those that determine the level of these bills through their investments. This leads to sub-optimal economic results, as infrastructure investments decisions are taken with an eye to minimize costs at the purchase point, rather than energy expenses in the mid- to long-term. The same problem arises with rented accommodation, where the tenant would benefit from energy efficiency investments in home appliances (heating and cooling systems, etc.), but it is the landlord who has to finance these investments and in most cases is under-incentivized to do so (unless in very competitive housing markets) (Brown and Sovacool 2011: 176).

An alternative approach would revolve around utilities conducting systematic auditing of their customers' energy consumption, and funding energy-saving, smart appliances on behalf of their consumers. Utilities have both the liquidity and the capacity to acquire bank loans on favorable terms, invest in a demand management policy, reap the fruits and provide multiple ecological and social benefits. Not only would consumers see their bills fall, but corporate profits could also increase since utilities would charge higher prices per unit of (less) energy. Utilities could this way also decrease their dependence on imports, supply contracts prices and pricing fluctuations.

Such projects have been implemented in some cases (Sacramento is a good example) but remain far and few between, rather than the norm (Jackson 1996: 130–3). To the contrary, as we saw above, supply-side solutions remain preponderant, reproducing the supply-side bias in energy markets at the very time that turning demand management into a key policy carries huge potential. Such a policy is also preferable to Hansen's (2009) fee and dividend proposal. Charging the fossil industry and returning this money to end-consumers with an eye to bring consumption down leaves much to be desired. A top-down approach that focuses on demand management, to the contrary, seems much more apt for the purpose.

Energy efficiency is not an issue of concern only for importers. Exporters also stand to benefit from policies and practices inspired by a steady-state approach. Even if these countries do not adopt a steady-state policy altogether, applying these energy efficiency practices would save them energy, delay fossil extraction projects and contribute to a decrease of overall energy use. To elaborate, for one, the gas flaring issue is indicative of the inappropriate and sub-optimal policy, business and intellectual mindsets governing the production of energy (Carbonnier and Brugger 2013: 68). Russia, for example, is notorious both for flaring billions of cubic meters of gas on an annual basis, as well as for its remarkably inefficient downstream energy sector (Bradshaw 2014: 113). These costly and irrational policies ironically take place at the very time that the Kremlin has decided to postpone indefinitely exploration in the Shtokman field, and faces severe hurdles in delivering on its Eastern Gas Program. While the current gas glut is one reason behind this, ecological, financial, and technical reasons are also largely at play (Henderson and Mitrova 2015: 21). Adopting broad energy efficiency measures, on the other hand, would conserve the country's energy reserves, rendering the need for new upstream investments obsolete for years to come (Bradshaw 2014: 113, 115).

These problems are far from restricted to Russia. Energy-endowed countries around the world find it increasingly difficult and uneconomic to explore further fields and hence to retain export capacity at current levels. At the same time, domestic demand rises in most energy exporting countries, putting pressure on reserves and spare capacity (Omri 2013). These emergent patterns raise the broader issue of energy illiteracy at both upstream and downstream levels. Managing and rationalizing exploration, delivery, consumption and flexibility remains a muted point in energy policy (Brown and Sovacool 2011: 170–1). Energy conservation and efficiency thus is also a prudent policy for exporters, as wasting energy is unprofitable on all counts (Table 3.2).

Table 3.2 Steady-state versus mainstream low carbon energy policy

Supporting policies	**Steady-state**	**Low carbon**
Monetary	Constant money supply defined by biophysical capacity undercuts demand for energy consumption/imports within range of biophysical limits	Exponential money supply retains energy use beyond biophysical limits
Trade	Restrictive trade policy (compensatory tariffs, low-carbon fuel standards and/or tariffs on all carbon-based imports) Support of an open trade regime in ideas and sharing of knowledge Substantial decrease of the volume of energy-intensive trade Indigenous renewable energy generation more likely	Subsidized trade Distorted rules of the game (free trade dogma, patents, blocking the sharing of knowledge) Energy-intensive trade
Investment	Mobilizing public finance Engaging the financial community Focus on transport and aviation Encouraging global cooperative platforms	Investment on anti-climate policies Underinvestment on climate-mandated schemes Artificial capital scarcity
Tax	An ecological tax reform Tax bads, not goods Tax energy consumption, proportionately relieve income and labor tax Recycle gains within society to compensate losers Setting a cap-and-trade system Setting a compensation fund for fossil energy exhaustion	Fossil energy production, consumption and use subsidized High tax on income and labor Shallow institutionalization of carbon taxes and cap-and-trade systems to green, rather than stem, growth
Core energy policies		
Caps and moratoria	Caps on energy use Moratoria on fossil exploration and production	No caps on energy use No moratoria on fossil energy production
State support and regulation	Subsidies/regulation to encourage renewable energy generation and energy efficiency	Subsidies and permissive regulation on shale and extreme energy along with inferior support for renewables

Role of renewables and energy efficiency	Renewable energy and energy efficiency to largely substitute for oil, gas and coal	Renewable energy generation and energy efficiency to cover energy demand increase and fulfil modest climate goals
Focus on micro-generation	Endorsement of bottom-up diffusion of renewable energy generation	Sub-optimal overall support, funding and regulation for local energy schemes
Energy efficiency	Resonates with steady-state's emphasis on frugality Essential for meeting energy needs Focus on tackling energy inefficiencies	Inferior for success of supply-biased energy policy Energy efficiency standards a good start Energy inefficiencies remain by and large
Demand-side measures (deployment of smart grids, demand response management, prosumers markets, energy efficiency)	Demand-side measures with the goal to arrest growth and bring energy use within biophysical limits	Demand-side measures with the aim to improve energy efficiency as a means to boost growth, rather than achieve bold climate goals

Conclusion

To sum up, a consistent steady-state energy policy aims at and revolves around clean energy sources, mostly renewables-run smart energy systems and practices that undo existing energy inefficiencies within short timeframes. While the centralized energy architecture blueprint of energy transition leaves a lot to be desired, community energy and micro-generation have the potential to mushroom and exponentially increase the supply of renewable energy, not least due to the learning effects they produce and their capacity to actively engage citizens. In both blueprints, however, the key issue is demand response management within biophysical limits, as opposed to the perpetuation of supply-side biases and policies. The role of regulation in steering demand-side policies and promoting a combination of the two blueprints of energy transition that better matches each local and national community's needs and resource-endowment is pivotal for bringing forth deep decarbonization.

In tune with the progressive electrification of the energy system and the ensuing proliferation of energy end-uses catered for by electricity, most energy needs can be fulfilled via green carriers of electricity. The energy needs in the residential and industry sectors fall under this category. The crucial spill-over of electricity to the transportation sector via electric, plug-in vehicles, which should be proactively supported by a steady-state investment policy, will amount to a substantial greening by and large of the energy mix. As long as technological breakthroughs in aviation—facilitated by a steady-state investment policy—and restricted energy use in shipping—brought forward by means of a steady-state trade policy—materialize, sustenance within biophysical limits will become an achievable goal, rather than the current very distant case.

Since some of the aspects of the steady-state energy policy presented here overlap with the energy transition currently unfolding under the growth mindset, it is essential to once more highlight what effectively distinguishes steady-state energy policies from contemporary mainstream decarbonization and energy policies embedded in green growth agendas. To reiterate, the utilization of the benefits provided by smart grids; efficient demand response management; large-scale investments in renewable energy generation; the establishment of low-carbon standards and the increasing efficiency of infrastructure, appliances, and devices constitute significant pillars of the green growth agenda. However, such measures—as the sum of the nationally determined growth drive contributions—will fail to achieve climate mitigation goals and to circumscribe economic activity and energy use within biophysical limits. This can be seen in scalar terms, whereby efforts towards decarbonization proliferate, but are not up-scaled to such an extent to achieve emissions reductions targets that will meet at a minimum the 2 degrees Celsius temperature target. It can also be understood in temporal terms; states following this path may finalize a green transition but at a much later date than climate change mandates (Bradshaw 2014: 192; Young 2011: 634; Larkin et al. 2017b).

Steady-state energy policies, to the contrary, prioritize biophysical limits and set strict carbon budgets on this basis, rather than on the estimated feasibility of current green reforms to proceed hand in hand with growth (Daly 1996; Lawn 2007; Daly and Farley 2004; Dietz and O'Neill 2012). In this context, steady-state energy policies revolve around setting caps on fossil energy use and moratoria on fossil energy exploration; putting in place regulation to prioritize under all circumstances green to fossil energy; and incentivizing both exponential centralized and decentralized renewable energy schemes, and wide-ranging demand response management within given supply bands. None of this is part of the green growth agenda.

At the same time, these measures are grounded in and effectively supported by a wider steady-state policy framework, involving

- the institutionalization of an ecological tax reform and a much more stringent cap-and-trade system;
- a restrictive trade policy through compensatory tariffs and other trade instruments, if needed;
- the commitment to promote open collaborative global platforms to share knowledge, know-how and technology as a means to achieve the revolutionary technological advances needed to drastically minimize fossil energy use;
- a targeted clean energy investment policy; and
- a more or less constant money supply within the remaining carbon budget.

While progress has been achieved within core energy policies—albeit within a growth mindset and thus lacking the required urgency, speed, scale and scope—it is these broader economic policies and their links with energy policy that remain undertheorized, underexplored, and underappreciated. Steady-state energy policies, however, cannot come to fruition in case money supply expands demand for fossil energy; energy-intensive trade remains extensive; the trade regime retains barriers to the transmission and sharing of knowledge; capital remains artificially scarce (rather than channeled to clean energy investments); and the tax system continues to favor fossil over renewable energy sources.

Returning to the three goals of a steady-state energy policy, growth policies promote renewable energy but do not put brakes on (fossil) energy demand and consumption. As a result, unless technology enables the establishment of an almost wholly renewable energy based system in a very short timeframe, emissions will exceed the benchmark threshold of 450 parts per million (ppm) in the atmosphere. The perpetuation of fossil energy and the sluggish growth of renewable energy generation—compared to what must be the case for climate change mitigation goals—also speaks to the persistent failures within the growth paradigm to lead to deep decarbonization in the very near future. Clean renewable energy systems, thirdly, are still dependent on the availability of resources and materials along the supply chain. Energy policy hence must follow steady-state principles with regard to these subtle issues as well. Promoting technologies based on materials that regenerate faster than others, and taking into account land use and food security concerns for the cultivation of biofuels (among other energy souces) are crucial issues. Indeed, the fiasco surrounding the embracement of first generation biofuels without assessing full assessment of their socio-ecological impacts regarding increased carbon emissions, land clearing, and loss of habitat resonates with growth-driven rationales and policies (Di Lucia 2017: 265–6). The setting of sound sustainability criteria on the production and consumption of biofuels, on the other hand, aligns with steady-state approaches that lie in the nexus of ecology and the economy. While growth-driven mindsets cede scarce attention to these issues, ecological and steady-state economics pay due emphasis on these caveats and can guide the transition to clean energy systems and sources in an optimal way.

Notes

1. The switch from the increasingly scarcer and more costly light, sweet crude oil to the more common heavy crude creates additional problems for refineries, most of which have been built to refine the former type of oil. An additional layer of costs then regards building further refining capacity (see Kuzemko et al. 2015: 184).
2. One could counter-argue that once tax reform catches on and both corporations and citizens adjust to the new system, state revenues will plummet.

That would be great news in the first place, since it would mean that unsustainable practices will have been removed and energy use will have been rationalized. Nevertheless, fossil energy use is unlikely to be eradicated altogether in the near future, this meaning that the state will retain considerable associated income. Tax-induced savings, moreover, would free up income to be consumed in further economic activities thus generating profits for the economy as a whole, part of which is taxed back into the state cashiers (Lawn 2007: 213–4).

3. Lower income taxes, on the other hand, would also mean higher purchasing power for citizens. This can act as stimulus for the rise of aggregate demand that remains low for years. More importantly, this demand would revolve around services, rather than products, further dematerializing the economy. Corporations, on their part, would be able to invest more in human labor and green technology. Lower unemployment and increased sustainability could thus ensue, and the linkage between growth and employment would be lessened (Lawn 2007: 271–81; Jackson 1996).
4. A significant caveat is that tax instruments 'need and presuppose well functioning markets where many private actors will take advantage of them' (Gunningham 2013: 311). Non-mature, weak and dysfunctional markets, to the contrary, are fraught with imperfect and asymmetric information, the principal/agent problem, seemingly non-rational responses and ensuing high risks of rent-seeking, speculation and even fraud. This raises the significance of the parallel need to develop resilient markets across sectors that will make optimal use of ecological tax instruments (Gunningham 2013: 307–10, 313).
5. Externalities, it should be stressed, are emphatically undemocratic and exclusionary, in that the largest, most affected and least well-off part of the population (including future generations that are unrepresented) shoulders the costs of economic activity and energy use that generates generous profits for the few at the top (Brown and Sovacool 2011: 56).
6. The profound changes under way, moreover, open up space for the establishment of a new corporate actor: aggregators. Aggregators can invest in renewable power generation, and/or contract quantities produced from a number of small energy producers. Since flexibility becomes a premium service in a complex power market where supply and demand balancing becomes more demanding, there is enough scope for aggregators to sell this aggregated electricity to utilities and energy companies in times of increased demand. These actors can thus contribute to the stability of the network and the delivery of energy services at all times (Boscán and Poudineh 2016: 2, 8).
7. This section has benefited from my brief engagement with the WiseGRID project.

References

Armstrong, R. et al. 2016. The Frontiers of Energy. *Nature Energy,* 1: 1, 1–8.

Bere, J. et al. 2017. Energy and Development in the Periphery: A Regional Perspective on Small Hydropower Projects. *Environment and Planning C: Politics and Space,* 35: 2, 355–375.

Bhattacharyya, S. 2013. Energy Access and Development, in A. Goldthau (ed.), *The Handbook of Global Energy Policy*. Chichester: Wiley-Blackwell, 227–243.

Bishop, R. 1993. Economic Efficiency, Sustainability, and Biodiversity. *Ambio*, 69–73.

Boscán, L. and Poudineh, R. 2016. Flexibility-Enabling Contracts in Electricity Markets. *Oxford Energy Comment, The Oxford Institute for Energy Studies,* 1–11.

Bowen, A. and Rydge, J. 2011. The Economics of Climate Change, in D. Held, A. Fane-Hervey and M. Theros (eds), *The Governance of Climate Change. Science, Economics, Politics & Ethics*. Cambridge: Polity Press, 68–88.

BP. 2016. *BP Statistical Review of World Energy*, 1–48.

Bradshaw, M. 2014. *Global Energy Dilemmas*. Cambridge: Polity Press.

Bressand, A. 2013. The Role of Markets and Investment in Global Energy, in A. Goldthau (ed.), *The Handbook of Global Energy Policy*. Chichester: Wiley-Blackwell, 15–29.

Bridge, G. et al. 2013. Geographies of Energy Transition: Space, Place and the Low-Carbon Economy. *Energy Policy,* 53, 331–340.

Brown, L. 2009. *Plan 4.0 B: Mobilizing to Save Civilization*. New York: Norton.

Brown, M. and Sovacool, B. 2011. *Climate Change and Global Energy Security: Technology and Policy Options*. Cambridge, MA: MIT Press.

Buchan, D. and Keay, M. 2016a. EU Energy Policy – 4th Time Lucky?. *Oxford Energy Comment*, *The Oxford Institute of Energy Studies*, 1–9.

Buchan, D. and Keay, M. 2016b. *Europe's Long Energy Journey – Towards an Energy Union*. Oxford: Oxford University Press.

Carbonnier, G. and Brugger, F. 2013. The Development Nexus of Global Energy, in A. Goldthau (ed.), *The Handbook of Global Energy Policy*. Chichester: Wiley-Blackwell, 64–78.

Clastres, C. 2011. Smart Grids: Another Step towards Competition, Energy Security and Climate Change Objectives. *Energy Policy,* 39: 9, 5399–5409.

Cowell, R. et al. 2017a. Rescaling the Governance of Renewable Energy: Lessons from the UK Devolution Experience. *Journal of Environmental Policy & Planning,* 19: 5, 480–502.

Cowell, R. et al. 2017b. Energy Transitions, Sub-national Government and Regime Flexibility: How Has Devolution in the United Kingdom Affected Renewable Energy Development?. *Energy Research & Social Science*, 23, 169–181.

Cowell, R. 2010. Wind Power, Landscape and Strategic, Spatial Planning – The Construction of 'Acceptable Locations' in Wales. *Land Use Policy,* 27, 222–232.

Daly, H. 1996. *Beyond Growth: The Economics of Sustainable Development*. Boston, MA: Beacon Press.

Daly, H. and Farley, J. 2004. *Ecological Economics. Principles and Applications.* Washington: Island Press.

Depuru, S., Wang, L. and Devabhaktuni, V. 2011. Smart Meters for Power Grid: Challenges, Issues, Advantages and Status. *Renewable and Sustainable Energy Reviews,* 15: 6, 2736–2742.

Deutsch, K. 1957. *Political Community and the North Atlantic Area: International Organisation in the Light of Historical Experience*. Princeton: Princeton University Press.

Di Lucia, L. 2017. External Governance and Europeanization beyond Borders: EU Biofuel Policies in Mozambique, in I. Solorio and H. Jörgens (eds), *A Guide to EU Renewable Energy Policy. Comparing Europeanization and Domestic Policy Change in EU Member States.* Cheltenham: Edward Elgar, 265–286.

Dietz, R. and O'Neill, D. 2012. Enough is Enough: Building a Sustainable Economy in a World of Finite Resources. London: Earthscan.

Douthwaite, R. 1996. Short Circuit: A Practical New Approach to Building More Self-Reliant Communities. Devon: Green Books.

Dubash, N. and Florini, A. 2011. Mapping Global Energy Governance. *Global Policy,* 2: 1, 6–18.

Dyrhauge, H. 2017. Denmark: A Wind-Powered Forerunner, in I. Solorio and H. Jörgens (eds), *A Guide to EU Renewable Energy Policy. Comparing Europeanization and Domestic Policy Change in EU Member States.* Cheltenham: Edward Elgar, 85–103.

Egenhofer, C. 2013. The Growing Importance of Carbon Pricing in Energy Markets, in A. Goldthau (ed.), *The Handbook of Global Energy Policy.* Chichester: Wiley-Blackwell, 358–372.

Eid, C., Hakvoort, R. and de Jong, M. 2016. Global Trends in the Political Economy of Smart Grids: A Tailored Perspective on 'Smart' for Grids in Transition. *UNU-WIDER Research Paper wp2016-022. World Institute for Development Economic Research*, 1–19.

El Serafy, S. 1989. The Proper Calculation of Income from Depletable Natural Resources, in Y. Ahmad et al. (eds), *Environmental Accounting for Sustainable Development*. Washington, DC: World Bank, 10–18.

Elkind, J. 2010. Call for a Broader Energy Agenda, in C. Pascual and J. Elkind (eds), *Energy Security: Economics, Politics, Strategies, and Implications.* Washington, DC: Brookings Institution, 119–148.

Escribano, G. 2017. RES in the Hood and the Shrinking Mediterranean Solar Plan, in I. Solorio and H. Jörgens (eds), *A Guide to EU Renewable Energy Policy. Comparing Europeanization and Domestic Policy Change in EU Member States.* Cheltenham: Edward Elgar, 247–264.

European Commission. 2016. The New Energy Efficiency Measures. *MEMO – Clean Energy for All,* 30 November, 1–6.
European Commission. 2017. Proposal for a Directive of the European Parliament and of the Council on the Promotion of the Use of Energy from Renewable Sources (recast), Brussels, 23.2.2017. COM(2016) 767 final/22016/0382(COD) CORRIGENDUM.
Fischer, S. 2016. An Energy World Order in Flux, in O. Thränert and M. Zapfe (eds), *Strategic Trends 2016. Key Developments in Global Affairs.* Zurich: Center for Security Studies, 83–100.
Franca, L., de Jong, D. and van der Linde, C. 2016. The Future of Gas: The Transition Fuel?, in S. Colombo, M. El Harrak and N. Sartori (eds), *The Future of Natural Gas Markets and Geopolitics.* Netherlands: IAI/OCP, 25–40.
Fuhr, L. 2016. Radical Realism About Climate Change. *Project Syndicate* [Online]. Available: https://www.project-syndicate.org/commentary/paris-climate-agreement-and-geo-engineering-by-lili-fuhr-2016-11. [Accessed on 11 November 2016].
Giddens, A. 2011. *The Politics of Climate Change.* Cambridge: Polity Press.
Goldthau, A. 2013. Introduction: Key Dimensions of Global Energy Policy, in A. Goldthau (ed.), *The Handbook of Global Energy Policy.* Chichester: Wiley-Blackwell, 1–12.
Goldthau, A. and Sovacool, B. 2012. The Uniqueness of the Energy Security, Justice, and Governance Problem. *Energy Policy,* 41, 232–240.
Gunningham, N. 2013. Regulation, Economic Instruments, and Sustainable Energy, in A. Goldthau (ed.), *The Handbook of Global Energy Policy.* Chichester: Wiley-Blackwell, 305–321.
Hansen, J. 2009. *Storms of My Grandchildren.* New York: Bloomsbury.
Hargreaves, T., Nye, M. and Burgess, J. 2013. Keeping Energy Visible? Exploring How Householders Interact With Feedback from Smart Energy Monitors in the Longer Term. *Energy Policy,* 52, 126–134.
Held, D., Fane-Hervey, A. and Theros, M. 2011. Editors' Introduction, in D. Held, A. Fane-Hervey and M. Theros (eds), *The Governance of Climate Change. Science, Economics, Politics & Ethics.* Cambridge: Polity Press, 1–10.
Helm, D. 2014. The European Framework for Energy and Climate Policies. *Energy Policy*, 64, 29–35.
Henderson, J. and Mitrova, T. 2015. The Political and Commercial Dynamics of Russia's Gas Export Strategy. *The Oxford Institute for Energy Studies Paper*, NG 102, 1–89.
Hinrichs-Rahlwes, R. 2017. Foreword, in I. Solorio and H. Jörgens (eds), *A Guide to EU Renewable Energy Policy. Comparing Europeanization and Domestic Policy Change in EU Member States.* Cheltenham: Edward Elgar, xi-xvi.
Hiteva, R. and Maltby, T. 2017. Hitting the Target But Missing the Point, in I. Solorio and H. Jörgens (eds), *A Guide to EU Renewable Energy Policy.*

Comparing Europeanization and Domestic Policy Change in EU Member States. Cheltenham: Edward Elgar, 224–244.

International Energy Agency. 2008. *World Energy Outlook 2008*. Paris: OECD/IEA.

Jackson, T. 2009. *Prosperity without Growth? The Transition to a Sustainable Economy*. London: Sustainable Development Commission.

Jackson, T. 1996. *Material Concerns: Pollution, Profit, and Quality of Life*. London: Routledge.

Jaffe, A. and Soligo, R. 2008. Militarization of Energy: Geopolitical Threats to the Global Energy System. *The Global Energy Market. Comprehensive Strategies to Meet Geopolitical and Economic Risks Working Paper*. Energy Forum, James A. Baker III Institute for Public Policy, Rice University.

James, P. and Patomäki, H. 2008. Globalization and Finance Capitalism: Beyond All-or-Nothing Arguments. *Arena Journal*, 29/30, 101–130.

Jansen, J. and van der Welle, A. 2013. The Role of Regulation in Integrating Renewable Energy: The EU Electricity Sector, in A. Goldthau (ed.), *The Handbook of Global Energy Policy*. Chichester: Wiley-Blackwell, 322–339.

Jewell, J., Cherp, A. and Riahi, K. 2014. Energy Security Under De-carbonization Scenarios: An Assessment Framework and Evaluation Under Different Technology and Policy Choices. *Energy Policy*, 65, 743–760.

Jones, K. and Zoppo, D. 2014. *A Smarter, Greener Grid. Forging Environmental Progress through Smart Energy Policies and Technologies*. Oxford: Praeger.

Jörgens, H., Öller, E. and Solorio, I. 2017. Conclusions: Patterns of Europeanization and Policy Change in the Renewable Energy Policy Domain, in I. Solorio and H. Jörgens (eds), *A Guide to EU Renewable Energy Policy: Comparing Europeanization and Domestic Policy Change in EU Member States*. Cheltenham: Edward Elgar, 289–314.

Kazakov, V. 2016. Russia and the Post-Oil Economy. *Project Syndicate* [Online]. Available: https://www.project-syndicate.org/commentary/oil-prices-russia-political-implications-by-vitaly-kazakov-2016-06 [Accessed on 29 June 2016].

Kryukov, V. and Moe, A. 2013. Oil Industry Structure and Developments in the Resource Base: Increasing Contradictions?, in J. Godzimirski (ed.), *Russian Energy in a Changing World: What is the Outlook for the Hydrocarbons Superpower?*, Surrey: Ashgate. 35–55.

Kuzemko, C., Keating, M. and Goldthau, A. 2015. *The Global Energy Challenge: Environment, Development and Security*. London: Palgrave Macmillan.

LaBelle, M. and Horwitch, M. 2013. The Breakout of Energy Innovation: Accelerating to a New Low Carbon Energy System, in A. Goldthau (ed.), The Handbook of Global Energy Policy. Chichester: Wiley-Blackwell, 113–126.

Larkin, A. et al. 2016. Aviation and Climate Change – The Continuing Challenge. In *Encyclopedia of Aerospace Engineering*. Chichester: Wiley.

Larkin, A., Smith, T. and Wrobel, P. 2017a. Shipping in Changing Climates. *Marine Policy*, 75, 188–190.

Larkin, A. et al. 2017b. What if Negative Emission Technologies Fail at Scale? Implications of the Paris Agreement for Big Emitting Nations. *Climate Policy* (first online), 1–25.

Lawn, P. 2007. *Frontier Issues in Ecological Economics*. Cheltenham: Edward Elgar.

Leal-Arcas, R., Lesniewska, F. and Proedrou, F. 2017. Prosumers: New Actors in EU Energy Security. *Queen Mary University of London, School of Law Legal Studies Research Paper,* No. 257/2017, 1–35.

Lehmann, P. and Gawel, E. 2013. Why Should Support Schemes for Renewable Electricity Complement the EU Emissions Trading Scheme?. *Energy Policy,* 52, 597–607.

Lesage, D., van der Graaf, T. and Westphal, K. 2010. *Global Energy Governance in a Multipolar World*. Surrey: Ashgate.

Lesser, A. and Su, X. 2008. Design of an Economically Efficient Feed-in Tariff Structure for Renewable Energy Development. *Energy Policy,* 36, 981–990.

Lovins, A. 1977. *Soft Energy Paths*: *Toward a Durable Peace*. Cambridge, MA: Ballinger Publishing Company and Friends of the Earth International.

Mazzucato, M. 2016. Traditional Economics Can't Help. We Need to Rethink Growth and Capitalism. *Evonomics* [Online]. Available: http://evonomics.com/modern-economics-rethink-growth-capitalism-mazzucato/ [Accessed on 12 February 2017].

Mazzucato, M. 2015. *The Entrepreneurial State: Debunking Public vs. Private Sector Myths*. New York: Anthem Press.

Miliband, D. 2011. Green Peace: Energy, Europe and the Global Order, in D. Held, A. Fane-Hervey and M. Theros (eds), The Governance of Climate Change. Science, Economics, Politics & Ethics. Cambridge: Polity Press, 185–193.

Morin, F. 2013. *A World Without Wall Street?*. Chicago: University of Chicago Press Economics Books.

Noreng, O. 2013. Global Resource Scramble and New Energy Frontiers, in A. Goldthau (ed.), *The Handbook of Global Energy Policy*. Chichester: Wiley-Blackwell, 159–175.

Norgaard, R. 1990. Economic Indicators of Resource Scarcity: A Critical Essay. *Journal of Environmental Economics and Management*, 19, 19–25.

Odum, H. 2007. *Environment, Power and Society for the Twenty-First Century. The Hierarchy of Energy*. New York: Columbia University Press.

OECD/IEA. 2014. *Capturing the Multiple Benefits of Energy Efficiency. Executive Summary*. Paris: OECD/IEA.

Omri, A. 2013. CO2 Emissions, Energy Consumption and Economic Growth Nexus in MENA Countries: Evidence from Simultaneous Equations Models. *Energy Economics,* 40, 657–664.

Organization for Economic Cooperation and Development/International Energy Agency. 2015. Renewable Energy Medium-Term Market Report. Market Analysis and Forecasts to 2020. *Executive Summary*, 1–8.

Overland, I. 2015. Future Petroleum Geopolitics: Consequences of Climate Policy and Unconventional Oil and Gas, in J. Yan (ed.) *Handbook of Clean Energy Systems,* vol. 6, 3517–3544.

O'Sullivan, M., Overland, I. and Sandalow, D. 2017. The Geopolitics of Renewable Energy. *Working Paper*. New York: Center on Global Energy Policy Columbia University, 1–59.

Parag, Y. and Sovacool, B. 2016. Electricity Market Design for the Prosumer Era. *Nature Energy* 1 (first online), 1–6.

Pascual, C. 2015. *The New Geopolitics of Energy*. Columbia: Center on Global Energy Policy.

Paterson, M. 2011. Selling Carbon: From International Climate Regime to Global Carbon Market, in J. Dryzek, R. Norgaard and D. Schlosberg (eds), *The Oxford Handbook of Climate Change and Society*. Oxford: Oxford University Press, 611–624.

Proedrou, F. 2012. *EU Energy Security in the Gas Sector: Evolving Dynamics, Policy Dilemmas and Prospects*. Surrey: Ashgate.

Proedrou, F. 2015. Rethinking Energy Security: An Inter-Paradigmatic Debate. *ELIAMEP Policy Paper*, 1–18.

Proedrou, F. 2017a. A New Framework for EU Energy Security: Putting Sustainability First. *European Politics and Society*, 18: 2, 182–198.

Proedrou, F. 2017b. Are Smart Grids the Key to EU Energy Security?, in R. Leal-Arcas and J. Wouters (eds.), *Research Handbook on EU Energy Law and Policy*. Cheltenham: Edward Elgar, 450–459.

Ruester, S. et al. 2014. From Distribution Networks to Smart Distribution Systems: Rethinking the Regulation of European Electricity DSOs. *Utilities Policy,* 31, 229–237.

Sager, J. 2015. The Ecological Keynesian: Energy, Money, and Oil Cycles in the Global System [A Dissertation Submitted in Partial Satisfaction of the Requirements for the Degree of Doctor of Philosophy in Energy and Resources in the Graduate Division of the University of California, Berkeley].

Sharples, J. 2013. Russian Approaches to Energy Security and Climate Change: Russian Gas Exports to the EU. *Environmental Politics*, 22: 4, 683–700.

Steinhilber, S., Wells, P. and Thankappan, S. 2013. Socio-technical Inertia: Understanding the Barriers to Electric Vehicles. *Energy Policy,* 60, 531–539.

Solorio, I. and Bocquillon, P. 2017. EU Renewable Energy Policy: A Brief Overview of Its History and Evolution, in I. Solorio and H. Jörgens (eds), *A Guide to EU Renewable Energy Policy: Comparing Europeanization and Domestic Policy Change in EU Member States.* Cheltenham: Edward Elgar, 23–42.

Solorio, I. and Fairbrass, J. 2017. The UK and EU Renewable Energy Policy: The Relentless British Policy-Shaper, in I. Solorio and H. Jörgens (eds), *A Guide to EU Renewable Energy Policy. Comparing Europeanization and Domestic Policy Change in EU Member States.* Cheltenham: Edward Elgar, 104–120.

Solorio, I. and Fernandez, R. 2017. Spain and Renewable Energy Promotion: Europeanization Upside Down, in I. Solorio and H. Jörgens (eds), *A Guide to EU Renewable Energy Policy. Comparing Europeanization and Domestic Policy Change in EU Member States*. Cheltenham: Edward Elgar, 141–161.

Sovacool, B. and Brown, M. 2010. Competing Dimensions of Energy Security: An International Perspective. *Annual Review of Environment and Resources*, 35, 77–108.

Sovacool, B. and Drupady, I. 2016. *Energy Access, Poverty, and Development: The Governance of Small-Scale Renewable Energy in Developing Asia*. London and New York: Routledge.

Sovacool, B. 2016. How Long Will It Take? Conceptualizing the Temporal Dynamics of Energy Transitions. *Energy Research & Social Science*, 13, 202–215.

Stiglitz, J. 2010. *Freefall: America, Free Markets, and the Sinking of the World Economy*. New York: Norton.

Stirling, A. 2016. Outgrowing the Twin Simplifications of Growth and Degrowth: Part 3. *STEPS Centre. Paths to Sustainability* [Online]. Available: http://steps-centre.org/2016/blog/outgrowing-the-twin-simplifications-of-growth-and-degrowth-part-3/ [Accessed on 30 January 2017].

Stirling, A. 2014. Transforming Power: Social Science and the Politics of Energy Choices. *Energy Research & Social Science*, 1, 83–95.

The Green Growth Group. 2013. Going for Green Growth. The Case for Ambitious and Immediate EU Low Carbon Action, *UK Department of Energy & Climate Change and The Rt Hon Edward Davey, Policy Paper*, 1–39.

The Guardian. 2016. G20 Public Finance for Fossil Fuels 'Is Four Times More than Renewables'. Available: https://www.theguardian.com/world/2017/jul/05/g20-public-finance-for-fossil-fuels-is-four-times-more-than-renewables [Accessed on 12 September 2017]

The Guardian. n.d. Renewables Could Lose European Power Grid Priority, Documents Reveal. *The Guardian* [Online]. Available: https://www.theguardian.com/environment/2016/nov/01/renewables-could-lose-european-power-grid-priority-documents-reveal [Accessed on 30 August 2017].

The International Civil Aviation Organization. n.d. What is CORSIA and How Does it Work?. ICAO [Online]. Available: https://www.icao.int/environmental-protection/Pages/A39_CORSIA_FAQ2.aspx [Accessed on 13 September 2017].

Umbach, F. 2010. Global Energy Security and the Implications for the EU. *Energy Policy*, 38: 3, 1229–1240.

Van der Schoor, T. and Scholtens, B. 2015. Power to the People: Local Community Initiatives and the Transition to Sustainable Energy. *Renewable and Sustainable Energy Reviews*, 43, 666–675.

Van der Veen, E. 2015. Why Energy per Carbon Matters. The Relevance of Fossil Fuel Properties for Climate Change and Energy Transition Discussions and Policy-Making. *The Clingedael Institute Energy Programme Paper,* 2, 1–20.
Varaiya, P., Wu, F. and Bialek, J. 2011. Smart Operation of Smart Grid: Risk-Limiting Dispatch. *Proceedings of the IEEE,* 99: 1, 40–57.
Victor, P. and Jackson, T. 2015. The Trouble with Growth, in WorldWatch Institute (ed.), *State of the World 2015: Confronting Hidden Threats to Sustainability.* London: Island Press, 37–50.
Vogelpohl, T. et al. 2017. German Renewable Energy Policy: Independent Pioneering versus Creeping Europeanization?, in I. Solorio and H. Jörgens (eds), *A Guide to EU Renewable Energy Policy. Comparing Europeanization and Domestic Policy Change in EU Member States.* Cheltenham: Edward Elgar, 45–64.
Von Weizsäcker, E.U. 2014. Overcoming the Mikado Situation. *Global Policy*, 5, 21–23.
Wackernagel, M. et al. 2006. Ecological Footprint Accounts for Advancing Sustainability: Measuring Human Demands on Nature, in P. Lawn (ed.), *Sustainable Development Indicators in Ecological Economics.* Cheltenham: Edward Elgar, 246–267.
Walker, G. and Devine-Wright, P. 2008. Community Renewable Energy: What Should it Mean?. *Energy Policy*, 36, 497–500.
Walker, G. 2008. What Are the Barriers and Incentives for Community-Owned Means of Energy Production and Use?. *Energy Policy,* 36: 12, 4401–4405.
Wissner, M. 2011. The Smart Grid – A Saucerful of Secrets?. *Applied Energy,* 88: 7, 2509–2518.
Wüstenhagen, R. and Menichetti, E. 2013. The Influence of Energy Policy on Strategic Choices for Renewable Energy Investment, in A. Goldthau (ed.), *The Handbook of Global Energy Policy.* Chichester: Wiley- Blackwell, 373–387.
Yergin, D., 2011. *The Prize: The Epic Quest for Oil, Money & Power*. Simon and Schuster.
Young, O. 2011. Improving the Performance of the Climate Regime: Insights from Regime Analysis, in J. Dryzek, R. Norgaard and D. Schlosberg (eds), *The Oxford Handbook of Climate Change and Society.* Oxford: Oxford University Press, 625–638.

CHAPTER 4

Energy Security in a Steady-State World

Introduction

The benchmark for assessing an effective energy policy is whether, and to what extent, it delivers energy security. Energy security (for a full discussion see Szulecki 2018) can be defined as the 'situation whereby states face no energy shortages and meet their energy needs at no excessive cost and without further deteriorating the state of the environment' (Proedrou 2012: 3). The IEA (2011: 9) defines it as the 'uninterrupted physical availability [of energy] at a price which is affordable, while respecting environmental concerns'. Energy security then has three principal dimensions: security of supply, affordability, and sustainability.

The concept of energy security has been the dominant prism through which all risks, threats, gains, and advances have been incorporated into stakeholders' strategies (Proedrou 2012: 4). As we briefly saw in Chap. 1, energy security has been monopolized by security of supply and demand considerations (Jewell et al. 2014: 744). This boils down to the smooth flow of energy that will satisfy consumption needs in importing states and revenue-raising needs for exporters. Energy has been systematically securitized precisely because energy trade faces substantial geopolitical risks, as well as has often been in conflict with broader geopolitical aspirations and strategies (Dannreuther 2015).

Furthermore, affordable prices for both exporters and importers—meaning profitable exports and reasonable import prices—remain an omnipresent concern for both parties. Abrupt price swings and persistently

F. Proedrou, *Energy Policy and Security under Climate Change*,
https://doi.org/10.1007/978-3-319-77164-9_4

high oil prices remain fundamental horror scenarios for policy-makers in the importing world (Proedrou 2012: 3–7). Persistently low prices, on the other hand, constitute a nightmarish scenario for exporters, who usually depend on oil profits for regime survival, the pursuit of a dynamic foreign policy, and satisfactory welfare standards for their populations (Aras and Falk 2015; Fattouh and Sen 2016: 6). Both market and geopolitical factors interfere in price formation thus leading to volatility and price disequilibria (Proedrou 2012: 4–17; Kallis and Sager 2017: 566–8).

The burgeoning scholarly literature in energy security, as a result, has focused on questions like

- how geological, geopolitical threats, and risks to security of supply are to be prevented or tackled;
- what steps energy importers have to take in order to increase their security of supplies; and
- how energy markets can continue functioning to the benefit of their stakeholders (Victor et al. 2006; Pascual 2015; Goldthau and Sitter 2014).

Sustainability, the third dimension of energy security, traditionally refers to energy production, transport, refining, and consumption in ways that do not result in significant damages to the environment (Proedrou 2012: 3–4). As fossil-fuel induced ecological degradation and smothering climate destabilization unfold (Zimmerer 2014: 268), nonetheless, sustainability remains only an adjunct of the two main energy security preoccupations—a marginal priority and clearly inferior goal for current policymakers. As a rule, energy security has traditionally been framed within the disciplines of geopolitics (Pascual and Elkind 2010; Pascual 2015) and global political economy (Keating et al. 2012; Kuzemko et al. 2015), rather than within ecological and sustainability studies. Climate change, however, presents a compelling case that immediate attention must be paid to this third dimension. Indicative of this line of thought, the traditional focus of energy security has gradually been supplemented by a shallow sustainability agenda (Goldthau 2013c: 521). Cherp and Jewell (2014), for example, expand the discussion by elaborating on a more normative-based energy security approach and agenda. In their analysis, energy security should be about availability, accessibility, affordability, and acceptability. This fourth dimension alters the referent object of energy security, the values that energy security policy endeavors to serve, and the threats it aims to tackle. In doing so, it breaks from traditional definitions of energy security and shifts the debate to focus on whether fossil energy consumption that perpetuates and exacerbates climate change should be considered acceptable; in other words, if energy security frameworks revolving around fossil fuel supply and demand should continue dominating energy policy-making structures, processes, and mindsets. Bradshaw (2014: 193) also makes the point that energy security should be seen as more than secure and affordable supplies of primarily fossil fuels, with emphasis tilting towards the fight against climate change.

In this conceptual setting, defining energy security as low vulnerability of vital energy systems across geographical and sectoral boundaries that support critical social functions opens up a more diverse and normative energy security agenda. In the same vein, assessing energy security in terms of energy systems' resilience to a wide array of risks (including geopolitical crises that jeopardize the smooth flow of supplies, deterioration of ecosystems, massive accidents, skyrocketing prices, worsening political relations, institutional failures, etc.) underscores the plurality of problems plaguing contemporary energy security without succumbing to replicating the bias towards traditional energy security concerns (Cherp and Jewell 2014; Jewell et al. 2014: 744).

Still, however, current working definitions and energy security frameworks fail to capture the emphasis that must urgently be placed on sustainability as a conceptual pillar. In fact, there has been a dearth of critical attention on ways to yield energy security within biophysical limits and avert runaway climate change. The integration of energy and climate policy hence remains lacking, at least from a radical, steady-state perspective (Kuzemko et al. 2015). Seeing climate change mitigation as a global public good (Goldthau 2013b: 2), on the other hand, necessitates the reshuffling of the study of energy security around the key goal of sustainability; this contrasts sharply with mainstream grown-driven energy security policies that prioritize supply security and affordability (Mulligan 2010: 88).

This chapter aims to assess the value of a radical, steady-state energy policy through the prism of classical energy security understandings. At the same time, it makes a strong case for reversing the prioritization of the three dimensions of energy security, this way essentially redefining the concept itself. This resonates with Jewell et al. (2014: 744) conviction that assessments of 'energy security implications of long-term climate policies should be both reflective of policy concerns and suitable for future energy systems that may be radically different from present ones'. Dannreuther (2015: 480–1) has convincingly shown how the structures and processes of the global political economy generate different foci of energy security policy and argues that

> there is nothing essential or objective in the way in which the hegemonic meaning of energy security has been … so critically linked to oil and to concerns of insecurity in the Middle East. There are many other ways in which energy security can be understood … One major contender for a paradigm shift in the meaning of energy security is equating it with environmental sustainability and climate security. Arguably, this more radical conceptualization of energy security has been on the ascendance in European discourses and institutionalized through the creation of IRENA. However, beyond Europe, in Asia and the United States, the more traditional conception of energy security, linked to oil and gas and with a particular regional focus on the Middle East, remains paramount. In practice, it would only be when there is a decisive shift in the global political economy to prioritize the transition to a post-carbon future that the meaning of energy security will itself be transformed. This again highlights the need to see energy security as inextricably linked to the specificities and shifting dynamics of the global political economy.

Re-prioritizing the dimensions of energy security speaks to the fundamental principle that no energy security policy that perpetuates emissions beyond biophysical limits can be considered sustainable and thus successful in any meaningful sense. Embracing sustainability and energy consumption within biophysical limits as the overarching goal—an ecological and steady-state economics' imperative—at the same time bears profound ramifications for both the security of supply and affordability aspects of energy security. Drawing from both mainstream energy security and ecological, steady-state economics' strands of literature, this chapter aims, firstly, to show that sustainability does not have to be achieved at the cost of supply security and affordability. Secondly, it endeavors to make a convincing case that radical, steady-state energy policies are significantly preferable to mainstream, growth-driven ones. The arguments is not least due to the numerous and severe pitfalls presented by growth-driven policy frameworks, left on the back bench up to now and hence treated more or less as given and acceptable risks (Proedrou 2015; Proedrou 2017a). This is of crucial significance since the implications of a radical energy policy condition and affect the political resolve to address the climate change challenge (Jewell et al. 2014: 743, 755–6). Getting these implications right and exposing their full scope, hence, increases the feasibility of energy systems transformation at the required scale.

In what follows, this chapter assesses how a steady-state energy policy can live up to all three main energy security goals. On a normative footing, the discussion begins with sustainability and the merits of very low carbon energy systems powered primarily by renewable energy and energy efficiency. The third section unveils the true costs of fossil energy juxtaposed with the affordability of renewable energy. At a more profound level, this section also revisits the role of energy pricing, subsequently reframing the dimension of energy affordability within the steady-state economic and energy framework presented in the previous two chapters.

Delivering Sustainability

It is almost tautological to say that a radical, steady-state energy policy will yield sustainability—one can hardly talk of a steady-state energy policy in the first place if this is not the case. Seeing energy security as a fundamentally ecological issue (Mulligan 2011: 633), steady-state energy policies target first and foremost sustainability. Sustainability is a normative concept that refers to a state of affairs whereby the needs of today are not fulfilled at the cost of the needs of tomorrow. A sense of responsibility, equity, and intergenerational justice thus underpins sustainability (Agarwal and Narain 1991; Wackernagel and Rees 1998; Cherp and Jewell 2014). While sustainability is a rather broad concept encompassing a multitude of factors, issues, and threats (Matson et al. 2016), our focus here is on its most imperiled and critical aspect; the threat of climate change. Two issues are of key importance for the mitigation of climate change: (1) the reversal of anti-climate upstream policies; and (2) the substantial scaling-up of clean energy sources and systems. While a steady-state energy policy centers upon these priorities, current mainstream energy policy both remains overall supportive of the extractive industries—including unconventional energy exploration—and approaches climate change in a circumscribed way. The next two sections critically discuss these shortcomings.

Reversing Extreme and Unconventional Energy Exploration

Unconventional and extreme fossil exploration is profoundly averse in ecological terms. Starting with Arctic exploration, the Arctic ecosystem is particularly vulnerable to climate change, and any further interference with it may lead to additional destabilizing feedback loops. Moreover, tackling potential oil spills under the ice lies beyond humanity's contemporary level of know-how and technical expertise, thus raising further concerns (Bradshaw 2014: 36–7). The specter of exploration of oil and gas in the Arctic hence remains daunting.

The exploration of unconventional energy is also hugely problematic. This umbrella term includes tight oil and gas, trapped in sandstone; coal-bed methane where gas is associated with coal; shale oil and gas trapped in shale deposits; and, oil or tar sands. Shale oil and gas, in particular, is much more water-intensive; exploration practices contaminate the limited flow-back water that returns to the surface, which in its turn has to be managed in a viable way (Brown and Sovacool 2011: 64). Most importantly, shale oil and gas exploration produces significantly more emissions, since it provokes substantially higher methane leakage than conventional oil and gas, and perhaps even coal. At the same time, shale exploration calls for drilling a plethora of wells as each declines rapidly, while the shale gas industry remains notoriously non-transparent regarding the chemicals it uses in the hydraulic fracturing process. Significantly, Alberta's boreal forest, where large shale gas deposits sit, constitutes a globally significant carbon sink that is at risk of progressive deforestation (Bradshaw 2014: 61–7).

Oil or tar sands are for the time being primarily developed by means of an open pit process in which the top soil is removed, akin to coal mining techniques. In-situ techniques, in which drilling is followed by stem injection that causes the bitumen to melt and rise to the surface, are anticipated to become prevalent in the near future. While this method is less intrusive to the environment, it requires gas-fired facilities to produce the steam. What both techniques have in common is that they produce more emissions than conventional oil drilling, are water- and energy-intensive, contaminate water, and lead to significant air pollution (Bradshaw 2014: 68–9).

To wrap up, Arctic and unconventional exploration provide exemplary illustrations of the costs to Earth's environmental sinks as resources limitations are stretched with new technologies (Noreng 2013: 165). In a world of full sinks, business as usual and conventional energy policies become clearly counter-productive—impoverishing rather than enriching (Douthwaite 1992; Daly 1996; Wackernagel and Rees 1998; Victor and Jackson 2015: 38; Daly and Farley 2004; Lawn 2007). Challenges to sustainability cannot be treated as affordable collateral damage.

Scaling-up the Energy Transition

Secondly, it is hard to exaggerate the importance of strict caps on (emissions or) energy use for the full-fledged transition to clean energy sources and systems. Contemporary energy policy, nonetheless, remains reluctant to enforce strict caps, and subsequently moves very sluggishly to address the substitution problem. While a wide array of measures have been put in place, they generally lack teeth and are projected to achieve significantly lower levels of emissions reductions compared to what is required for climate change mitigation goals (Falkner 2016: 1108, 1115). This can be attributed to the imperative of growth that hampers radical moves to makeshift energy structures (Davidescu 2017: 205; Baker 2006). In what follows, we briefly review the shortcomings of the main actors' energy policies that naturally perpetuate unsustainable practices.

A few countries around the world serve as pioneers in sustainability and ambitious climate policy. Denmark and Japan are two of them, with a consistent record of energy measures to green their energy mix and increase their energy efficiency (Sovacool and Brown 2010: 103). They have neither designed a strict carbon budget, however, nor legislated caps in energy consumption (either directly or through bold enough emissions caps). This, together with the rebound effect (the more energy efficiency increases, the more energy is consumed) means that, at the end of the day, resulting benefits have been far from remarkable (Sovacool and Brown 2010: 94–100, 103). Sustainability concerns have only led to modest results in the absence of a radical, steady-state energy policy in place.

The EU, an early advocate of relatively bold climate policy, has legislated its 20–20–20 strategy (referring to percentage of greenhouse gas emissions reduction, share of renewables in its energy mix and energy efficiency by 2020) in the belief that a pro-active climate agenda is indispensable in a climate-changing world that will sooner or later face peak oil (see below) (Helm 2014). This has been followed and expanded by the EU's new 40–27–27 strategy for 2030 (Solorio and Bocquillon 2017). The targets set, however, are modest compared to what is required to meet climate mitigation needs. The efficiency and renewable energy targets, in particular, have been watered down in the decision-making process, with the former being downgraded to a non-binding target (Khrushcheva and Maltby 2016: 810). These amputated goals do not convey strong enough incentives for massive investments into a more sustainable direction (Helm 2014; Zgajewski 2014). In particular, the EU climate agenda and push for renewables seems to have lost steam following the financial crisis, with diminished strategic resolve and less support among EU Member States for renewable energy support schemes (Hinrichs-Rahlwes 2017; Solorio and Bocquillon 2017; Escribano 2017: 248).

The EU has also been a pioneer in establishing an Emissions Trading System (ETS). With caps set too high, though, carbon prices have remained depressed (aggravated further by the long-drawn recession) with limited impact on emissions reductions. It is carbon quantities, however, that need to be capped instead of prices as has been the case in practice. A further fundamental drawback of this mechanism has been the exclusion of some sectors, most prominently transport (Creutzig et al. 2014: 7). As a result, this scheme has failed to significantly contribute to falling emissions and sustainability.

The envisaged Energy Union remains for the time being an empty box in which each stakeholder aims to contribute what they wish. As a result, the EU remains mired in conflict as to the nature and priorities of the Energy Union. Sustainability is one of them, but so are an emphasis on domestic sources (read coal), affordability, diversification to hedge against Russia (which also props up coal use), liberalization, and further integration of the single market (Szulecki et al. 2016: 1). Dissenting voices have for now blocked the decisive switch to profoundly sustainable directions. Vested interests—in particular the coal and gas lobby—retain significant market power in support of fossil energy (Solorio and Bocquillon 2017: 38; Jankowska and Ancygier 2017: 198). Decarbonization has also been framed in the European arena not so much in terms of economic convergence but, on the contrary, as involving economic and consumer losses. In this context, the central and eastern European states have attracted concessions that enable the pursuit of less ambitious climate targets (Khrushcheva and Maltby 2016: 810; Solorio and Bocquillon 2017: 35).[1] Where there seems to be consensus is in the primary role of natural gas for the next decades as part of a 'gas first policy' that emphasizes investments to secure ample gas quantities and hence prioritizes a high share of gas in the EU energy mix. This policy, though, either raises the spectrum of an array of stranded gas assets or precipitates locks-in gas consumption that will undermine sustainability in the near future (Proedrou 2017a; Stern 2017).

Despite the ambiguous U.S. rhetoric regarding climate change, a few top-down initiatives and a multitude of bottom-up policies at state level have generated cleaner strategies and outcomes (Sovacool and Sidortsov 2013). At the same time, though, the shale revolution underway represents nothing less than the exploitation of extreme energy. Hydraulic fracturing has enabled significant increases in unconventional resource production, which is, as we saw above, far more hazardous both in terms of emissions and interference with the physical environment. Although unconventional sources have for the time being allegedly displaced emissions from coal (Haas 2017), the entrenchment of the unconventional oil and gas industry can only lead to increase of emissions in the near future.

The recent decision by the United States to withdraw from the Paris agreement both reflects the U.S. commitment to a growth policy unencumbered by sustainability concerns and international commitments and further obscures U.S. decarbonization policy—let alone its scale, scope and speed (Haas 2017).

China, on the other hand, is embarked on an ambitious domestic energy agenda with the twin goals of replacing mostly endogenous coal resources with domestic and imported gas and an exponential increase of share of renewable energy in the energy mix (Chen and Lees 2016). As long as the Chinese policy does not contemplate shale gas exploration as a new source of domestic gas supply, this agenda amounts to rapid greening of growth and is essential for the country's developmental policy. Three caveats, however, remain. Firstly, the prospective import of shale gas implicates China in the perpetuation of one of the most problematic and counter-productive anti-climate policies (this applying to the EU as well). Secondly, the potential of this agenda to place the Chinese economy in a sustainable trajectory is circumscribed. Thirdly, and related to the point above, while further growth can yield substantial developmental fruits in the Chinese case, this also hinges upon the energy policies of the other prominent players and the space for growth they will create for the countries of the Global South. Chinese growth together with further growth in the Global North—the business as usual scenario in other words—will only perpetuate, aggravate, and accelerate climate change undermining sustainability prospects.

In all, the main climate stakeholders and energy consumers around the world share the premise of growth as part of their energy strategies. As a result, all of them address sustainability in parallel with security of supply and affordability concerns and only insofar as this does not undermine these overarching goals. Setting caps and stemming the increase of fossil energy usage would bear repercussions on growth, an end-result no government is willing to grapple with (Kuzemko et al. 2015; Mulligan 2010: 87). As long as energy policy remains premised on growth, however, real reforms towards sustainability will remain partial at best.

The same also holds true for exporters and their energy strategies. Contrary to Russia which remains obstinately fixed on a fossil-dominated economy (Khrushcheva and Maltby 2016), Saudi Arabia has made its first steps out of the fossil fixation. In light of the profound dip of oil prices during the last two years, the country has decided to place some of the shares of its energy behemoth, Saudi Aramco, up for sale in the open market and invest the revenues in the generation of renewable energy (Micklethwait 2016). This move, while in the right trajectory, emphasizes the piecemeal character of the transition underway, and remains incongruent with the pressing timeframes imposed by climate change. While it is guided by the understanding that the oil era will sooner or later end, it does not turn against growth itself, but aims for a partial and slow greening process over time. A mediocre reduction of emissions in the mid-term will do little to combat climate change.

To wrap up, the most imperiled aspect of sustainability, runaway climate change, is insufficiently dealt with by mainstream energy security policies around the world. Unless energy security paradigms are revisited and energy policies accordingly radically reformed following the steady-state blueprint, there is certainty that the next generation will inherit an unsustainable, resource depleted, and over-warmed planet.

Enhancing Supply Security

While it is hard to argue that a steady-state energy policy will fail on the sustainability front, it is much easier to argue that drastically reducing coal, gas, and oil consumption—as steady-state energy policy mandates—presents an immense threat to security of supply and, ultimately, to communities' welfare and prosperity. These allegations play into the very normal anxiety and fears ahead of any kind of profound change. This having been said, though, deep decarbonization following the steady-state blueprint presents a handful of important merits. In particular, smart local renewable energy systems present higher potential with regard to both access to energy and its physical availability vis-à-vis traditional fossil and import-based energy systems.

Access to Energy

To begin with, renewable energy possesses a clear local character. Renewable energy projects are undertaken in most cases by national/local actors supported by schemes designed to feed the national/local market. Micro-generation and distributed energy, in particular, showcases the potential for local ownership at its fullest. In this sense, smart local renewable energy systems also emerge as more just, equitable, and emancipatory in nature compared to traditional, top-down fossil energyy systems.

The transition to widespread localized power generation, leading to both extensive self-consumption and distributed energy, combined with the progressive roll-out of smart grids, can cover substantial energy needs in effective ways. In these revolutionary modes of energy production and consumption, consumers themselves become pillars of their energy security, and actively facilitate it. This is of critical significance not only for the Global South that is persistently faced with energy poverty, but also for an increasing part of the population of the Global North which is plagued by energy poverty (Brown and Sovacool 2011: 188–9; Bradley et al. 2013: 313).

Two points merit closer examination linked to affordability of energy considerations for improved energy access, reduced energy poverty, and better security of supply (Proedrou 2017c). Firstly, proposals for the widespread deployment renewable energy have faced stringent opposition with arguments, as we saw in Chap. 3, that they are in general inferior substitutes for the higher energy content of fossil fuels (Daly 1996; Odum 2007). Fossil fuels, however, are stocks and provide concrete amounts of energy for concrete quantities purchased at given prices. Renewable energy power generation, to the contrary, is best understood in terms of energy flows. The charge concerns the installation (and periodical service) of renewable energy generation equipment (e.g. solar panels and wind turbines), and is not contingent upon how much energy one derives from it. In this sense, renewables enjoy a significant comparative advantage vis-à-vis fossil fuels (Scholten and Bosman 2016: 279–80).

Add to this the predictability of the renewables energy harvest (despite their intermittent character), compared to the variable oil harvest cycles that result in ebbs and flows in oil prices (Sager 2015: 85), and renewables seem to be better placed to provide secure, stable access to energy. Upward fluctuations of the oil price, in particular, have traditionally impacted on all the other commodity markets, this way absorbing a critical part of the purchasing power of the least well-off and in many cases even leading to a drop in core functions like health, education, and development (Goldthau 2013b: 5). The structurally cyclical nature of international energy prices (see below) and their ensuing boom-and-bust cycles also contrast sharply with the startlingly diminishing costs for renewable energy generation and the projections for their further decrease (OECD/IEA 2015: 5). Moreover, while high fossil energy prices are at times indispensable in order to finance a new wave of investments and the exploration of more demanding fields—in other words non-affordability as a pre-requisite for increased supply security at a later stage—this is not the case with renewable energy and its low price volatility (Proedrou 2017a). Access to renewable energy seems both easier and preferable to access to fossil energy.

The steady-state, local-based energy security architecture also compares favorably with the geopolitical risks plaguing conventional energy security policies around the world. These risks emanate from conflictive relations in the global system and perceptions of dependence on and vulnerability to unreliable trade partners (Umbach 2010; Yergin 2006: 75; Cable 2010: 75–82). In this sense, oil imports from the Middle East have been securitized exactly due to the unstable character of the regimes of the region, especially after the geopolitically engendered embargo and the ensuing oil crisis of 1973 (followed by the second, also politically-induced, oil crisis in 1979) (Dannreuther 2015). Disruptions at the local level, on the other hand, bear minimal effects on supply security compared to events at the global level that either endanger physical supplies or lead to price increases. Decentralized energy generation hence seems more secure than imports of globally traded fossil fuels.

Consolidation of energy resources in the hands of states (currently at 90 percent) brought resource nationalism back in the surface in the 2000s, along with concomitant concerns of endangered security of supply. Energy and geopolitical interests appeared again to be in close lock, ceding credence to an understanding of energy as ‘the exploitation of a nation’s advantages in energy output and technology to promote its global interests and undermine those of its rivals’ (Klare 2015). Resource nationalism, as a result, both reinforced an entrenched the dividing line between importers and exporters, stimulating a new scramble for resources guided by the perception of looming scarcity. According to Jaffe and Soligo (2008: 45),

> in this new setting, where oil and gas suppliers might be more inclined to use energy as a lever to political ends, energy security could be redefined as reducing the vulnerability of the economy to the reduction or cut off from supplies from any given supplier or group of suppliers or to sudden large increases in prices of specific energy commodities such as oil and natural gas.

Given the presence of this mindset, high import dependent EU Member States in central and eastern Europe consistently securitize Russian gas supply. Russia role as a single-supplier is considered to afford the Kremlin extensive political leeway. Such an approach is also mirrored in the EU’s hardened energy strategy and envisaged Energy Union, especially under the shadow of the eruption of the crisis in Ukraine in 2014 (Skalamera and

Goldthau 2016).[2] This is why some scholars 'penalize' energy imports, and in particular imports from unstable countries, in their energy security assessments, to denote a sub-optimal state of supply security and access to energy (Jewell et al. 2014: 755).

These aspects of energy policy have been amply documented and highlight the geopolitical volatility that underpins energy markets. Current developments are also creating anxieties for the future operation of the global energy market. In particular, the United States has traditionally pursued a policy of open access for global resources. In so doing, it has established a wide monitoring, surveillance, and strategic network that facilitates smooth energy trade. In case its indigenous shale oil and gas renders it in broad terms autarchic, the United States might withdraw from its role as a global energy policeman, thus creating a vacuum that allows new actors to emerge.[3] Such a move would potentially create new risks with regard to energy transport and access to energy (Kuzemko et al. 2015: 181–3). Such risks, very real in today's global oil market, are projected to be minimal in very low carbon energy scenarios (Jewell et al. 2014: 745).

While all these risks render security of supply problematic for the Global North, the Global South is persistently faced with energy poverty. Less and least developed countries, as well as many rural regions in developing India and China, for example, face shortages and burn primitive fuels instead (Khandker et al. 2010; Collier 2007). Increased competition for resources, in other words, equates to the lack of energy access for the poorest and neediest of the world (Sovacool and Drupady 2016: 1–16).

Problematic access emanating from competition and geopolitics is to a certain extent amenable via proactive policy-making. In fact, contemporary energy policy for securing energy supplies revolves around three main principles: interdependence/forging close relations with exporters; diversification of fuel sources, suppliers, and routes of supply; and liberalization to boost resilience of the market (Proedrou 2012). This having been said, though, dependence both on a few fuels and on a handful of suppliers remains the currency of the day for most importers around the world. Liberalization/market measures can only improve supply security as long as a minimum of incoming external supplies is guaranteed. (Szulecki 2018: 2). Indeed, renewables have initially featured as appendages to diversification policies to lessen dependence on preponderant fossil fuels and suppliers (Proedrou 2017c). The risks regarding fossil energy supply, nonetheless, remain extensive, and the resilience of afflicted political actors to tackle them circumscribed (Jewell et al. 2014: 745). Projections for very low carbon scenarios, on the other hand, show greater diversity of sources, thus alleviating concerns for dependence on single fuel(s) or single suppliers (Jewell et al. 2014: 754).

In all, security of supply under the current paradigm is frequently compromised by energy crises. While oil crises are global in nature and usually manifest themselves in abrupt price hikes, gas crises are more often than not regional in character and hence translate in supply cuts in addition to increased prices (Goldthau 2012: 70–1). Renewable energy systems, due to their mostly local/national character, to the contrary, do not feature such risks of deficient access to energy, nor are they contingent upon broader geopolitical relations and balance of power considerations. While international markets for renewable energies may emerge in the future, these will hardly feature the entrenched supply risks of the globalized fossil energy markets (see Chap. 5). In this changing landscape, access to energy becomes by and large desecuritized, and metamorphoses into a problem of a different kind and of inferior status. States' success in catering for their energy needs will hinge more on the management of energy infrastructure, rather than on energy trade and surrounding political and diplomatic relations with exporters (Bosman and Scholten 2013; Scholten and Bosman 2016). Access to energy moves from the high- to the low-politics sphere.

Resource Availability

Availability of resources is a key issue in energy security. Non-rival, infinite renewable energy sources are widely available (e.g. wind, solar, tidal, and geothermal energy). It incumbent on communities to marshal the necessary political, economic, and technical resources to bring projects to fruition. Fossil fuels, to the contrary, are by definition non-renewable, exhaustible resources and thus bring concerns of availability in the mid-term.

Indeed, peak-oil theorists have systematically warned that at some point, availability will start shrinking, prices will skyrocket, intense competition will ensue, and eventually societies will not be able to ensure needed quantities. The boom in global energy demand in the 2000s, precipitated by the emerging economies' increasing energy consumption, rendered the peak-oil hypothesis even more plausible (Heinberg 2011; Hubbert 1969), while some peak-oil theorists made the case that peak-oil had indeed been reached at the dawn of the second decade of this century (Heinberg 2011).[4] Super-cycles theorists, to the contrary, point to the effect higher prices have for stimulating further exploration and to the capacity of human innovation and technology to drill more and more efficiently, this way pushing limits of resource scarcity well into the future. Indeed, advanced technologies have consistently improved drilling techniques and output, allowing many geologically challenging fields to be added to global reserve estimates (Cable 2010; Odell 2004; Tonnensson and Kolas 2006: 57; Kazakov 2016; Pike 2010).

While both theories have significant merits, a more precise statement is that we cannot know how much oil and gas lies underground. First of all, the definition of oil itself is far from clear since it covers conventional types of oil, substitutes, and a different types of unconventional oil (e.g. heavy oil, deep-water, tight and shale oil) (Noreng 2013: 163; Bressand 2013: 21). In this more nuanced setting, 'a long and sustained "oil plateau" extending broadly from 2005 to the next three decades with successive peaks in different types of oil, conventional in 2005, deepwater in the early 2020s and tight around or after 2030s seems to be in place' (Bressand 2013: 22). Any such projections, though, have to be treated with caution. This is because all the assumptions peak-oil analysis is based upon are shaky. For one, knowledge of the world's oil reserves is far from complete. Not only can we not know whether it is feasible to make new discoveries, but for many oil-endowed states the size of their reserves remains a closely held top secret. For these reasons, we can only talk of estimates, which are also constantly changing. The level of technology sophistication, associated costs and oil prices, as well as regulation and consumer utility, are all variable and dynamic, thus potentially accelerating or decelerating exploration and production. Last but not least, other macro-economic factors such as interest rates, exchange rates, and inflationary expectations bear an impact on oil exploration, and hence on overall estimated reserves over time (Noreng 2013: 162–4; Brown and Sovacool 2011: 33; Bradshaw 2014: 26–30).

The reality that the goalposts of the peak-oil theory debate are ever shifting is best epitomized by the shale revolution, which has added massive new resources to reserve estimates. Hydraulic fracturing and horizontal drilling have enabled the extraction of oil and gas previously deemed technologically too challenging and economically unviable (O'Sullivan 2013: 30), while the Arctic region is heralded as pool of reserves with similar potential. With sustainability concerns marginalized, one might hypothesize that extreme energy resolves availability concerns and ensures security of supply for all. Market fundamentals, nevertheless, point to the contrary. The year 2015 has been marked by the bankruptcy of numerous companies exploring shale oil and gas for a number of reasons. The free fall in international oil prices due to a combination of depressed global demand and increased global supply, in conjunction with Saudi Arabia's strategic resolution to retain its own production intact, rendered many shall resource projects unprofitable (Fattouh et al. 2016). This points to the contingency of availability of resources on market parameters, an issue to which we return in the next section.

In all, rates of discovery have declined since discoveries themselves peaked half a century ago and energy returns on investment continue to recede over time. Despite the near term impact on supply of shale resource development, shale deposits feature even higher decline rates (Kallis and Sager 2017: 566), hence seemingly constituting 'nothing more than a medium-term blip in the pattern of resource decline' (Kuzemko et al. 2015: 157). The ultimate challenge can be recast as one of maintaining declining rates of production, and the risk as one of facing recessionary cycles all too often, rather than utter collapse (Mulligan 2010).[5] The above landscape must to be juxtaposed against the potential of renewable forms of energy that are (nearly) exempt from availability concerns.

To conclude, against the background of strongly founded concerns regarding the physical availability of fossil energy and the scores of geopolitical risks jeopardizing access, smart renewable energy systems emerge as viable alternatives that can deliver on the supply security front. Their broad physical availability, local character, and advantages in terms of energy flows and access to energy, reinforce such a conclusion.

Delivering Affordable Energy for Sustainable Communities

A widely cited argument has been that renewable energy is more expensive than fossil energy; any switch to solar, wind, tidal, or geothermal power, the argument continues, will translate into higher prices for consumers, essentially compromising affordability (Cowell et al. 2017). The counter-argument made here in response to this critique is threefold:

- Fossil energy features high hidden costs—once properly accounted for, renewable energy become relatively much more affordable;
- The global fossil energy market is inherently unstable, thus presenting consumers with significant affordability risks; and

- Energy pricing has to be revisited from serving growth to serving sustainable communities. High taxes on energy and proportional compensatory measures are pivotal in accelerating sustainable energy schemes in a world under climate strains.

Unmasking Fossil Energy Costs and Putting Renewables' Costs in Perspective

A good starting point for unveiling the hidden costs of fossil energy is the discussion on the enormous subsidies the fossil industry receives, a topic we touched upon in the previous chapter. Crucially, subsidies transmit entirely false signals to the market that fossil energy sources are amply available (Daly 1996; Daly and Farley 2004; Stiglitz 2010). Indeed, the paradox of the 2000s has been that energy demand increased despite augmenting resource scarcity and heightened concerns about climate change. While free market proponents are right to suggest that the lifting of these distortive subsidies would lead to a sounder supply-demand balance, energy is also a public good and critical for people's survival and welfare (Dannreuther 2015). Absent corresponding corrective measures (see below), allowing prices to skyrocket would create extensive (energy) poverty and provoke serious economic, political, and social turmoil (Mares 2010: 9; Checchi et al. 2009: 22–4; Wright 2006). States hence opt for huge subsidies to insulate their populations (and corporations) from the negative impacts of energy scarcity and ensuing high prices (Bradshaw 2012: 213; Jackson 1996: 113). On top of that, they support and subsidize the exploration of unconventional energy, this way enlarging the 'carbon bubble' and further meddling with supply-demand dynamics. As a result, they help in the conveyance of false signals of fossil fuels' availability and the delay in the switch to alternative energy sources (Compston and Bailey 2013).

Mainstream economics, moreover, only marginally incorporates externalities, the costs, that is, born out of ecological degradation and climate change. Fossil fuel extraction, notably, brings with it a high ecological cost not paid for by the energy industry. A more comprehensive approach compels us to add the associated costs of exploration and greenhouse gases emissions to energy prices. In this case, the price of fossil energy, let alone shale oil and gas, would have been many times greater, thus discouraging its extensive consumption. Building further on this line of argumentation, some scholars also suggest that we should add to this equation the massive costs of both building and maintaining an extensive war industry, as well as retaining military training and boots on the ground to secure the oil industry in oil-producing regions, particularly in the Middle East. The same applies to the policing of global energy trade, most prominently in narrow checkpoints and against risks and dangers such as piracy (O'Hanlon 2010; Latouche 2009: 74; Kuzemko et al. 2015: 182). These costs are estimated to correspond to a startling 40 percent of the U.S. military budget (Brown and Sovacool 2011: 32). Eventually, some of these costs will have to be incorporated in energy prices in order to help strained national budgets, to enhance ecosystems protection, and/or to sustain military overstretch (Wackernagel et al. 2006).

Moreover, the fact that oil is priced in dollars creates contingencies upon the dollar's value, which has nothing to do with oil's state of scarcity or abundance in the biosphere. When the dollar is depressed, lower prices convey the wrong signal of ample availability of fossil fuels in the biosphere (Daly 1996). This brings us to the broader point that prices denote availability of a product or service in the market, not the biosphere; as such, market mechanisms are far from the optimal indicator for resource scarcity (Rees and Wackernagel 1999; Daly and Farley 2004: 186–92).

To sum up, the full internalization of the ecological and military costs in energy prices is indispensable in order to appreciate the true, unaffordable costs of fossil energy. These costs also constitute a sound benchmark against which the costs implicated in the establishment and operation of smart, clean energy systems can be analyzed and compared. To begin with, the deployment of renewable generation infrastructure and equipment calls for a substantial monetary investment. This regards both onshore and offshore renewable energy parks, as well as community energy and micro-generation schemes. The former benefit from economies of scale and hence can attract very low interest rates; at the same time, though, they also necessitate significant injections of public funds in the form of FITs to guarantee profitability in all cases. With regard to micro-generation and distributed energy, 'soft loans' and FITs are also essential to marshal the resources necessary towards fossil fuel substitution. Community banking, in congruence with steady-state proposals for bringing forth sustainable economic structures, could provide invaluable support to this goal. The supply chain of renewable energy is also a significant cost factor to consider, not least since the raw materials need to be sourced in some cases from abroad. This, crucially, may also lead to higher prices and contingencies impacting the functionality of international commodities markets (Hensel 2012).

Another category of costs regards the deployment of smart grids. These include upfront costs for the necessary equipment, transmission lines and stations, and for increased load management requirements in light of the intermittent nature of renewable energy. A further layer of costs concerns protection against cyber-attacks (Liu et al. 2012). Three caveats are, nonetheless, important. Firstly, the deployment of smart grids constitutes the next step in the evolution of power markets irrespective of the advent of renewable energy generation, and in many cases transmit electricity produced by coal and gas (Proedrou 2017c: 450–1). It is hence debatable whether this layer of costs should be factored-in the equation and cost comparison between fossil and renewable sources. Secondly, the final costs regarding load management are contingent upon the success of demand response management and customer engagement (Bradley et al. 2013). Demand response management, thirdly, will allow the avoidance of very costly capacity mechanisms, thus dispensing with a significant source of costs burdening traditional power systems (Buchan and Keay, 2016: 3).

These costs can be balanced through lower electricity bills in the mid- to long-term, which will emanate from self-consumption and/or from sales of the surplus electricity generated in prosumers markets (Proedrou 2017c; Scholten and Bosman 2016). Goldthau (2017: 204) suggests that 'aggressive upfront spending on low-emissions technologies and energy efficiency reduces fuel bills later, and is cheaper compared to inaction - even without considering the damages that would be avoided by lessening climate change'. Empirical evidence stemming from the EU's hesitant low-carbon transition provides credibility to such assertions. The European Commission (2016a: 4) estimates overall annual savings of the magnitude of €20 billion by means of reduced fossil imports. In addition, it has assessed that €55 billion of extra revenue, originating in lower fossil imports and energy efficiency initiatives such as Eco-design and Energy Labelling, accrue for industrial and other market players in the wholesale and retail sectors (European Commission 2016b: 4).

Three qualitative arguments, moreover, distinguish between applicable costs to the fossil and non-fossil industries, supporting a strong case in favor of the latter. While in the fossil fuel industry costs are invested abroad and benefit in the main foreign regimes, renewable energy projects constitute mainly inward investments that benefit national and local infrastructure, human and social capital, and employment and aggregate demand (especially when investments expand across the supply chain, see Bere et al. 2017) (Solorio and Bocquillon 2017: 35; Proedrou 2017c).

Secondly, investments in clean energy bring broader social benefits. To use one example, by means of shifting away from coal via massive investments in a host of renewable sources, Ontario achieved—besides substantial energy savings—a dramatic fall in the number of associated illnesses and deaths. These also translated into lower health, environmental, financial, and infrastructure maintenance costs, resulting in annual multibillion savings (Sovacool 2016: 210).

Thirdly, we can evaluate the affordability of a radical energy transition vis-à-vis a perpetuation of business as usual practices under two different decision-making frameworks. Cost-benefit analysis follows a strictly utilitarian approach that quantifies the total monetary costs and benefits of respective schemes, compares them by virtue of their net benefits after discounting for time and risk, and guides decision-making accordingly. Scores of renewable energy projects systematically lose out to heavily subsidized fossil ones on these grounds. The result that ensues is their relatively piecemeal roll-out and slow pace of deployment (Brown and Sovacool 2011: 186–7). Cost-effectiveness analysis, on the other hand, with wide application to even public policy issues such as public education, is preferential in those cases where benefits and costs are hard to put into monetary terms—diverse and multivalent where far-reaching benefits across sectors and time-scales are generated. Climate change mitigation implicates such aspects and hence falls more neatly into this latter decision-making approach by valuing damage avoidance, intergenerational discounting, and their multiplier effects. In this framework, the costs implicated in a radical makeshift of the energy system appear fully justified, as they generate cascading positive outcomes across time-scales and sectors (Brown and Sovacool 2011: 186–8).

Pulling Away from a Troubling Global Market

By mandating a swift substitution of renewable energy for fossil fuels, a steady-state energy policy would also pull states away from an inherently volatile, non-transparent and inefficient global market. It is to this more general point that discussion turns to, before taking up the issue of revisiting the role of energy pricing in climate-strained economies.

The global energy market features a macroscopic trend towards the end of cheap oil and a progressive rise in global fossil fuel prices. Most of the oil and gas currently produced around the world features marginal costs many times higher than what used to be the case decades ago. Current prices of around 50 dollars per barrel appear to be low in comparison to their peak that touched 150 dollars a barrel in 2008, but remain many times higher compared to past levels (the norm throughout most of the twentieth century has been a price below 10 dollars per barrel). This begs the question of the impact of persistently higher and volatile prices since

> energy must be costly enough to be profitable for producers, yet cheap enough to be affordable to consumers. The higher that prices must rise to sustain production, the more likely is a situation of reduced demand, economic malaise, and rising debt. (Victor and Jackson 2015: 14)

To add insult to injury, prices have become more volatile since the 1990s, negatively impacting the energy security of both importers and exporters. This does not refer only to the range of price movements, but also to the frequency of price fluctuations.

The volatility of the global energy market creates significant challenges for exporting countries. The Dutch curse summarizes the pathogenies of resource economics (Shaffer 2011; Coutinho 2012) and reveals the exporters' dependence on international prices and ensuing lock-in effects. While Russia, for example, hugely benefited from booming oil prices in the 2000s, its economy is under severe strains under current low energy prices (Pascual 2015). Saudi Arabia's pivotal energy role also comes under increasing scrutiny in light of increased supply (and suppliers) and relatively low oil prices, while all the poor exporting states feel the brunt of decreased oil-induced revenues (Fattouh and Sen 2016: 6).

The welfare of the Global North, to the contrary, has been historically built upon cheap (coal and) oil with a strong correlation that appears to exist between high energy prices and economic recession (Deese 1979; Sager 2015). Low-income and least developed countries, on their side, suffer the most from oil price surges as they are disproportionately affected (Sovacool and Drupady 2016: 46–7). Higher oil prices amplify the need for increased foreign exchange in dollars, this way further burdening their problematic trade balance. In juxtaposition to the Global North that spends 1–2 percent of its GDP on oil purchases, moreover, this percentage varies from 4.5 to 9 percent of GDP in developing countries. The Global South experiences a second critical blow, since increased oil prices inflate transportation costs as well as the price of commodities (Brown and Sovacool 2011: 32–3; Daly 1996). High oil prices, furthermore, render the purchase of adequate energy quantities by destitute countries and regions near impossible. In all, the contemporary global energy market excludes portions of the global population; frequently burdens importers with extravagant expenses; and provides contradictory and perplexing signals to both exporters and importers, thus handicapping their performance (Proedrou 2015). Especially for the less and least developed countries, the only realistically affordable option seems to lie in renewable energy generation at a local level, rather than in their participation in such a volatile global fossil energy market (Kuzemko et al. 2015: 190).

In general, the lack of demand elasticity due to the utility provided by fossil energy in essence holds consumers in importing states hostage to high oil prices, and negatively impacts their purchasing power. Importers' defensive toolset (e.g. energy reserves, swap deals, enhanced infrastructural and interconnectedness capacity, etc.) lessens the consequences of increased energy prices, but falls short of nullifying them. Ironically, prudent policies in importing countries from a security of supply perspective, namely diversification and liberalization, call for significant infrastructural investments that render the price of retail energy prices even higher (Yegorov et al. 2015).

Critics could point to the shale revolution and the anticipated benefits from future technological innovations to argue that international prices will again decrease with time. The most convincing counter-argument to this type of rhetoric derives precisely from the shale gas industry's own empirical evidence. While shale resource production led to a significant rise in global energy supply, tertiary effects—namely the fall of energy prices—jeopardize the economics of continued exploration. When oil price decreased to 30 dollars per barrel (and only rebounded up to 50), drilling profitability either significantly decreased or evaporated altogether since shale exploration *presupposes* high energy prices (OPEC 2015; Proedrou 2017a: 194). Many shale fields were unprofitable at prices of 50–70 dollars per barrel while tar sands need a global price of around 100 dollars per barrel to be profitable (Bradshaw 2014: 70).

This situation reveals a deeper structural problem with energy prices; instability and abrupt fluctuations are an inherent part of the problematic nature of global energy markets and their pricing mechanisms (Stevens 2010). Implicit in the super-cycles theory is the assumption that energy prices *cannot* remain stable for long. Once supply becomes excessive and prices drop, energy production will stall for some time, thus creating a new price hike. As a result, 'until the fuel base of the global economy changes, that economy will keep "banging its head" against the ceiling of affordable energy prices' (Mulligan 2010: 90). This is because

> the global business cycle and the oil and gas investment cycle have not been synchronized with high oil prices stimulating new investment in production, which then comes on to the market when the economy is in a downturn (in which energy prices are often implicated) and demand is stagnant. This exacerbates the problem of oversupply and further depresses prices. This in turn results in a reduction in new investment, such that when growth returns and demand picks up there is insufficient supply. (Bradshaw 2014: 35)

It is indicative that in the aftermath of the first oil crisis in 1973, oil-importing states embarked upon ambitious energy efficiency and renewable energy generation schemes. The incongruence of the global business and fossil energy investment cycles, though, wrought low prices in the 1980s pushing energy demand upwards back to previous levels (Sovacool and Brown 2010: 100).

As a result, it remains indeterminate at what level of international energy prices the global economy can be economically sustainable and will not provoke demand destruction and an economic downhill. Saudi Arabia's increasing domestic energy needs mean that an oil price approximating 100 dollars per barrel is necessary to sustain its budget. Most oil exporting states need an oil price between 70 and 100 dollars per barrel (Bressand 2013: 27; Bradshaw 2014: 146). The Organization of Petroleum Exporting Countries (OPEC) estimates that oil price will feature a 100 dollars price in the future, a ten-fold increase compared to two decades earlier (Kuzemko et al. 2015: 47). Due to the fact that 'competition over market shares among oil producers is economically irrational … since the low price elasticity of oil demand makes the risk of price decline and income disproportionate in relation to potential volume gains' (Noreng 2013: 165), the most prudent export policy is to retain excess supplies that can come into the market when badly needed, rather than to produce at maximum capacity. In this context, withholding quantities from the market makes sense for exporters and can create artificial price hikes to unsustainable levels for consumers, up to the point where it destroys demand and ends up hitting back on exporters (Bradshaw 2014: 144–5).

Countervailing interests are in play here as well, however. All energy exporters, with Saudi Arabia traditionally acting as the swing supplier, have an interest in balancing and moderating the prices so that demand destruction is averted and the oil market remains functional. At the same time, fossil energy exporters do not operate in a financial vacuum, but have to generate income to placate their populations. This is what explains, together with the determination to outcompete shale production schemes and render them unprofitable,[6] Saudi Arabia's resolve to maintain high production levels in the last two years, with the effect that international prices remain relatively low (Fattouh et al. 2016). The complexity of the global energy market, the conflicting policy priorities of exporters, and the divergent interests of exporters and importers render its workings and outputs (see prices) bumpy and unpredictable.

To wrap up, price volatility is endogenous to the global energy markets; the multifarious interests of stakeholders only exacerbate a structurally fluid, unstable, and ever-shifting global energy market, which adversely affects affordability on both sides. As Goldthau (2012: 67–9) maintains, global energy markets suffer from imperfect competition, the existence of cartels, and the extravagant concentration of powers in both the demand and supply sides, thus creating market distortions and allowing the most potent powers excessive leeway to manipulate the market. The fluid and volatile nature of the energy markets is further aggravated by their extensive financialization with oil trading instruments, virtual transactions, and futures markets now integral to the system (Noreng 2013: 164; Kallis and Sager 2017: 566). These schemes bring us to the subjective, intersubjective, and reflective understandings of stakeholders (Buzan and Hansen 2009: 35; Minsky 1992; Strange 1998: 10–13; Strange 1997: 77) that in their turn shape supply-demand equilibria and precipitate movements in international oil prices—in some cases without resonance with actual market fundamentals (Belyi 2016). In this context, global energy markets suffer from incomplete information, and are fraught with collective action problems that undermine adequacy of supplies, stable prices, long-term investment, and synchronized investment and market cycles (Goldthau 2012: 70; Dubash and Florini 2011: 12; Noreng 2013: 164).

The main conclusions that emanate from the above analysis are twofold. Firstly, one can hardly expect affordable fossil energy prices in the long run. Secondly, volatility and participation in this unstable global energy market work against the goals of a competitive and efficient economy. The predictability of the renewable energy harvest and the local character of renewable energy generation thus contrast sharply, and favorably, with traditional energy markets. This having been said, though, one has to move beyond traditional understandings of energy pricing, as climate-strained, steady-state economies require different energy price levels and signals compared to growth-driven ones.

Revisiting Energy Pricing[7]

Affordable energy remains a fuzzy term, mired in confusion, and meaning different things at different times. In many cases, for example, it is tantamount to low or stable energy prices; in others it denotes levels of prices that allow energy access and resist energy poverty; and in others still it translates into competitiveness for the whole economy (Jewell et al. 2014: 745). A more broad understanding of affordability would boil down to energy prices that do not impede growth, or preferably, that facilitate growth (Sager 2015).

In a climate-strained world, energy pricing retains its central importance for the function of the economy, but in a fundamentally reverse way. In this understanding, energy prices should reflect energy's scarcity in the biosphere, and accordingly structure economic activity in an energy-frugal and sustainable way. The ecological tax reform, presented in the previous chapter, represents an indispensable policy tool to incentivize this turnaround, and achieves two principal goals. First, it provides standard nudges and incentives for perpetual economization of energy, this way enhancing subsistence within biophysical limits (Jackson 1996; Von Weizsäcker 2014: 22; Daly 1996; Wackernagel and Rees 1998; Lawn 2007). Secondly, ecotaxes benefit the local/national economy in multiple ways. Not only do they lead to significant revenue streams through energy savings, but ecotaxes can also provide a sound business context for corporations to remain active nationally and locally, rather than outsource part of their activities or flee abroad altogether (Proedrou 2017a: 193–4; Von Weizsäcker 2014: 22; Lawn 2007). The ecological tax reform thus also enhances national/local supply chains, employment, aggregate demand, liquidity and so on, this way generating broader economic benefits (Bere et al. 2017). In Douthwaite's (1996: 128-9) words,

> energy imports weaken local economies through the loss of direct spending (leakage) and the loss of that spending's respending (the multiplier effect). By contrast, the money for both the energy-saving equipment as well as the moneys saved through improved energy efficiency will most likely be spent locally thus stimulating the local economy … The ability of renewable energy projects to facilitate the local retention of wealth is a potentially significant indirect benefit.

Ecological tax reform hence is much broader in scope than the oft-discussed carbon tax. It constitutes a different approach to pressing climate, energy and economic problems, rather than a simple policy measure to decrease energy consumption (Table 4.1).

Table 4.1 Energy security in the steady-state and mainstream energy policy framework

Dimensions of energy security	*Steady-state energy policy*	*Mainstream energy policy*
Sustainability	Energy use within biophysical limits Reversal of unsustainable and ecologically harmful unconventional and extreme energy production schemes Scaling-up of energy transition to catch ambitious climate goals	Energy use exceeding biophysical limits Perpetuation of unsustainable and ecologically harmful unconventional and extreme energy production schemes Modest energy transition not achieving the 2 degrees goal
Security of supply	Physical availability Enhanced access to energy Local ownership Predictability of energy harvest	Geological risks (peak oil, resource scarcity, adverse conditions) Geopolitical risks (resource nationalism, conflictive international relations, balance of power considerations) Foreign dependence Unpredictable oil harvest cycles
Affordability	Renewables costs to be seen in perspective Pulling out of an inherently volatile global energy market Revisiting the role of energy pricing in the economy	Full fossil costs are exorbitant/ unaffordable, hence generously subsidized Endogenous volatility of the global energy market Rising oil prices trends Subsidized, artificially low oil and gas prices an unsustainable basis for competitive and efficient economies

Conclusion

In conclusion, contemporary energy policy fails to live up to the climate change challenge; remains fraught with geological, geopolitical, and market risks; and does not consistently provide affordable energy supply to the Global North—let alone modern energy services to significant parts of the Global South. Given these pitfalls, taking the steady-state, deep decarbonization path seems much more promising across the three dimensions of energy security. Its local character improves access to energy, allows for predictable energy harvest, and—crucially—is a much closer fit for the energy needs of the Global South. The non-exhaustible character of renewable energy also outrivals fossil fuel supply that systematically revolves around ubiquitous concerns regarding peak oil, receding reserves, and skyrocketing prices. Compared to the volatility and very high costs of fossil energy, smart local energy systems seem to offer much brighter potential. Deployment also yields broader social benefits across the board despite the significant costs subsidies required to bring them into operation. Most importantly, it is essential to revisit the role of energy pricing in sustainable communities. Rather than opting for low energy prices that disregard the notion of limits, eco-taxes should render energy expensive so that communities minimize, rationalize, green, and optimize their energy use within biophysical limits to procure high welfare standards. In all, the fact that a steady-state energy policy not only ensures sustainability but also tackles traditional energy security concerns effectively is promising, in that it provides grounded hope that policy-makers will be increasingly prone to experiment, undertake novel approaches, and integrate energy security and climate mitigation agendas (Jewell et al. 2014: 756).

This chapter assessed the projected outcomes of the suggested application of a steady-state energy policy, and the impact this would bear on the energy security of states; the discussion, in other words, was situated at the domestic level. The next chapter effectively extends the discussion to the global level, and the broader realms of security, geopolitics, and development. It explores how far-reaching changes in energy systems as envisaged by steady-state energy policies would affect broader geopolitical structures, states' security, and the status of development around the world.

In doing so, Chap. 5 also discusses in broad terms what the geopolitics of renewable energy would look like. This is paradoxically a rather underexplored area of study (Scholten and Bosman 2016: 273), which nonetheless merits close scrutiny for three reasons. First of all, it is imperative to show that deep decarbonization around the world can in many cases have secondary healing effects on other global problems. Secondly, it is only academically sound and ethical to consider and, to the extent possible, resolve likely potential risks and adverse developments involved in the transition away from fossil-based energy geopolitics. Thirdly, a more peaceful and equitable world, as was noted in the first chapter, is a prerequisite for a more sustainable world. In this understanding, realizing peace in more corners of the world—eliminating repression, inequalities, regional instability, and disorder—also represents a key factor for successful climate policies that help societies organize in more far-reaching, meaningful and sustainable ways.

Notes

1. To make things worse, Britain's abstruse decision to exit the EU leaves the EU without one of its most fervent climate proponents, and creates further uncertainties for the Union's climate policy (Fischer and Geden 2016).
2. This event also gave full force to the enactment of Russia's Asian pivot, the implementation of which nonetheless remains indeterminate since Beijing and Moscow find it hard to agree on the terms of their energy partnership. This reflects their hard political relationship. Bejing in particular fully appreciates Russia's enfeebled position under Western sanctions and depressed international energy prices, while Moscow denies to succumb to Bejing's terms and become a 'resource appendage to China' (Bradshaw 2012: 219; Skalamera and Goldthau 2016; Gabuev 2015; Proedrou 2017d). Flows of energy, contractual and infrastructure commitments, and security of supply and demand remain profoundly entangled with geopolitical considerations, fears and concerns.
3. This move seems unlikely for now for broader geopolitical, rather than energy security reasons. A US withdrawal from the Pacific and the China Sea, where China is attempting to carve out an extended zone for energy exploration at the mounting dissatisfaction of its much weaker neighbours, would allow China a free hand and would constitute a significant shift in the regional and global balance of power.
4. Noreng (2013: 169) brings to light an intriguing, reverse aspect of the peak oil discussion. He argues that different views on peak oil are far from interest-neutral. Peak oil theory plays nicely into the hands of those oil companies keen to see the perpetuation of high oil prices, of investors in alternative sources of energy, and of de-growth movements. What is more, peak oil encourages militaristic strategies to secure access to oil, and potentially also to deny access to energy to others. Negating that peak oil is a reality, on the other hand, matches the interests of oil companies wishing to up-scale exploration, and of the whole petroleum value chain.
5. In fact, the views on and understandings of peak oil will define how societies prepare for the post-carbon era, and will feed back into the structure of fossil energy prices. Dwindling exploration will boost extraction costs and culminate in the cascading divestment of the fossil sector (Bressand 2013: 20).
6. Bronson (2016) offers an alternative perspective. He argues that, ironically, it is to Saudi Arabia's interest that the supply of unconventional energy from other producers increases, as this would protect Saudi Arabia's excess capacity. For Saudi Arabia, the ultimate issue of concern is whether an abrupt increase of global oil demand, unmatched for by a proportional supply increase, will dramatically reduce its reserves, thus rendering it just another country producing at full capacity. This would dilute Saudi Arabia's excess

capacity and its ensuing wherewithal to act as swing producer, in other words the essential assets that allow Saudi Arabia to influence the international oil price, and this way maximize its revenues and geopolitical clout.

7. This section draws from Proedrou, F. 2017. A New Framework for EU Energy Security: Putting Sustainability First. *European Politics and Society*, 18: 2, 182–198.

References

Agarwal, A. and Narain, S. 1991. *Global Warming in an Unequal World: A Case of Environmental Colonialism*. New Delhi: Centre for Science and Environment.

Aras, B. and Falk, R. 2015. Authoritarian 'Geopolitics' of Survival in the Arab Spring. *Third World Quarterly,* 36: 2, 322–336.

Baker, S. 2006. *Sustainable Development*. London: Routledge.

Belyi, A. 2016. Why is the Oil Price Not about Equilibrium?: An Economic Sociology Account of Petroleum Markets. *Energy Policy*, 96, 45–49.

Bere, J. et al. 2017. Energy and Development in the Periphery: A Regional Perspective on Small Hydropower Projects. *Environment and Planning C: Politics and Space,* 35: 2, 355–375.

Bosman, R. and Scholten, D. 2013. How Renewables Will Shift the Balance of Power [Online]. Available: http://reneweconomy.com.au/2013/how-renewables-will-shift-the-balance-of-power-78579 [Accessed on 11 June 2017].

Bradley, P., Leach, M. and Torriti, J. 2013. A Review of the Costs and Benefits of Demand Response for Electricity in the UK. *Energy Policy,* 52, 312–327.

Bradshaw, M. 2012. Russian Energy Dilemmas: Energy Security, Globalization and Climate Change, in P. Aalto (ed.), *Russia's Energy Policies: National, Interregional and Global Levels*. Cheltenham: Edward Elgar, 206–229.

Bradshaw, M. 2014. *Global Energy Dilemmas*. Cambridge: Polity Press.

Bressand, A. 2013. The Role of Markets and Investment in Global Energy, in A. Goldthau (ed.), *The Handbook of Global Energy Policy*. Chichester: Wiley-Blackwell, 15–29.

Bronson, R. 2016. The Geopolitics of Energy: Will a Boom Follow Today's Bust in Energy Prices?. *Energy Quarterly*, 41, MRS Bulletin, 429.

Brown, M. and Sovacool, B. 2011. *Climate Change and Global Energy Security: Technology and Policy Options*. Cambridge, MA: MIT Press.

Buchan, D. and Keay, M. 2016. EU Energy Policy – 4th Time Lucky?. *Oxford Energy Comment, The Oxford Institute of Energy Studies*, 1–9.

Buzan, B. and Hansen, L. 2009. *The Evolution of International Security Studies*. Cambridge: Cambridge University Press.

Cable, V. 2010. *The Storm: The World Economic Crisis and What it Means*. London: Atlantic Books.

Checchi A., Behrens, A. and Egenhofer, C. 2009. Long-Term Energy Security Risks for Europe: A Sector-Specific Approach. *CEPS Working Document, 309* [Online]. Available: http://aei.pitt.edu/10759/1/1785.pdf [Accessed on 17 March 2017].

Chen, G. and Lees, C. 2016. Growing China's Renewables Sector: A Developmental State Approach. *New Political Economy*, 21: 6, 574–586.

Cherp, A. and Jewell, J. 2014. The Concept of Energy Security: Beyond the Four As. *Energy Policy,* 75, 415–421.

Collier, P. 2007. *The Bottom Billion. Why the Poorest Countries are Failing and What Can Be Done About It*. Oxford: Oxford University Press.

Compston, H. and Bailey, I. 2013. Climate Policies and Anti-Climate Policies. *Open Journal of Political Science,* 3: 4, 146–157.

Coutinho, L. 2012. Optimal Natural Wealth Management, in H. Faustmann (ed.), *Cyprus Offshore Hydrocarbons: Regional Politics and Wealth Distribution*. Nicosia: Friedrich Ebert Stiftung and the PRIO Cyprus Centre, PCC Report 1/2012, 45–56.

Cowell, R. et al. 2017. Energy Transitions, Sub-national Government and Regime Flexibility: How Has Devolution in the United Kingdom Affected Renewable Energy Development?. *Energy Research & Social Science*, 23, 169–181.

Creutzig, F. et al. 2014. Challenging the European Climate Debate: Can Universal Climate Justice and Economics Be Reconciled with Particularistic Politics?. *Global Policy,* 5, 6–14.

Daly, H. 1996. *Beyond Growth: The Economics of Sustainable Development*. Boston, MA: Beacon Press.

Daly, H. and Farley, J. 2004. *Ecological Economics. Principles and Applications.* Washington: Island Press.

Dannreuther, R. 2015. Energy Security and Shifting Modes of Governance. *International Politics,* 52: 4, 466–483.

Davidescu, S. 2017. The Europeanization of Renewable Energy Policy in Romania, in I. Solorio and H. Jörgens (eds), *A Guide to EU Renewable Energy Policy. Comparing Europeanization and Domestic Policy Change in EU Member States.* Cheltenham: Edward Elgar, 204–223.

Deese, D. 1979. Energy: Economics, Politics, and Security. *International Security,* 4: 3, 140–153.

Douthwaite, R. 1992. *The Growth Illusion: How Economic Growth Enriched the Few, Impoverished the Many, and Endangered the Planet*. Gabriola Island, BC: New Society Publishers.

Douthwaite, R. 1996. *Short Circuit: A Practical New Approach to Building More Self-Reliant Communities.* Devon: Green Books.

Dubash, N. and Florini, A. 2011. Mapping Global Energy Governance. *Global Policy,* 2: 1, 6–18.

Escribano, G. 2017. RES in the Hood and the Shrinking Mediterranean Solar Plan, in I. Solorio and H. Jörgens (eds), *A Guide to EU Renewable Energy*

Policy. Comparing Europeanization and Domestic Policy Change in EU Member States. Cheltenham: Edward Elgar, 247–264.

European Commission. 2016a. The Revised Renewable Energy Directive. *MEMO – Clean Energy for All*, 30 November, 1–6.

European Commission. 2016b. The New Energy Efficiency Measures. *MEMO – Clean Energy for All*, 30 November, 1–6.

Falkner, R. 2016. The Paris Agreement and the New Logic of International Climate Politics. *International Affairs*. 92: 5, 1107–1125.

Fattouh, B., Henderson, J. and Sen, A. 2016. *Saudi-Russia Production Accord: The Freeze before the Thaw?*. Oxford Institute for Energy Studies, Oxford Energy Comment, 1–10.

Fattouh, B. and Sen, A. 2016. *OPEC Deal or No Deal? This is Not the Question*. The Oxford Institute for Energy Studies, Oxford Energy Comment, 1–8.

Fischer, S. and Geden, O. 2016. *Brexit: Impacts on Europe's Energy and Climate Policy. CSS Analyses in Security Policy*, ETH Zurich, 1–4.

Gabuev, A. 2015. *A "Soft Alliance"?: Russia-China Relations after the Ukraine Crisis*. London: European Council on Foreign Relations.

Goldthau, A. 2012. A Public Policy Perspective on Global Energy Security. *International Studies Perspectives*, 13, 65–84.

Goldthau, A. 2013b. Introduction: Key Dimensions of Global Energy Policy, in A. Goldthau (ed.), *The Handbook of Global Energy Policy*. Chichester: Wiley-Blackwell, 1–12.

Goldthau, A. 2013c. Conclusion: Global Energy Policy: Findings and New Research Agendas, in A. Goldthau (ed.), *The Handbook of Global Energy Policy*. Chichester: Wiley-Blackwell, 521–525.

Goldthau, A. 2017. The G20 Must Govern the Shift to Low-Carbon Energy. *Nature Comment*, 546: 7657, 203–205.

Goldthau, A. and Sitter, N. 2014. A Liberal Actor in a Realist World? The Commission and the External Dimension of the Single Market for Energy. *Journal of European Public Policy*, 21: 10, 1452–1472.

Haas, P. 2017. Parxit, the United States, and the World. *Chinese Journal of Population Resources and Environment* [first online], 1–3.

Heinberg, R. 2011. *The End of Growth: Adapting to our New Economic Reality*. Gabriola Island, BC: New Society Publishers.

Helm, D. 2014. The European Framework for Energy and Climate Policies. *Energy Policy*, 64, 29–35.

Hensel, N. 2012. An Economic and National Security Perspective on Critical Resources in the Energy Sector, in S.F. Krishna-Hensel (ed.), *New Security Frontiers: Critical Energy and the Resource Challenge*. Surrey: Ashgate, 113–138.

Hinrichs-Rahlwes, R. 2017. Foreword, in I. Solorio and H. Jörgens (eds), *A Guide to EU Renewable Energy Policy. Comparing Europeanization and Domestic Policy Change in EU Member States*. Cheltenham: Edward Elgar, xi–xvi.

Hubbert, M.K. 1969. *Resources and Man*. Washington, DC: National Academy of Sciences and National Research Council.

International Energy Agency. 2011. The IEA Model of Short-Term Energy Security. Primary Energy Sources and Secondary Fuels. Working Paper, 1–48.

Jackson, T. 1996. *Material Concerns: Pollution, Profit, and Quality of Life*. London: Routledge.

Jaffe, A. and Soligo, R. 2008. Militarization of Energy: Geopolitical Threats to the Global Energy System. *The Global Energy Market. Comprehensive Strategies to Meet Geopolitical and Economic Risks Working Paper.* Energy Forum, James A. Baker III Institute for Public Policy, Rice University.

Jankowska, K. and Ancygier, A. 2017. Poland at the Renewable Energy Policy Crossroads: An Incongruent Europeanization?, in I. Solorio and H. Jörgens (eds), *A Guide to EU Renewable Energy Policy. Comparing Europeanization and Domestic Policy Change in EU Member States.* Cheltenham: Edward Elgar, 183–203.

Jewell, J., Cherp, A. and Riahi, K. 2014. Energy Security Under De-carbonization Scenarios: An Assessment Framework and Evaluation Under Different Technology and Policy Choices. *Energy Policy*, 65, 743–760.

Kallis, G. and Sager, J. 2017. Oil and the Economy: A Systematic Review of the Literature for Ecological Economists. *Ecological Economics,* 131, 561–571.

Kazakov, V. 2016. Russia and the Post-oil Economy. Project Syndicate [Online]. Available: https://www.project-syndicate.org/commentary/oil-prices-russia-political-implications-by-vitaly-kazakov-2016-06 [Accessed on 29 June 2016].

Keating, M. et al. 2012. Introduction: Bringing Energy into International Political Economy, in M. Keating et al. (eds), *Dynamics of Energy Governance in Europe and Russia*. London: Palgrave Macmillan, 1–19.

Khandker, S., Barnes, D. and Samad, H. 2010. Energy Poverty in Rural and Urban India: Are the Energy Poor also Income Poor? *IDEAS* [Online]. Available at: http://ideas.repec.org/p/wbk/wbrwps/5463.html [Accessed on 3 January 2017].

Khrushcheva, O. and Maltby, T. 2016. The Future of EU-Russia Energy Relations in the Context of Decarbonisation. *Geopolitics,* 21: 4, 799–830.

Klare, M. 2015. Hard Power, Soft Power, and Energy Power – The New Foreign Policy Tool. *Foreign Affairs.* March (snapshot).

Kuzemko, C., Keating, M. and Goldthau, A. 2015. *The Global Energy Challenge: Environment, Development and Security.* London: Palgrave Macmillan.

Latouche, S. 2009. *Farewell to Growth.* Cambridge: Polity Press.

Lawn, P. 2007. *Frontier Issues in Ecological Economics.* Cheltenham: Edward Elgar.

Liu, J. et al. 2012. Cyber Security and Privacy Issues in Smart Grids. *IEEE Communications Surveys & Tutorials*, 14: 4, 981–997.

Mares, D. 2010. *Resource Nationalism and Energy Security in Latin America: Implications for the Global Oil Supplies. James A. Baker III Institute for Public Policy, Rice University Working Paper,* 1–42.

Matson, P., Clark, W. and Andersson, K. 2016. *Pursuing Sustainability: A Guide to the Science and Practice*. Princeton: Princeton University Press.

Micklethwait, J. 2016. Saudi Arabia Plans $2 Trillion Megafund for Post-Oil Era: Deputy Crown Prince. *Bloomberg*, 1 April [Online]. Available: http://www.bloomberg.com/news/articles/2016-04-01/saudi-arabia-plans-2-trillion-megafund-to-dwarf-all-its-rivals [Accessed on 12 April 2016].

Minsky, H. 1992. The Financial Instability Hypothesis. *The Jerome Levy Economics Institute Working Paper*, 74.

Mulligan, S. 2010. Energy, Environment, and Security: Critical Links in a Post-peak World. *Global Environmental Politics,* 10: 4, 79–100.

Mulligan, S. 2011. Energy and Human Ecology: A Critical Security Approach. *Environmental Politics*, 20: 5, 633–649.

Noreng, O. 2013. Global Resource Scramble and New Energy Frontiers, in A. Goldthau (ed.), *The Handbook of Global Energy Policy*. Chichester: Wiley-Blackwell, 159–175.

O'Hanlon, M. 2010. How Much Does the United States Spend Protecting Persian Gulf Oil?, in C. Pascual and J. Elkind (eds), *Energy Security: Economics, Politics, Strategies, and Implications*. Washington, DC: Brookings Institution, 59–72.

O'Sullivan, M. 2013. The Entanglement of Energy, Grand Strategy, and International Security, in A. Goldthau (ed.), *The Handbook of Global Energy Policy*. Chichester: *Wiley-Blackwell*, 30–47.

Odell, P. 2004. *Why Carbon Fuels Will Dominate the 21st Century's Global Energy Economy*. Brentwood, Essex: Multi-Science Publishing.

Odum, H. 2007. *Environment, Power and Society for the Twenty-First Century. The Hierarchy of Energy*. New York: Columbia University Press.

Organization for Economic Cooperation and Development/International Energy Agency. 2015. Renewable Energy Medium-Term Market Report. Market Analysis and Forecasts to 2020. Executive Summary, 1–8.

Organization of Petroleum Exporting Countries. 2015. Monthly Oil Report, 16 March.

Pascual, C. 2015. *The New Geopolitics of Energy*. Columbia: Center on Global Energy Policy.

Pascual, C. and Elkind, J. (eds). 2010. *Energy Security: Economics, Politics, Strategies, and Implications*. Brookings Institution Press.

Pike, W. 2010. Challenges and Solutions for 2011 and Beyond. *World Oil*, December Issue, 29–30.

Proedrou, F. 2012. *EU Energy Security in the Gas Sector: Evolving Dynamics, Policy Dilemmas and Prospects*. Surrey: Ashgate.

Proedrou, F. 2015. Rethinking Energy Security: An Inter-Paradigmatic Debate. *ELIAMEP Policy Paper*, 1–18.

Proedrou, F. 2017a. A New Framework for EU Energy Security: Putting Sustainability First. *European Politics and Society*, 18: 2, 182–198.

Proedrou, F. 2017c. Are Smart Grids the Key to EU Energy Security?, in R. Leal-Arcas and J. Wouters (eds.), *Research Handbook on EU Energy Law and Policy*. Cheltenham: Edward Elgar, 450–459.

Proedrou, F. 2017d. Russia's Structural Power in Europe: Deficiencies and Potential of Its Energy Strategy. *Europe-Asia Studies* (forthcoming).

Rees, W. and Wackernagel, M. 1999. Monetary Analysis: Turning a Blind Eye on Sustainability. *Ecological Economics*, 29: 1, 47–52.

Sager, J. 2015. The Ecological Keynesian: Energy, Money, and Oil Cycles in the Global System [A dissertation submitted in partial satisfaction of the requirements for the degree of Doctor of Philosophy in Energy and Resources in the Graduate Division of the University of California, Berkeley].

Scholten, D. and Bosman, R. 2016. The Geopolitics of Renewables: Exploring the Political Implications of Renewable Energy Systems. *Technological Forecasting & Social Change*, 103, 273–283.

Shaffer, B. 2011. *Energy Politics*. Pennsylvania: University of Pennsylvania Press.

Skalamera, M. and Goldthau, A. 2016. Russia: Playing Hardball or Bidding Farewell to Europe? Debunking the Myths of Eurasia's New Geopolitics of Gas. *Discussion Paper Summary, Belfer Center for Science and International Affairs*, 1–54.

Solorio, I. and Bocquillon, P. 2017. EU Renewable Energy Policy: A Brief Overview of its History and Evolution, in I. Solorio and H. Jörgens (eds), *A Guide to EU Renewable Energy Policy. Comparing Europeanization and Domestic Policy Change in EU Member States*. Cheltenham: Edward Elgar, 23–42.

Sovacool, B. 2016. How Long Will It Take? Conceptualizing the Temporal Dynamics of Energy Transitions. *Energy Research & Social Science*, 13, 202–215.

Sovacool, B. and Brown, M. 2010. Competing Dimensions of Energy Security: An International Perspective. *Annual Review of Environment and Resources*, 35, 77–108.

Sovacool, B. and Drupady, I. 2016. *Energy Access, Poverty, and Development: The Governance of Small-Scale Renewable Energy in Developing Asia*. London and New York: Routledge.

Sovacool, B. and Sidortsov, R. 2013. Energy Governance in the United States, in A. Goldthau (ed.), *The Handbook of Global Energy Policy*. Chichester: Wiley-Blackwell, 435–456.

Stern, J. 2017. The Future of Gas in Decarbonising European Energy Markets: The Need for a New Approach. *The Oxford Institute for Energy Studies Paper, NG 116*, 1–31.

Stevens, P. 2010. The "Shale Gas Revolution": Hype and Reality. *A Chatham House Report*. Chatham House.

Stiglitz, J. 2010. *Freefall: America, Free Markets, and the Sinking of the World Economy*. New York: Norton.

Strange, S. 1997. *Casino Capitalism*. Manchester: Manchester University Press.

Strange, S. 1998. What Theory? The Theory in Mad Money. *CSGR Working Paper*, 18/98, 1–29.

Szulecki, K. 2018. The Multiple Faces of Energy Security: An Introduction, in K. Szulecki (ed.), *Energy Security in Europe: Divergent Perceptions and Policy Challenges*. London: Palgrave Macmillan, 1–29.

Szulecki, K. et al. 2016. Shaping the 'Energy Union': Between National Positions and Governance Innovation in EU Energy and Climate Policy. *Climate Policy,* 16: 5, 548–567.

Tonnensson, S. and Kolas, A. 2006. *Energy Security in Asia: China, India, Oil and Peace. Report to the Norwegian Ministry of Foreign Affairs.* Oslo: PRIO.

Umbach, F. 2010. Global Energy Security and the Implications for the EU. *Energy Policy,* 38: 3, 1229–1240.

Victor, D., Jaffe, A. and Hayes, M. (eds). 2006. *Natural Gas and Geopolitics: From 1970 to 2040*. Cambridge: Cambridge University Press.

Victor, P. and Jackson, T. 2015. The Trouble with Growth, in World Watch Institute (ed.), *State of the World 2015: Confronting Hidden Threats to Sustainability*. London: Island Press, 37–50.

Von Weizsäcker, E.U. 2014. Overcoming the Mikado Situation. *Global Policy,* 5, 21–23.

Wackernagel, M. and Rees, W. 1998. *Our Ecological Footprint*. Gabriola Island, BC: New Society Publishers.

Wackernagel, M. et al. 2006. Ecological Footprint Accounts for Advancing Sustainability: Measuring Human Demands on Nature, in P. Lawn (ed.), *Sustainable Development Indicators in Ecological Economics*. Cheltenham: Edward Elgar, 246–267.

Wright, P. 2006. *Gas Prices in the UK: Markets and Insecurity of Supply*. Oxford: The Oxford Institute for Energy Studies.

Yegorov, Y., Wirl, F. and Dehvani, J. 2015. *Future of Natural Gas in EU: Will Geopolitics Take over Economics*?. *IAEE Conference Paper,* Antalya, Turkey, 1–12.

Yergin, D. 2006. *Ensuring Energy Security*. Foreign Affairs, March/April, 69–82.

Zgajewski, T. 2014. The European Union Launches a New Risky 2030 Strategy for Climate and Energy. *Egmont Royal Institute for International Relations* [Online]. Available: http://www.egmontinstitute.be/publication_article/the-eu-must-seriously-rethink-its-approach-to-climate-and-energy-2/ [Accessed on 6 January 2015].

Zimmerer, J. 2014. Climate Change, Environmental Violence and Genocide. *The International Journal of Human Rights*, 18: 3, 265–280.

CHAPTER 5

Geopolitics and Development in a Steady-State World

Introduction

Due to its central role in modern societies, the remit of energy extends beyond energy issues *per se*. Energy policy hence influences a handful of high-order goals in the global system, the fulfillment of which is essential for truly sustainable livelihoods in the broadest sense of the concept (Jaffe and Soligo 2008). In this context, several scholars have stressed the need for re-calibrating the logic underpinning energy security to include fundamental human goals. Cherp and Jewell (2014), for example, question whether fossil energy should be considered acceptable in the first place, since it undermines security, development, peace, human rights, and sustainable welfare standards and livelihoods. In the same logic, Bradshaw (2014: 193) assesses that energy security cannot be equated simply with secure and affordable supplies of primarily fossil fuels, and urges that emphasis should shift towards equitable access. The analysis in this chapter takes these arguments further. Building on the foundations laid in the previous two chapters, it scrutinizes the impact steady-state energy policies would have on

- geopolitics, in the sense of contrasting notions of conflict or cooperation, war or peace, stability or instability, and amity or enmity; and
- development, encompassing democracy, rule of law, human rights, eradication of poverty, and overall improvement of welfare standards.

F. Proedrou, *Energy Policy and Security under Climate Change*,
https://doi.org/10.1007/978-3-319-77164-9_5

Although the imperatives of climate change has forced the need for a profound energy transition onto the global agenda, the slow pace of current transition efforts has monopolized the debate, ostensibly drawing focus away from important research topics on geopolitical and developmental implications. More specifically, the implications of a switch towards steady-state policies on geopolitics and development remains a muted point in the literature. This chapter aims to fill this gap.

A steady-state energy policy, as we saw in Chap. 3, consists in parallel strategies to curtail fossil energy production and consumption within biophysical limits, and boost renewable energy generation and energy efficiency proportionately. The former will in effect break the amply documented link between fossil energy and conflict, as well as reshape the patterns of interaction underpinning the contemporary fossil-driven world, this way also leading to critical changes in the global balance of power and creating winners and losers. Such groundbreaking changes are expected to unlock significant conciliatory potential. The transition towards a non-fossil fueled world, nonetheless, is very likely to be bumpy and hazardous, unless more cooperative understandings 'grounded in discourses of global and human security' prevail in the face of the formidable challenge (Mulligan 2010: 94). After critically discussing such scenarios, the chapter moves to explore the nascent geopolitics of renewable energy. It reviews the limited existing literature, with the dual aim to

- place in context mainstream understandings that reproduce and transpose traditional competition and scarcity dynamics onto the geopolitics of renewables; and
- discuss the properties of the new system, and highlight its inherently more local and detached, hence less conflictive, character.

Secondly, steady-state energy policies are critical in breaking the link between fossil energy on the one hand, and energy poverty, the resource curse, authoritarianism, and underdevelopment on the other. The power base of resource-endowed regimes will collapse with the divestment of the fossil sector, thus opening up windows of opportunity for societal changes that can emancipate and improve conditions for people in the Global South (again with the caveats outlined for the transition period). In more practical and straightforward terms, utilization of local renewable energy systems is a much closer fit to the Global South's energy needs, and can serve as the indispensable developmental springboard.

In all, this chapter supplements analysis in Chap. 4 and further strengthens the grounds for revisiting mainstream understandings of energy security and, subsequently, traditional energy policies. It does so by substantiating the argument that the broad adoption of steady-state energy policies can deliver on fundamental global goals outside the confines of energy and climate. While this is crucial on its own merits, it is also pivotal for climate change mitigation reasons, since peace, development, and welfare are themselves prerequisites for sustainability (Wackernagel et al. 2006: 248–9).

Towards a New, Ambiguous, but Promising Geopolitics

Geopolitics can be defined as 'the battle for space and power played out in a geographical setting' (Kaplan 2014), or 'great power competition over access to strategic locations and natural resources … [encompassing] the relationships between geography, power, and international relations' (Overland 2015: 3518). Energy geopolitics revolves around the competition for access to natural resources and the trade routes that bring those resources to consumers; is contingent upon the global energy supply-demand balance; and severely affects power relations between energy players (Kaplan 2014; Overland 2015: 3517). This is a result of oil's central role in global markets and politics, its 'position at the central hubs of global networks of finance and energy' that 'provides an enormous amount of power to move markets and damage rivals in the process' (Kallis and Sager 2017: 568–9).

A significant part of the scholarly literature has focused on the linkages between energy politics, foreign policy, security, and conflict (O'Sullivan 2013; Kanet and Sussex 2015; Shaffer 2011; Cohen 2009; Klare 2015; Proedrou 2012: 12–13). A unifying theme that emerges and a widely shared conclusion is that the web of geopolitical alliances, the contemporary global order and the global balance of power are in various ways entangled with energy politics (Andrews-Speed and Dannreuther 2011; Jaffe and Soligo 2008; Perovic et al. 2009; Phillips 2013; Andrews-Speed et al. 2002).[1]

Sager (2015) writes eloquently about the U.S. dominance in the global system since 1945 focusing on the linkages between fossil energy availability, on the one hand, and the U.S. monetary, trade, and economic hegemony on the other. The initial period of widely available cheap oil, which marked the apogee of U.S. economic supremacy, was followed by the dwindling availability and affordability of energy; this wrought the collapse of the Breton Woods monetary system, along with increasing trade imbalances in the 1970s. Oil harvest cycles have since worked their way through the recycling of petrodollars, and fluctuations in interest rates, money supply and trade balances, and maintained U.S. hegemony for decades. The informal U.S.-China monetary-trade agreement (U.S. retains stark trade deficits and China provides liquidity to the United States for deficit finance) has effectively sustained the global regime the last two decades. The question that emerges from his analysis is how resource scarcity together with climate-related measures will affect geopolitics and the global energy-trade-monetary regime (Kallis and Sager 2017: 569). In the face of dwindling availability and affordability of fossil energy and the subsequent need for a transition to cleaner energy systems, Sager himself asserts that 'the global economic system is stuck, waiting for a direction to be set, and the next regime to emerge: a new monetary system, tied to a new energy system, with a new leadership structure' (Sager 2015: 19).

A comprehensive adoption of steady-state energy policies would effectively convert oil and gas from essential strategic goods into marginalized commodities in a fading global market. This critical shift would pave the way for a sweeping reshuffling of global politics, and impact upon the risk of conflict, state security, and balance of power in the global scene. In what follows, we briefly explore potential avenues of change emanating from the progressive divestment of the fossil sector.

The Reshuffling of Geopolitics, State Security, and Winners and Losers in the New Era

To begin with, it is reasonable to assume that the lessening importance of oil and gas would lead to reduced risk of conflict in instances where oil and gas interests are implicated. Oil and gas wars (Meierding 2016), to the extent that they constitute part of global politics, may become irrelevant, a relic of the past. At the same time, energy-related sticks and carrots, such as supply cuts (or threats thereof), arbitrary pricing policies, politics of blackmail utilizing monopolistic and/or monopsonistic positions, and sanctions targeting the energy industry will lose currency. Such changes can have significant transformative effects on EU-Russia relations, to take an example. Asian politics, to take another example, has been tense with the South China Sea littoral states' competing claims on the ownership of natural resources, drawing the United States into the picture and raising the spectrum of a great power controversy. The energy rationale behind these disputes would evaporate in a post-fossil world, and with it also the risk for conflict (Len 2015). In this context, 'international security dilemmas associated with fossil energy will gradually evaporate as their use diminishes. A new set of factors will arise, which will shape the ends, ways, and means of grand strategy' (O'Sullivan 2013: 43).

In its quest for procuring energy supplies, moreover, China has actively engaged in resource extraction across Africa. This strategic move has been tainted with the provision of *de facto* protection to brutal autocratic regimes from preventive or punitive action by the international community, and has derailed international efforts at conflict resolution and reconciliation (O'Sullivan 2013: 34–6). The same also applies to the unholy alliances big industrial players of the West, enjoying the tacit support of their parent governments, strike with repressive regimes in Africa (Obi 2010). The lessening importance of fossil fuels may facilitate more proactive, international law-based treatment of such cases.

Import dependence, moreover, has systematically bred concerns not only for energy security but for its wider ramifications for importers' security and global posturing. Indeed, many scholars have made a strong case that mainstream fossil- and import-based energy policies have systematically compromised importing states' freedom and leverage to act in the global system. In such a conceptual setting, energy security is optimally fulfilled when access to energy neither depends on, nor in any way compromises, parallel geopolitical, diplomatic, and security policies. In this context, the United States pays a significant diplomatic price for its access to Middle Eastern oil supplies. The same argument can to a lesser degree also be extended to the EU, and in particular to some of its ex colonial powers (O'Sullivan 2013: 31). The Wicks Report, for example, argued that it was crucial that the UK 'retains independence in its foreign policy through avoiding dependence on particular nations' (Judge and Maltby 2017: 13). Sager (2015: 12) makes a broader point, alleging that 'once a significant portion of the energy supply is imported, exchanged for hard currency on the open market, a nation's financial position changes irrevocably—and the nation with it'.

Fossil energy has also been notorious for playing into the hands of terrorist groups. Extremist groups like the Taliban and Al-Qaeda, for example, have received hundreds of millions from the Saudi government, the major revenue of which comes from oil exports (Brown and Sovacool 2011: 32). Most recently, Islamic State in Iraq and Syria (ISIS) operations have benefited enormously both from oil trade in black markets and from grants originating in oil-rich Gulf countries (Watkin 2014; Martin and Solomon 2017; Gulmohamad 2014). In a world of divested fossil energy, such groups will need to seek alternative finance sources outside oil and gas, and thus will find themselves into a much more handicapped position.

Such sweeping changes will bear significant impact on the global balance of power. On the face of it, one can discern two groups of winners and losers with oil and gas importers finding themselves in the former group and exporters in the latter (Mecklin 2016; Jewell et al. 2014: 756). Adding technological leadership, know-how and management capacity to the equation would provide a more nuanced dichotomy between countries of the Global North and rising powers like India and China, on the one hand, and exporters on the other (Haas 2017: 2). Still, countries like Australia, Norway and Canada present more complicated cases. While they may incur substantial costs due to circumscribed export-born energy revenues, they possess the resources both to restructure their economies in a sustainable way, as well as to retain high welfare standards.

The case of oil and gas exporters seems much more straightforward. A collapse in demand for oil and gas would cripple resource-based, non-diversified economies like those of Russia and Saudi Arabia, let alone Central Asia, and debilitate their geopolitical clout (Goldthau 2017: 203, 205; Overland 2015: 3528). In a context of severe economic losses and subsequent loss of international currency, these states' elites will struggle to remain in power. Turning current fossil-induced revenues into sustainable investments of one kind or another constitutes the only viable way out of descent. These can take the form of advanced renewable energy infrastructure, tradable emissions rights, digital and cutting-edge technology services or other marketable services. In the contrary case, these states are very likely to go through recession, face internal and external threats, and suffer progressive decay (Overland 2015; O'Sullivan et al. 2017).

At the same time, though, one should not downplay the negative effects the falling importance of oil and gas would bear on bulky energy purchasers, like the EU block, the United States and China. These entities derive strength in international affairs exactly from their large purchasing power; strength that will decline as fossil energy wanes. The spectrum of the divestment of the fossil energy sector also brings in particularly strong focus the traditional American dilemma between internationalism and isolationism. Linked to this latter point, the waning currency of oil and gas will put traditional alliances to strong tests. The most central one in this area is the Saudi-U.S. bilateral relationship; the question of whether this alliance will endure in a post-fossil era once oil wealth—its major component—evaporates or falters altogether will bear significant ramification for global geopolitics (Overland 2015: 3528).

In the very end, what will determine the distribution of power as we muddle through the twenty-first century may be the different countries' capacity and wherewithal to marshal resources towards a fast, full-fledged, and wide-ranging transition customized to their own special needs, cultures, and the tools/resources at their disposal. In the words of O'Sullivan, Overland and Sandalow (2017: 29), these states will 'over time enjoy significant soft power and credibility advantages over states not prepared to respond adequately to the threat of climate change'.

A Hazardous Transition?

Energy geopolitics and conflict constitute an intertwined whole. Breaking this vicious cycle is definitely promising, and may open up opportunities for more cooperative global politics. At the same time, though, it will remove the certainties of the past, thus potentially creating permissive ground for renewed disorder, instability and conflict (Rothkopf 2009; Westphal and Droege 2015; Westphal 2011; Paltsev 2016). It is imperative hence to draw a distinction between the end-state of deep decarbonization and the process itself. Contrary to the end-state, the transition presents formidable challenges in its own right and merits a separate discussion, as it will be both a 'creative and destructive process that significantly changes how different places are related to each other, economically, politically, and even culturally, and at a range of different scales' (Bridge et al. 2013: 339, cited in Overland 2015: 3532).

To begin with, the divestment of fossil assets may well bring forward some catastrophic responses. These boil down to states, as well as all sorts of guerilla organizations and rebel groups, accelerating oil and gas production and (illicit) trade in their quest to secure privileged positions, dominance, and leverage (Mulligan 2010: 95). Paltsev (2016) and Rothkopf (2009: 1) anticipate a last wave of petro-wars; they see it as only normal for incumbents to defend their fossil-earned dominance as the carpet is pulled from under their feet. This argument bears high resonance in Africa and the Middle East. The exact shape of events in the most resource-endowed regime of Saudi Arabia will be of critical significance, both as a point of reference, as well as in light of the country's central position in diachronically polemical Middle East politics. A first issue of content regards its long-held alliance with the United States, as we saw above. Also contingent upon the evolution of this alliance in light of the waning importance of oil, the regime may succumb to the wave of change, open up and reform, or it may, otherwise, be emboldened to turn more repressive internally and adventurist externally (Overland 2015: 3528; O'Sullivan et al. 2017: 26). For Andrews-Speed et al. (2002: 96), the latter scenario seems much more plausible as authoritarian regimes usually fight challenges to their legitimacy with more repressive tactics. At the same time, the enfeeblement of resource-endowed regimes may invite conflict by means of encouraging their enemies or other third states to pursue confrontational strategies. The divestment of the fossil sector may fuel their ambitions to move against disempowered regimes (Overland 2015: 3528).

In the case of the Middle East, in general, the mosaic of tribal, sectarian, national, and religious differences renders reconciliation, cooperation and stability a distant prospect, despite the fading currency of fossil energy. In other words, while the decreasing importance of oil and gas will definitely influence regional politics, it is far from certain that it will transform the nature of regional politics itself. This is because oil and gas constitute only one, albeit central, factor behind conflict and polemical politics in the region. It is reasonable to expect, moreover, that foreign intervention in the politics of the Middle East will decline in light of the region's fading importance in global politics, a change that can both facilitate and further endanger peace, order, and stability (Overland 2015: 3528). In the same vein, incumbent regimes in Central Asia survive and in some cases thrive on the basis of their resource-endowment and the favorable treatment they receive from great powers on these grounds. The waning importance of oil and gas poses an existential threat to these regimes, and is certain to generate significant political developments; in this changing landscape, a descent into chaos features as a likely scenario, although one cannot preclude a more rule-based political and economic transition (Overland 2015: 3528).

An important aspect of this change is the potential to shake solid, albeit clearly unsustainable (in ecological, but also in broader political and economic terms) regimes that serve as shock absorbers and pillars of regional stability. This will weaken and undermine international stability, and pave the way for adventurous and polemical politics. The recent challenges to autocratic regimes in North Africa and the Middle East (especially Syria and Libya) that unleashed various centrifugal forces and led the region into incessant violence illustrates the potential dangers that may loom large and should serve as sufficient warning for what may lie ahead (Aras and Yorulmazlar 2016).

Moreover, the progressive divestment of the fossil industry will mean in practice that only the most efficient part of the industry will remain in place to cater for the dwindling global oil and gas needs. Effectively, thus, the transitory period may be characterized by the concentration of the least-cost reserves in a few states/regions, notably within the Middle East. This can create anew monopolistic dynamics, lead to abuse of economic power, and generate geopolitical leverage, even if in the short-term. More importantly, states with high stakes in the fossil industry—and thus with too much to lose in the changing geopolitical context—may put up a fierce fight against change. For example, one cannot preclude the possibility that Russia could decide to force its regional allies to sustain imports of Russian oil and gas in order to retain part of its shrinking fossil pie. In the same context, Russia may read the institutionalization of steady-state energy policies by the EU or China in geopolitical, rather than climate, economic, and sustainability terms. In fact, evidence suggests that the hesitant low-carbon transition the EU has initiated has been received and understood in Moscow in geopolitical terms (Sharples 2013). In this context, renewed friction between the EU and Russia, rather than lessening risks of conflict and rapprochement, may accompany the divestment process of the fossil sector.

It is important at this point to consider the remote likelihood of a more structured transition. In this scenario, oil is swiftly phased out, natural gas however remains in broad use as the transition fuel. Global energy consumption hence stays within the global carbon budget under the condition that hardly any quantities of unconventional gas are consumed. In this case, the preceding analysis is largely relevant to oil exporters and their relations with oil importers. Gas exporters, to the contrary, become the greatest beneficiaries, and their geopolitical clout vis-à-vis gas importers rises exponentially. At the same time, the balance of power between oil and gas exporters changes dramatically, with Qatar, for example, becoming the Saudi Arabia of the next decades (Overland 2015: 3535). In this scenario, the Qatari side will be significantly fortified in its diplomatic conflict with Saudi Arabia. In the same vein, the unfolding competition for regional supremacy between gas-rich Iran and Saudi Arabia would decisively tilt to Iran's favor. Qatar and Iran would see their geopolitical leverage significantly increase in this scenario, which in its turn might set in motion a competition between the liberal and theocratic pathways and their projection to the rest of the Middle East.

Overall, the broad adoption of steady-state energy policies will affect geopolitics in two principal ways. The first, as explored above, lies in the way energy-rich regimes will be impacted, and how these effects will subsequently reshape domestic politics and feed into regional politics. The second is indirect; the divestment of the global fossil industry will generate heightened need (and pressure) for the simultaneous management of a host of stranded assets, and for muting their repercussions. Besides a handful of resource-endowed states, a wide and dispersed number of economic actors (e.g. energy behemoths both in the Global North and the emerging powers, banks, hedge funds, pension funds, insurance companies, and municipalities, etc.) retain assets in the fossil industry. As

> financial markets consist of large numbers of actors attempting to anticipate the market's—that is, each other's—future moves … [they] tend to move in flock as market participants interpret each other as moving in one direction or another. Should the notion of stranded carbon assets thus catch on among a large enough minority of market actors, it might spread to others trying to anticipate market movements, leading to accelerating divestment in greenhouse gas-emitting industries. (Overland 2015: 3535)

The value of these assets is estimated in the trillions of dollars (Goldthau 2017: 204). Stranded energy assets, therefore, represent an acute threat to many national economies and the global economy by and large, and are bound to destabilize governments' policies and posturing, and subsequently domestic and global politics. The divestment of the sector practically means that most of these assets will be lost, leading to loss of tax revenues, waning account balances, corporate bankruptcies and defaults, lack of liquidity, bail-out pledges, unemployment and so on, potentially leading to yet another global financial crisis (Goldthau 2017: 203–4).

The responses governments around the world will come up with to tackle such mishaps will shape regimes' resilience, national politics and their international ramifications as well. This challenge is everything but marginal as it endangers 'political order and human welfare, and … therefore is highly amenable to securitization' (Mulligan 2011: 634).

In light of the breadth and magnitude of the effects of the fossil divestment, one cannot exclude the possibility that more collaborative approaches will prevail in response. This becomes imperative in light of Odum's (2007: 388) insightful observation that the 'way down of some countries may be cancerous for the rest as well'. The anarchical collapse of resource-endowed regimes and the large-scale liquidation of lucrative assets will severely affect the global system, and hence lead to calls for global deliberations and collective understandings. Congruent with and building upon global cooperative platforms and agreements to deal with urgent global problems, such as the Montreal Protocol, and existing energy clauses in the North American Free Trade Agreement (NAFTA), IEA and the EU regarding solidarity, sharing, self-restraint and trade in cases of emergency, states could come up with a global energy descent plan and tradable energy quotas (Mulligan 2010: 94–7). These changes, however, can be triggered only in case more profound understandings develop regarding the role of energy and the price of conflic.

As Odum (2007: 46) elaborates, energy supplies that pursue growth are counter-productive on two fronts. Firstly, in the short-term they can only lead to outgrowing and outdoing others, leading to a self-perpetuating, fiercely competitive world. Using energy to retain one's advantageous position and to force competitors into submission in the mid-term, secondly, is unsustainable and will eventually lead to the demise of the states holding to these mindsets and undertaking such strategies. A central reason for this is that the sustenance of excessive military capacity requires so much fossil energy that it becomes counter-productive in a world of waning fossil resources. Indeed, the practical implications of the divestment of the fossil industry is that the oil-run war industry will have to suffer (as was briefly the case post-1973 as well). While economies can remain up and running, as renewables-run electricity systems can sustain the information structure of the society and thus retain welfare levels as we saw in Chap. 3, it is war and competition that have to be revisited and recast as part and parcel with the evolving divestment of the fossil industry (Odum 2007: 305, 385–7). A global understanding regarding the downscaling of energy use for military purposes thus appears to be essential. While such a daunting task bumps against classical security dilemmas, and subsequently against difficulties similar to the ones surrounding nuclear diplomacy, a lucid historical record of nuclear-free zones, disarmament, and non-proliferation treaties attests to the fact that such a ground-breaking shift is historically realizable (Heywood 2011: 273–80). The example of Europe post-1945 and the ostracizing of violence from intra-European affairs speaks to the historical feasibility of such a project.

The More Favorable Geopolitics of Renewables

The divestment of the fossil sector will be accompanied by a growing use of renewable energy; within this shift, there has been a lot of talk of the new geopolitics of renewable energy. The limited literature on the impact the energy transformation will bear on geopolitics has replicated business as usual scenarios; in these, traditional geopolitical challenges are replaced with new ones. In this context, the focus has been on rare earth materials that are critical for manufacturing renewable energy technologies (e.g. wind turbines, solar panels, electric vehicles, and energy-efficient lighting) (Hensel 2012). The quest for exponential renewable energy generation, it is often argued, may lead to competition for the mining of a handful of, in most cases geographically concentrated, rare earth metals (De Ridder 2013; Exner et al. 2015; Hurd et al. 2012; Rothkopf 2009).

Overland and Kjaernet (2009: 1) present the transition to renewable energy in terms of a 'global strategic race' in which states compete with each other to secure limited resources and this way obtain or secure advantages vis-à-vis other states. Other scholars call it 'a driver of new geopolitical tensions in its own right' (Sujatha 2013; Laird 2013), while Paltsev (2016) makes the argument that the geopolitics of renewable energy create even graver contingencies than fossil fuels in respect to issues associated with technological access, transmission infrastructure, and primary resources and materials among others. In this narrative, the role of China as home to a significant portion of the earth's rare materials, and hence as the ultimate beneficiary of the transition under way, has been highlighted. Nevertheless, a more nuanced account as things stand is that China, offers the most efficient geographic location to extract these critical materials, with mines in the United States and South Africa poised to re-open in the event that availability of rare earth materials becomes a strategic concern

(Scholten and Bosman 2016: 280–1). Moreover, in contrast to fossil fuels, rare earth materials feature high levels of substitutability (Sager 2015: 83). A competitive global market is therefore expected to mute the geopolitical implications of the rare earth materials' supply challenges. In all, the geopolitics of renewable energy seems to reflect soft energy power when compared to the hard power traditionally embodied by fossil energy (Escribano 2017: 248).

A plain transposition of the problems plaguing oil and gas geopolitics to renewable energy fails—crucially—to understand the framework within which the latter will be deployed. Embracing steady-state energy policies would alleviate problems relating to raw materials in a number of ways. First of all, it would ensure the adjustment of economic processes to the properties of critical materials and the utilization of those that can regenerate faster and have longer life cycles. Secondly, green accounting and the use of distinct indices, as prescribed in Chap. 3, would alert states pursuing steady-state policies of looming scarcities in time to adjust their strategies. Thirdly, an extensive focus on recycling would ensure of the extension of longer time horizons for rare earth materials and primary resources (Exner et al. 2015). Fourthly, steady-state mindsets bring due attention to the rejuvenation of economic activity and entrepreneurship at the local level; clean energy systems dependent on scarce raw materials represent only one pillar of the energy transition. This extends crucially to envisaging a multitude of customized technological solutions that will tailor energy needs differently in different places, and will use different resources.

While renewables may well marginalize conflict risk (O'Sullivan et al. 2017: 29; Hoggett 2014), not least since access to energy can stem instability and conflict (O'Sullivan et al. 2017: v–vii), many scholars maintain that the transition to renewable energy will reshuffle traditional alliances and lead to new patterns of inter-state interdependence (Verrastro et al. 2010; Johansson 2013). Expansive renewable energy infrastructure, the argument continues, carries geopolitical implications, yielding privileged positions for more efficient producers, transit states, and big consumers. Three caveats are important at this point. Firstly, international renewable energy markets may well grow competitively, thus eroding the political leverage of the mightiest actors. In contrast to the global oil market and the globalizing gas market, moreover, trade in renewables is more likely to be of more circumscribed at a regional rather than global scale (Hübner 2016). This characteristic elevates the importance of regions, regional integration schemes, and broader inter-regional relations. However, it is also important to bear in mind the host of geopolitical, technological, practical, and business hurdles surrounding the implementation of mega-projects—as evidenced by the failure of the ambitious Desertec and Mediterranean Solar Plan projects to materialize (Van de Graaf and Sovacool 2014). Secondly, the nature of electricity networks restricts the ability of exporting states to enforce supply cuts in the network without significant side effects. Thirdly, and most importantly, renewable energy generation—as we saw in the two previous chapters—is more suited for local consumption. Transportation over long distances, in contrast, not only results in significant energy losses but also adds significant layer costs, not least due to load management and additional infrastructure requirements. As a result, a hybrid energy system is more likely to evolve in which most states produce at least part of their energy themselves, either in a centralized or decentralized mode, and become significantly less dependent on imports than is the case today. When states trade, crucially, they will do so principally for efficiency reasons (to buy cheaper renewable energy) rather than out of a complete lack of indigenous sources and the corresponding inability to generate their own energy. This picture seems more realistic if we bear in mind that different types of renewable energy can be generated (at variable costs) in different places across the world. In this setting, states around the world can become semi-autarchic. Given the ability of states to cover a substantial part of their energy needs on their own, energy is transformed into a simple commodity rather than a strategic good, becoming consequently desecuritized (Scholten and Bosman 2016; Hübner 2016).

As O'Sullivan et al. (2017: 16–17) insightfully write,

> Cheap solar, innovative business models, and a new breed of entrepreneurs are revolutionizing how energy access issues are addressed … The rise in the number of these successful start-ups that enable demand response is leading to increasingly more distributed energy systems. In turn, these more distributed systems may require a broadening of the decision-making power away from a concentrated set of a few countries and large players to one that empowers more individuals and smaller players.

Such a position lies close to Rifkin's (2011: 37) arguments that large-scale generation of renewable energy is a democratizing force in the global system. In this context, 'geopolitical implications of [renewable] energy supply are almost non-existent. As each country now generates its own electricity from renewables without the need to import sources, geopolitical concerns change from energy input to material input of clean energy production technology' (Scholten and Bosman 2016: 280). Crucially, once built, renewable infrastructure operates for decades. In contrast to the ubiquitous need for the constant flow of fossil energy as is nowadays the case, renewable energy leads to independence in the sense that clean technology companies retain very limited leverage once renewable energy infrastructure is sold. While countries would still compete on research and development of clean energy technologies also for strategic reasons, it 'makes little sense to discuss cross-border geopolitical implications in terms of producer, transit, and consumer country jargon … there is no need for global energy import, transport, or demand diversification policies' (Scholten and Bosman 2016: 280, 279).

To wrap up, the geopolitics of renewable energy should not be viewed through or reproduce the lenses of mainstream energy geopolitics. Their local, decentralized nature works to the benefits of all states (albeit not equally well for all) and brings significant emancipatory characteristics by allowing all countries to partially provide for their energy needs. As O'Sullivan et al. (2017: 37) write, 'at least in the long term, a global energy system dominated by renewable energy will be more stable, peaceful and just than one dominated by fossil fuels'.

Boosting the Developmental Potential of the Global South

Traditional understandings of energy security both embody and mirror wider deficiencies in social organization across the planet. In particular, energy remains essentially cut off from the human security discourse and developmental imperatives (Sovacool and Drupady 2016). Indicatively, the global energy market's developmental shortcomings, failing one fifth of the global population in a state of underdevelopment that leaves billions in energy poverty, remain outside the mainstream energy security agenda (Dannreuther 2015: 468). This global energy market also impedes the creation of an 'emissions headroom to allow for economic development in the rest of the world without substantial increases in carbon emissions' (Bradshaw 2014: 83).

With these conditions as a background, the following analysis builds upon recent trends in scholarship to integrate energy into the mainstream discourse in other fields, such as development and poverty reduction (Goldthau 2013: 521, 525). Energy security analysis, in this context, expands to assess the extent to which energy is 'properly governed and socially acceptable' (Brown and Sovacool 2011: 318). This brings us to the catchall term of 'development'. Defined as the freedom of people not only to enhance their well-being (itself defined in broad rather than narrow economic terms) but also to embark upon their own life choices and run their lives in ways that reflect their worldviews (Sen 1999), development remains very much in want around the world. Fossil energy has played a catalytic role in propping up repressive regimes and depriving individuals from the opportunity for self-determination. Accordingly, the divestment of fossil fuels raises high hopes for development as a major historical reversal of the status quo in many parts of the developing world. To the extent that the transition from fossil to non-fossil energy does not implicate resource-endowed developing countries in polemical politics and war, these states stand to gain substantially from the disentanglement of governance structures from the pervasive resource curse. Furthermore, as we briefly saw in Chap. 3, the establishment of a decentralized energy architecture via micro-generation and community energy speaks directly to the needs of the Global South and is a promising response to the persistent energy poverty and developmental pathogenies that act as a plague. For these reasons, the positive effects of steady-state energy policies are in many respects more promising and comprehensive for the Global South.

Combating Energy Poverty and Building Sustainable Livelihoods

To begin with, energy poverty, defined as 'lack of access to electricity and dependence on solid biomass fuels for cooking and heating' (Sovacool and Drupady 2016: 1), represents a structural factor behind the destitution, deprivation and rising inequalities in the Global South (Friedman 2009: 194–209). Most households in the least and less developed countries burn wood in order to cover basic energy needs. This introduces a self-reinforcing vicious cycle in these communities. First, emissions in closed spaces cause respiratory diseases, which account for a high number of health problems and deaths. At the same time, gathering wood for fire is a time-consuming, extremely demanding and hazardous task, carried out primarily by women and girls. This is also one reason why young girls drop education prematurely, do not pursue careers, and end up replicating traditional families. This, in its turn, makes it more likely for the future generations to face the same adverse conditions as well (Carbonnier and Brugger 2013: 66). Populations in the Global South are hence trapped in an under-developmental nexus of poverty, poor health, drudgery, low productivity, and household food insecurity—reinforcing one another and reproducing these conditions. At the same time, constant demand for wood bears dire ramifications for deforestation. This not only aggravates resource scarcity for these populations but also eliminates critical sinks for the absorption of growing greenhouse emissions (Carbonnier and Brugger 2013: 68). Such losses in natural capital mean further impoverishment and undermine development.

Contrast these abysmal contemporary conditions with smart local decentralized renewable systems. These bestow great developmental potential for the Global South with the potential to deliver practical, productive, and strategic benefits (Sovacool and Drupady 2016: 55). In particular, they can cover the population's basic energy services, most prominently cooking, heating and lighting, combat energy poverty, provide mechanical power for productive uses, and grant widespread energy access to poor communities (Scholten and Bosman 2016; Goldthau 2013: 521; Coelho and Goldemberg 2013: 468–70). Crucially, renewable energy schemes can alleviate the drudgery stemming from fuel collection; increase time availability and education attendance; serve as springboards for the improvement of human health; support income generation; and for the creation of employment places and new types of economic activity (Sovacool 2016; Sovacool and Drupady 2016). In doing so, they can substantially ease pressure on critical ecological sources and sinks, alter contemporary inimical demographics, facilitate economic development, and unleash progressive forces (Dubash and Florini 2011: 11; Sovacool and Drupady 2016: 11). Far from this being mere speculation, empirical evidence from a handful of such cases across the Global South supports this theory, namely that renewable energy brings multiple benefits to poor, marginalized communities (Sovacool and Drupady 2016). In this context, renewable energy seems the most practical vehicle to achieving the United Nations Sustainable Development Goals (UNSDGs) (Sovacool and Drupady 2016; O'Sullivan et al. 2017: 29–30).

Guided by a steady-state mindset, the international community can effectively scale-up the work of initiatives with global remit (e.g. the Global Village Energy Partnership and the Solar Electric Light Fund) to provide targeted support for the proliferation of clean, smart renewable energy systems in the Global South. In doing so, these activities would closely align energy access and services with the UNSDGs, and essentially give real substance to a nascent sustainable program paradigm of international development driven by environmental and social goals (Sovacool and Drupady 2016: 290). As steady-state policies in the Global North are no more by themselves sufficient to ensure climate stabilization, external policies directed to the same steady-state principles and goals are essential. These emanate from the enlightened self-interest to mitigate climate change, and begin with action to halt deforestation in the Global South, which represents both an increasingly potent source of emissions and a mounting threat to carbon sinks. In this context, as long as the international community is committed to funding, disseminating knowledge and know-how, and broadly supporting local initiatives, the transition to clean energy systems can boost the developmental cause in the Global South,. This benefits the climate change mitigation agenda both directly and indirectly. At a more profound level, development carries significant potential to rejuvenate repressive conditions in underdeveloped societies, enabling alternative visions for governance and facilitating entrepreneurial innovations—this way enriching pluralities and reinforcing the switch to sustainable livelihoods (Stirling 2016).

Bringing the Resource Curse to an End

The political implications emanating from such a profound energy transition can hardly be overestimated. Self-generation of energy not only empowers the people of developing countries, but also encourages more inclusive forms of governance (Sweijs et al. 2014: 73). This is even more crucial for the populations of resource-endowed states as it involves the much-desired liberation from the multivalent effects of the pervasive resource curse. As Ebinger and Avasarala (2013: 197–200) insightfully point out,

> shifting energy patterns have ramifications on the role of the Middle East, the geopolitical game around it and its domestic politics, the very understanding and definition of energy security from traditional concerns of

> secure and affordable supply to energy access placing the burden on the eradication of energy poverty and theorizing energy as a fundamental right rather than a privilege of the industrialized world. This in its turn has the potential to feed back into and impact on the governance nexus, the principles guiding it, and the interplay between a wide array of actors variably situated institutionally and across the international political spectrum.

Three aspects of the resource curse dominate the literature and merit attention here to the extent that they effectively work against development. First, resource endowment and autocratic modes of governance are closely linked (Kuzemko et al. 2015: 96–7; Keen 2008; Youngs 2009; Obi 2010). The influx of petrodollars makes the governments of these states immune from popular pressures for a more decent life; better education; more and fairer political participation and representation through democratic election; and the provision and protection of human rights (Shaffer 2011). In accordance with Friedman's (2009) first law of petropolitics, energy-induced revenues undermine freedom. It is indicative that out of the twenty-three states that overwhelmingly base their welfare on such revenues, none is a democracy. Paul Collier (2007) has exemplarily shown how natural resources-endowment, together with conflict, inimical geography and poor governance, conjoin to create four mutually reinforcing traps that go against fundamental human rights and welfare in parts of the Global South.

As a result, freedom is severely compromised and the potential for human development curtailed. Women face even direr restrictions and their emancipatory and developmental potential is more fiercely encumbered upon. Ross (2008) has convincingly argued that it is the impact of oil, rather than Islam, that compromises gender equality across the Global South by minimizing women's place in the labor market, and subsequently repressing their social, economic, and political role. Oil regimes perpetuate patriarchy across the social and political structures, and hence sustain and reproduce gender inequality.

Authoritarian regimes retain, as a result, the power to oppress their people with the tacit support of the importers, most of which are paradoxically consolidated democracies that support the protection of human rights internationally and spread of democracy (Douthwaite 1992; Youngs 2009). Through its deep-rooted alliances with undemocratic energy producers, the Global North is unreservedly complicit in the perpetuation of energy poverty, the suppression of freedom, and the persistent underdevelopment of the energy-endowed countries' populations (Friedman 2009). The U.S.-Saudi Arabia alliance serves as the most high-profile example; the EU's far too tolerant approach vis-à-vis the Caspian states (the case of Azerbaijan stands out here) is another case in point (Siddi 2017). Instigating a steady-state energy policy in the Global North (and a low-growth, low-carbon one in other importing states, most prominently China and India) would effectively stem demand for oil and gas, this way ceasing support for these autocratic regimes and instigating profound societal change. In this context, a steady-state energy policy at home, undertaken for fundamentally ecological and economic reasons, bears paramount implications for governance structures and societies in resource-endowed countries.

Crucially, a drastic reduction in the number of autocratic regimes in the world brings multiplying effects for the potential of peace on earth, as it reduces the number of conflict scenarios. The democratic peace proposition (Doyle 1983a, b; Russett and Oneal 2001), which posits that democracies do not fight each other, can be considered akin to a law of global politics given the overwhelming empirical evidence and statistical record—a rare status in in International Relations theory. To the extent that the dwindling importance of resource endowment will lead to democratization around the world then, the result will be crucial to the pacification of the global system, an indispensable prerequisite for development (Overland 2015: 3528).

Secondly, there is a strong correlation between resource-endowment, on the one hand, and the frequency of coups d'état and civil wars on the other. The central importance of rent-seeking in the absence of any other productive revenue-generating means leads to perpetual political pathogenies. Mutual reinforcement of the massive mismanagement and misappropriation of public funds, a relentless struggle for power, and a spiral of greed and grievances effectively drag states and whole regions into ubiquitous destitution (Collier 2007; Bradshaw 2014: 169, 176; Overland 2015: 3528). Complex historical and geographical factors also constitute significant variables and thus have to be taken into account when discussing the nexus between resource-endowment, civil conflict, and underdevelopment. In light of the statistically established causal relationship between resource-endowment and civil unrest, however, such a reductionist logic seems warranted (Overland 2015: 3528). Development can hardly take root in a state of perpetual civil unrest, violence, and bloody competition among factions.

Thirdly, resource-endowment effectively defines the workings of the economy and impacts on social structures in very repressive and limiting ways. A rentier fossil industry constitutes in effect an enclave economy that leads to 'retarded and deficient diversification, retarded urbanization, surplus rural labor and ensuing social tensions and income inequalities' (Bradshaw 2014: 174–5). What makes this staple trap more consequential is not only the rentier effect whereby the population lacks control over national resource since it does not itself generate the revenue stream, but also the repressive effect. This refers to the brutal reality that the government expenditures of revenues generated by fossil energy exports are directed towards the establishment and maintenance of oppressive regimes, supplemented by the provision of side-benefits to citizens so that the autocratic mode of governance becomes more palatable. Oil-rich states such as Saudi Arabia and Algeria, for example, were able to ward off protests in the wake of the Arab Spring by means of distributing higher dividends to their populations. The repressive effect naturally retards the emergence of a democratic opposition (the modernization effect) which in turn ensures a very slow evolution of worldviews in the presence of restricted information flows and ideas. The entrenchment of traditional patriarchic and anachronistic worldviews within repressive regimes is a side-characteristic of pivotal importance; inhuman laws persist, as a result, and women remain confined to traditional, repressed roles. Rallies for social and political change are thus effectively muted (Bradshaw 2014: 175–6).

While eliminating the resource curse is more likely to ensue from steady-state energy policies undertaken by importing nations, it is important to underline that this rent-based economic model is inherently problematic and unsustainable for resource-endowed regimes as well. This is because these regimes, as a means to placate their people, heavily subsidize domestic energy consumption. This, together with upward demographic and per capita energy consumption trends, translates into higher costs and reduced export capacity, which constitutes the very basis of the regimes' economic welfare or sustenance. Pressures on regimes become particularly intense when coinciding with low international prices (Fattouh and Sen 2016: 6). One can also note a certain correlation between the fluctuations of export-induced revenues and domestic political developments. The eruption of the Arab Spring in Egypt at a time of reduced energy windfalls for the regime is one example; the strengthening of democracy Indonesia over the past decade, to take another example, has taken place in tandem with evaporating fossil energy income and exit from the Organization of the Petroleum Exporting Countries (OPEC) (Overland 2015: 3526). Enlightened self-interest, thus, could also serve as a motivating factor for a ground-breaking policy shift from within the resource-endowed part of the world. Such developments can also be viewed in the anticipation that importing countries will inevitably take this path sooner. Related to this latter point, it is reasonable to expect that the more the energy dependency of the Global North declines with a shift away from fossil energy, the more openly critical and actively confrontational the Western world will become regarding poor human rights records and undemocratic modes of governance in resource-rich states (Overland 2015: 3528).

Current policies in support for low carbon transitions have hardly generated the necessary conditions to divest the fossil industry and extricate its impact on underdevelopment. Concerted steady-state energy policies, to the contrary, will produce much more far-reaching effects. The difference again is one of scope and scale. Current climate measures aim only to reduce emissions, and hence fossil imports, to a small extent, in fear that bolder goals will negatively affect growth. As a result, oil and gas retain significant market shares, and are projected to do so in the near future as well (OECD/IEA 2016: 5–7). Autocratic regimes hence hardly feel any pressure on the economic base of their power—no wonder then of the persistence of repressive practices and blocked developmental potential of societies in fossil resource-rich countries. In the event steady-state energy policies are pursued, the damage afflicted to budgets will be so stark that these regimes will be forced to revisit the structure of their economies. This would usher in an era of important decisions regarding the future political, economic, and social organization of these countries. Reframing the issue in temporal terms, a steady-state energy policy would pose an immediate existential threat to resource-endowed autocratic regimes and bring forth immediate change; low-carbon energy policies, to the contrary, allow resource-endowed autocratic regimes to buy time, cling to authoritarian practices, and persist with abhorrent human rights violations.

In all, the way the geopolitics of transition unfold—whether peaceful or messy, bloody regime change—will largely determine the developmental potential of the Global South in the decades to come. Countries that will become bogged down in regional and civil turmoil will see their welfare standards fall dramatically. In the presence of smooth and peaceful transitions, on the other hand, conducive ground will exist for successful developmental policies to take hold.

The inherent uncertainty regarding the trajectory and implications of change should not serve as pretext for delaying the transition to clean energy systems and divestment of the fossil sector. Energy has been a central factor behind authoritarianism, underdevelopment, and imprudent global politics (O'Sullivan 2013: 42). Absent the influx of petrodollars, unaccountable elites will ultimately have to find new ways to fund and hold onto power, or seriously risk ousting. Whether they will choose to act prudently with far-reaching institutional reforms that replace enclave economies with healthier, diversified and robust economic structure—thereby propelling further democratization and advance prosperity and inclusivity—remains to be seen. Energy-endowment, regardless, will cease to serve as a fierce structural impediment to such long-anticipated developments. Once the resource curse disappears, the dependence on global energy markets dwindles, and the staple trap dissolves, societies of the resource-endowed countries of the Global South will be freed to pursue their own developmental trajectories. While the road will be bumpy, historically repressed societies will have the chance to take on their developmental path.

In contrast to fossil fuel dependent economies, renewable energy based systems are unlikely to be plagued by a resource curse, even one linked to rare earth materials. This is so because, besides the substitutability of raw materials, a steady-state energy policy would place significant safeguards in place. Green auditing, engineering of critical material properties, maximum recycling, energy use close to source, and diversified local energy technologies customized to local needs, would make a renewable energy powered economy less prone to the resource curse. On top of that, the successful roll-out of clean energy systems is likely to lead to more diversified and refined economic structures since it calls for 'high governance capacity and the involvement of multiple sectors, including rare earths and metals, technology, skilled labor, manufacturing and construction' (O'Sullivan et al. 2017: 18).

The prevalence of fossil energy, to wrap up, represents a fundamental structural factor that propels and sustains civil unrest, repressive regimes and practices, and deficient economic and social structures. Mainstream energy policies in both the importing and the exporting world—resource-poor and the resource-endowed—fail to support developmental ideals. A steady-state energy policy, more likely instituted by the non-resource endowed but also benefiting resource-endowed states, could decisively break the link between the fossil energy sector and wide-ranging underdevelopment (Table 5.1).

Table 5.1 Geopolitics and development in the steady-state and mainstream energy policy framework

Impact on high order goals	*Steady-state energy policy*	*Mainstream energy policy*
Geopolitics		
Conflict, security and balance of power	Lower risk of conflict in these cases where oil and gas interests are implicated Reshuffling of alliances once oil and gas are no more the cementing glue Winners and losers Improved security for importers	Oil and gas linked with conflict, polemical politics, order and balance of power A global monetary-trade-geopolitics nexus Energy dependence a perpetual weakness of importers
Transition	Dangerous transition Potential for conflict eruption and order breakdown The specter of fossil divestment Need for radical, collective understandings	Current global order and balance of power unsustainable
The geopolitics of renewable energy	Geopolitical competition of rare earth materials exaggerated Energy becomes a commercial rather than strategic good Local nature of renewable energy an empowering factor for smaller, non-resource-endowed states, and a democratizing factor in the global system	Advent of renewables seen as reproducing competitive geopolitical dynamics akin to those of fossil fuels
Development		
Clean energy systems and development	A close fit to the Global South's developmental needs Combating energy poverty A developmental springboard	Energy poverty perpetuated Persistence of underdevelopment The Global South remains marginalized
Untangling fossil energy-underdevelopment nexus	Eliminating the resource curse Undoing the power base of resource-endowed autocratic, repressive regimes Developmental potential unlocked Potential for peace enhanced	Severe link between resource-endowment and autocracy Repression Developmental potential muted Marginalization of women

Conclusion

In conclusion, embracing a steady-state energy policy presents significant benefits on the geopolitical and developmental fronts. To reiterate, effecting a large-scale divestment of the global fossil industry will effectively dilute the central role of oil and gas in defining the global order and the global (and regional) balance of power. In the same context, it can be reasonably expected that divestment will lessen the risk of conflict where oil and gas are implicated. Equally important, the divestment of the fossil industry will inflict a severe blow to the power base of autocratic and repressive regimes around the world, and this way break the vicious link between fossil energy, on the one hand, and authoritarianism and underdevelopment on the other.

This having been said, the transition towards a steady-state world presents formidable difficulties and challenges. These challenges rest on the effects such a transition will have on the powerful resource-endowed regimes around the world, as well as to how the fossil divestment shocks will be absorbed by the global society of states. Unless more radical understandings regarding the role of energy and the price of conflict enter the mainstream, however, and global cooperation accordingly proliferates and deepens in that direction, these risks will be hard to effectively mitigate.

In contrast to the bumpy transition, a renewable energy powered world will be significantly less conflictive. Rather than reproducing traditional competitive geopolitical dynamics of fossil energy, renewable systems are more likely to reflect hybrid functional dynamics at the local and national levels, as well as secondary processes at the regional level. Furthermore, renewables can directly combat energy poverty and serve as the developmental springboard in the road to fulfilling the UNSDGs.

Low-carbon transitions lack the scope and scale of ambition to eliminate the central role fossil energy plays in the global system. The adoption of steady-state energy policies as an alternative bears significant geopolitical and developmental opportunities, including the end to the resource-curse that will bring resource-endowed autocratic regimes to their knees. While steady-state energy policies will bring forth radical developments on the ground within a few years, unfolding low-carbon transitions will only do so within decades.

In this context, it is hard to exaggerate the importance of the great powers' energy policies to both the distribution of power within the global society and for their future place in the world. The states that choose to build their economies within the Earth's regenerative and absorptive capacities will enjoy a significant advantage vis-à-vis the ones that delay this decision or fail to act. Choosing sustainability thus appears to represent the clear passport for the future (Wackernagel et al. 2006). The way that states will interact, cooperate, or conflict with each other along the energy and climate axis will also determine patterns of alliance, trade links, and global governance (political, economic, and climate) in the next decades. An understanding that one player's energy security hinges upon the security, social welfare, and sustainable development of others is key at this critical juncture (Carbonnier and Brugger 2013: 68). In this context, future energy policy may play an even more pivotal role for the configuration of global politics.

Note

1. Energy prerogatives are inherent pillars of the grand strategy of states around the world and can be conceptually distinguished as ends, ways and means (O'Sullivan 2013: 32; Kuzemko et al. 2015: 58–78, 97). More to the point, energy can be an end, as in the case of the Iraqi wars, although one has to make the crucial distinction between strategic and commercial goals. Secondly, energy can serve as a political weapon and a means to cement and hold together strategically important alliances. The role of energy in the establishment of the Eurasian Union under the auspices of Russia constitutes an indicative example. Thirdly, energy can be a means through the resources it generates. As such, natural resources endowment and management is critical for states' place in the world (O'Sullivan 2013: 32–41; Kallis and Sager 2017: 568).

References

Andrews-Speed, P. and Dannreuther, R. 2011. *China, Oil and Global Politics.* London: Routlegde.

Andrews-Speed, P., Liao, X. and Dannreuther, R. 2002. The Strategic Impact of China's Energy Needs. *International Institute for Strategic Studies.* London: Adelphi Paper.

Aras, B. and Yorulmazlar, E. 2016. State, Region and Order: Geopolitics of the Arab Spring. *Third World Quarterly,* 37: 12, 2259–2273.

Bradshaw, M. 2014. *Global Energy Dilemmas.* Cambridge: Polity Press.

Bridge, G. et al. 2013. Geographies of Energy Transition: Space, Place and the Low-Carbon Economy. *Energy Policy,* 53, 331–340.

Brown, M. and Sovacool, B. 2011. *Climate Change and Global Energy Security: Technology and Policy Options.* Cambridge, MA: MIT Press.

Carbonnier, G. and Brugger, F. 2013. The Development Nexus of Global Energy, in A. Goldthau (ed.), *The Handbook of Global Energy Policy.* Chichester: Wiley-Blackwell, 64–78.

Cherp, A. and Jewell, J. 2014. The Concept of Energy Security: Beyond the Four As. *Energy Policy,* 75, 415–421.

Coelho, S. and Goldemberg, J. 2013. Global Energy Policy: A View from Brazil, in A. Goldthau (ed.), *The Handbook of Global Energy Policy.* Chichester: Wiley-Blackwell, 457–476.

Cohen, A. 2009. Russia: The Flawed Energy Superpower, in G. Luft and A. Korin (eds), *Energy Security Challenges for the 21st Century.* West Port: Greenwood Publishing Group, 91–108.

Collier, P. 2007. *The Bottom Billion. Why the Poorest Countries are Failing and What Can Be Done About It.* Oxford: Oxford University Press.

Dannreuther, R. 2015. Energy Security and Shifting Modes of Governance. *International Politics,* 52: 4, 466–483.

De Ridder, M. 2013. *The Geopolitics of Mineral Resources for Renewable Energy Technologies.* The Hague: The Hague Center for Strategic Studies.

Douthwaite, R. 1992. *The Growth Illusion: How Economic Growth Enriched the Few, Impoverished the Many, and Endangered the Planet.* Canada: New Society Publishers.

Doyle, M. 1983a. Kant, Liberal Legacies, and Foreign Affairs. *Philosophy & Public Affairs,* 12: 3, 205–235.

Doyle, M. 1983b. Kant, Liberal Legacies, and Foreign Affairs. *Philosophy & Public Affairs,* 12: 4, 323–353.

Dubash, N. and Florini, A. 2011. Mapping Global Energy Governance. *Global Policy,* 2: 1, 6–18.

Ebinger, C. and Avasarala, G. 2013. The "Gs" and the Future of Energy Governance in a Multipolar World, in A. Goldthau (ed.), *The Handbook of Global Energy Policy.* Chichester: Wiley-Blackwell, 190–204.

Escribano, G. 2017. RES in the Hood and the Shrinking Mediterranean Solar Plan, in I. Solorio and H. Jörgens (eds), *A Guide to EU Renewable Energy Policy. Comparing Europeanization and Domestic Policy Change in EU Member States.* Cheltenham: Edward Elgar, 247–264.

Exner, A., Lauk, C. and Zittel, W. 2015. Sold Futures? The Global Availability of Metals and Economic Growth at the Peripheries: Distribution and Regulation in a Degrowth Perspective. *Antipode,* 47: 2, 342–359.

Fattouh, B. and Sen, A. 2016. OPEC Deal or No Deal? This is Not the Question. *Oxford Energy Comment, The Oxford Institute for Energy Studies,* 1–8.

Friedman, T. 2009. *Hot, Flat, and Crowded: Why We Need a Green Revolution – And How it Can Renew America Release 2.0.* New York: Picador.

Goldthau, A. 2013. Conclusion: Global Energy Policy: Findings and New Research Agendas, in A. Goldthau (ed.), *The Handbook of Global Energy Policy*. Chichester: Wiley-Blackwell, 521–525.
Goldthau, A. 2017. The G20 Must Govern the Shift to Low-Carbon Energy. *Nature Comment*, 546: 7657, 203–205.
Gulmohamad, Z. 2014. The Rise and Fall of the Islamic State of Iraq and Al-Sham (Levant) ISIS. *Global Security Studies,* 5: 2, 1–11.
Haas, P. 2017. Parxit, the United States, and the World. *Chinese Journal of Population Resources and Environment* [first online], 1–3.
Hensel, N. 2012. An Economic and National Security Perspective on Critical Resources in the Energy Sector, in S.F. Krishna-Hensel (ed.), *New Security Frontiers: Critical Energy and the Resource Challenge*. Surrey: Ashgate, 113–138.
Heywood, A. 2011. *Global Politics*. London: Palgrave Macmillan.
Hoggett, R. 2014. Technology Scale and Supply Chains in a Secure, Affordable and Low Carbon Energy Transition. *Applied Energy*, 123, 296–306.
Hübner, C. 2016. Political Agenda: Geopolitics of Energy Transition. *Regional Programme Energy Security and Climate Change in Latin America*. Konrad Adenauer Foundation, 1–10.
Hurd, A. et al. 2012. Energy-Critical Elements for Sustainable Development. *MRS Bulletin*, 37: 4, 405–410.
Jaffe, A. and Soligo, R. 2008. Militarization of Energy: Geopolitical Threats to the Global Energy System. *The Global Energy Market. Comprehensive Strategies to Meet Geopolitical and Economic Risks Working Paper*. Energy Forum, James A. Baker III Institute for Public Policy, Rice University.
Jewell, J., Cherp, A. and Riahi, K. 2014. Energy Security under De-carbonization Scenarios: An Assessment Framework and Evaluation under Different Technology and Policy Choices. *Energy Policy*, 65, 743–760.
Johansson, B. 2013. Security Aspects of Future Renewable Energy Systems. A Short Overview. *Energy*, 61, 598–605.
Judge, A. and Maltby, T. 2017. European Energy Union? Caught between Securitisation and 'Riskification'. *European Journal of International Security,* 2: 2, 179–202.
Kallis, G. and Sager, J. 2017. Oil and the Economy: A Systematic Review of the Literature for Ecological Economists. *Ecological Economics,* 131, 561–571.
Kanet, R. and Sussex, M. 2015. *Russia, Eurasia and the New Geopolitics of Energy: Confrontation and Consolidation*. Heidelberg: Springer.
Kaplan, R. 2014. The Geopolitics of Energy. Stratfor Global Intelligence [Online]. Available: https://www.stratfor.com/weekly/geopolitics-energy [Accessed on 14 April 2016].
Keen, D. 2008. *Complex Emergencies*. Cambridge: Polity Press.
Klare, M. 2015. Hard Power, Soft Power, and Energy Power – The New Foreign Policy Tool. *Foreign Affairs*. March (snapshot).

Kuzemko, C., Keating, M. and Goldthau, A. 2015. *The Global Energy Challenge: Environment, Development and Security*. London: Palgrave Macmillan.

Laird, F. 2013. Against Transitions? Uncovering Conflicts in Changing Energy Systems. *Science as Culture*, 22: 2, 149–156.

Len, C. 2015. China's 21st Century Maritime Silk Road Initiative, Energy Security and SLOC Access. *Maritime Affairs: Journal of the National Maritime Foundation of India,* 11: 1, 1–18.

Martin, M. and Solomon, H. 2017. Islamic State: Understanding the Nature of the Beast and Its Funding. *Contemporary Review of the Middle East,* 4:1, 18–49.

Mecklin, J. 2016. Introduction: International Security in the Age of Renewables. *Bulletin of the Atomic Scientists*, 72: 6, 377.

Meierding, E. 2016. Dismantling the Oil Wars Myth. *Security Studies*, 25: 2, 258–288.

Mulligan, S. 2010. Energy, Environment, and Security: Critical Links in a Post-Peak World. *Global Environmental Politics,* 10: 4, 79–100.

Mulligan, S. 2011. Energy and Human Ecology: A Critical Security Approach. *Environmental Politics*, 20: 5, 633–649.

O'Sullivan, M. 2013. The Entanglement of Energy, Grand Strategy, and International Security, in A. Goldthau (ed.), *The Handbook of Global Energy Policy*. Chichester: Wiley-Blackwell, 30–47.

O'Sullivan, M., Overland, I. and Sandalow, D. 2017. *The Geopolitics of Renewable Energy. Working Paper*. New York: Center on Global Energy Policy Columbia University, 1–59.

Obi, C. 2010. Oil as the 'Curse' of Conflict in Africa: Peering through the Smoke and Mirrors. *Review of African Political Economy,* 37: 126, 483–495.

Odum, H. 2007. *Environment, Power and Society for the Twenty-First Century. The Hierarchy of Energy*. New York: Columbia University Press.

Organization of Economic Cooperation and Development/International Energy Agency. 2016. World Energy Outlook. *Executive Summary,* 1–8.

Overland, I. 2015. Future Petroleum Geopolitics: Consequences of Climate Policy and Unconventional Oil and Gas, in J. Yan (ed.), *Handbook of Clean Energy Systems,* vol. 6, 3517–3544.

Overland, I. and Kjaernet, H. 2009. *Russian Renewable Energy: The Potential for International Cooperation*. Surrey: Ashgate.

Paltsev, S. 2016. The Complicated Geopolitics of Renewable Energy. *Bulletin of the Atomic Scientists*, 72: 6, 390–395.

Perovic, J., Orttung, R. and Wenger, A. 2009. *Russian Energy Power and Foreign Relations: Implications for Conflict and Cooperation*. CCS Studies in Security and International Relations. London: Routledge.

Phillips, A. 2013. A Dangerous Synergy: Energy Securitization, Great Power Rivalry and Strategic Stability in the Asian Century. *The Pacific Review*, 26, 17–38.

Proedrou, F. 2012. *EU Energy Security in the Gas Sector: Evolving Dynamics, Policy Dilemmas and Prospects*. Surrey: Ashgate.
Rifkin, J. 2011. *The Third Industrial Revolution. How Lateral Power is Transforming Energy, the Economy, and the World*. New York: Palgrave Macmillan.
Ross, M. 2008. Oil, Islam, and Women. *American Political Science Review,* 102: 1, 107–123.
Rothkopf, D. 2009. Is a Green World a Safe World? Not Necessarily. A Guide to the Coming Green Geopolitical Crises. *Foreign Policy*, September/October.
Russett, B. and Oneal, J. 2001. *Triangulating Peace. Democracy, Interdependence, and International Organizations*. New York: Norton.
Sager, J. 2015. The Ecological Keynesian: Energy, Money, and Oil Cycles in the Global System [A dissertation submitted in partial satisfaction of the requirements for the degree of Doctor of Philosophy in Energy and Resources in the Graduate Division of the University of California, Berkeley].
Scholten, D. and Bosman, R. 2016. The Geopolitics of Renewables: Exploring the Political Implications of Renewable Energy Systems. *Technological Forecasting & Social Change*, 103, 273–283.
Sen, A. 1999. *Development as Freedom*. Oxford: Oxford University Press.
Shaffer, B. 2011. *Energy Politics*. Philadelphia: University of Pennsylvania Press.
Sharples, J. 2013. Russian Approaches to Energy Security and Climate Change: Russian Gas Exports to the EU. *Environmental Politics,* 22: 4, 683–700.
Siddi, M. 2017. The Scramble for Energy Supplies to South Eastern Europe: The EU's Southern Gas Corridor, Russia's Pipelines and Turkey's Role, in M. Schröder, W. Wessels and M. Bettzuege (eds.), *Turkey's Potential as Future Energy Hub*. Baden-Baden: Nomos, 49–66.
Sovacool, B. 2016. How Long Will It Take? Conceptualizing the Temporal Dynamics of Energy Transitions. *Energy Research & Social Science,* 13, 202–215.
Sovacool, B. and Drupady, I. 2016. *Energy Access, Poverty, and Development: The Governance of Small-Scale Renewable Energy in Developing Asia* London and New York: Routledge.
Stirling, A. 2016. Outgrowing the Twin Simplifications of Growth and Degrowth: Part 3. *STEPS Centre. Paths to Sustainability* [Online]. Available: http://steps-centre.org/2016/blog/outgrowing-the-twin-simplifications-of-growth-and-degrowth-part-3/ [Accessed on 30 January 2017].
Sujatha, R. 2013. Fossilizing Renewable Energies. *Science as Culture,* 22: 2, 172–180.
Sweijs, T. et al. 2014. *Time to Wake Up: The Geopolitics of EU 2030 Climate and Energy Policies*. The Hague: The Hague Center for Strategic Studies.
Van de Graaf, T. and Sovacool, B. 2014. Thinking Big: Politics, Progress, and Security in the Management of Asian and European Energy Megaprojects. *Energy Policy,* 74, 16–27.

Verrastro, et al. 2010. The Geopolitics of Energy. Emerging Trends, Changing Landscapes, Uncertain Times. *A Report of the CSIS Energy and National Security Program*, 1–46.

Wackernagel, M. et al. 2006. Ecological Footprint Accounts for Advancing Sustainability: Measuring Human Demands on Nature, in P. Lawn (ed.), *Sustainable Development Indicators in Ecological Economics.* Cheltenham: Edward Elgar, 246–267.

Watkin, K. 2014. Targeting "Islamic State" Oil Facilities. *International Law Studies – US Navy War College,* 90: 1, 499–513.

Westphal, K. 2011. Energy in an Era of Unprecedented Uncertainty: International Energy Governance in the Face of Macroeconomic, Geopolitical, and Systemic Challenges, in D. Koranyi (ed.), *Transatlantic Energy Futures: Strategic Perspectives on Energy Security, Climate Change and New Technologies in Europe and the United States.* Washington, DC: Center for Transatlantic Relations, 1–26.

Westphal, K. and Droege, S. 2015. Global Energy Markets in Transition: Implications for Geopolitics, Economy and Environment, in M. Roth, C. Ulbert and T. Debiel (eds), *Global Trends 2015. Prospects for World Society*, Bonn: Development and Peace Foundation, Institute for Development and Peace Käte Hamburger Kolleg/Centre for Global Cooperation Research, 235–254.

Youngs, R. 2009. *Energy Security: Europe's New Foreign Policy Challenges.* London: Routledge.

CHAPTER 6

Conclusion

Towards a Brave New World

Not only have growth-based policies failed to provide a comprehensive response to the climate change challenge, future projections also show that mitigation remains a distant prospect. The analysis in this book originates from this empirical evidence and the concomitant assumption that policies that pursue growth are incompatible with the climate change-mandated notions of limits and prudent housekeeping. On these grounds, ecological and steady-state economics is presented as a theoretical framework that provides alternative conceptual understandings based on the ecology-economy nexus with suggested policies and policy tools to return economic activity within biophysical limits.

Since climate change is at its core an energy issue, the analysis scrutinizes the implications that the alternative steady-state policy framework carries for energy policy, presenting a radical steady-state energy policy for a world of full sources and sinks. The book sets out how such a transition would unfold, and evaluates its merits across the energy security, geopolitics, and developmental fronts. In doing so, it also aims to render these benefits as clear and transparent as possible, direct policy attention to important caveats, and this way enhance policy-making along more radical pathways inspired by ecological and steady-state realities.

A major contribution of this monograph to the scholarly literature lies precisely in bringing ecological and steady-state economics' principles, assumptions, and arguments into the energy realm. A close look at the

F. Proedrou, *Energy Policy and Security under Climate Change*,
https://doi.org/10.1007/978-3-319-77164-9_6

linkages between core economic policy reforms and a radical energy policy yields important policy prescriptions to return the economy within ecological limitations. To reiterate, a restrictive monetary policy circumscribes money supply within the remaining available limits for carbon equivalent emissions—retained more or less constant—with the effect that fossil energy use returns within biophysical limits. A revisited trade policy applies the brakes on energy-intensive and unsustainable trade rationalizes energy use in trade; undoes the persistent barriers to the free transmission of knowledge and ideas; supports global cooperative platforms; and favors more indigenous, renewable energy production. Side by side with monetary and trade policies, ecological and steady-state economists suggest the need for an ecological tax reform. This can play a pivotal role in reducing fossil energy use, not least by means of presenting ubiquitous incentives to create a virtuous cycle for energy efficiency and conservation gains, as well as the large-scale displacement of fossil fuels by renewable energy. Consistent with the needs of a climate-strained world, an investment policy that terminates the artificial capital scarcity, proactively engages with the financial community, and mobilizes public finance with a special focus on clean transport and aviation is also very much in need.

These policies are essential in two fundamental ways: firstly, they discourage fossil energy use; and, secondly, they favor the large-scale generation of renewable energy. They are, however, by themselves insufficient to bring about energy use within biophysical limits. A consistent, steady-state energy policy is therefore required. Effectuating a transition to steady-state energy use would begin with legislating caps on emissions in accordance with a stringent carbon budget. Rather than rely on reductions against the benchmark of emissions in 1990, a stringent carbon budget would impose moratoria on carbon-intensive coal and unconventional energy production. In order to fill the resulting massive gap in energy supply left by the non-utilization of fossil energy, a fast, full-fledged transition to smart renewable-run energy systems becomes indispensable. Chapter 3 presents two ideal-type blueprints for this transition and discusses their shortcomings as applied within the current growth-driven policy framework. It subsequently elaborates on the potential impact of steady-state energy policy on scaled-up opportunities for these two models, provides strategic support and appropriate relevant regulation for successful implementation, and aligns them with the climate change mitigation imperative. The hard pathway replicates mainstream business models, dominant market mindsets, and top-down processes of energy generation. In this paradigm, large energy corporations and financial players are incentivized through favorable regulation and subsidy schemes to invest heavily in renewable energy generation. This generation will then be fed into the grid, greening the mix and providing cleaner energy services. The soft pathway, on the other hand, revolves around the promotion of bottom-up renewable energy generation. Community energy, micro-generation, self-consumption and prosumption have the potential to distribute the availability of renewable energy in new cost-effective and sustainable ways. This avenue, however, remains sub-optimally supported by regulatory and financial schemes; its full potential, as a result, remains underexplored. Energy efficiency represents a common denominator within these energy transition pathways. Demand response management and policies to tackle remaining energy inefficiencies constitute crucial pillars in both centralized and decentralized energy systems by decreasing system requirements for renewable energy generation.

A combination of the hard and soft pathways of transition is gradually taking root in different corners of the world; the transition, however, lacks the urgency, speed, scale, and scope needed to bring fossil energy consumption down to biophysical limits. Reluctance to legislate strict limits to final energy use, tied to the primacy of economic growth, means to the presence of constraints on how much contemporary decarbonization policies can achieve in a growth-based economic and energy policy framework. Modest goals can only lead to modest policy measures; the setting of substandard goals hence in practice circumscribes the extent of success they can muster. Moreover, given that these measures lack the broader supportive framework of steady-state monetary, trade, tax, and investment policies, they can hardly rise to meet the climate change mitigation challenge.

A steady-state energy policy, to the contrary, would restrict fossil energy use within biophysical limits, mobilize resources to tap into energy efficiency's enormous potential, heavily promote and subsidize renewable energy generation schemes, and cede emphasis on local energy potential as a ground-breaking way to create and empower sustainable communities. The host of supportive policies described above would provide conducive ground for the consistent and successful implementation of these schemes, this way assisting in speeding up and scaling-up the energy transition.

Steady-state approaches, however, remain outside mainstream political thought. One then is justified to ask what can stimulate a radical shift from conventional to steady-state policies. Compared to the dystopia of a perpetually growing world economy that will inevitably lead to a much less hospitable physical environment in the near future, the utopia of reversing catastrophic climate change through regulating and restricting economic activity and energy use is a vital, even if daunting, possibility and pathway that has to be explored in its fullest. In pragmatic terms, one can hardly expect the world to suddenly become enlightened to the threat of climate change and move at once to steady-state policies. A more realistic approach is that importers—for a host of climate change, security, economic, ideological and social reasons—drastically reduce fossil energy use and this way effectively stem demand for fossil energy production. Such moves can precipitate the divestment of the fossil sector and bring sweeping changes to the global system in the fight against climate change.

Chapters 4 and 5 scrutinize the implications of such a radical shift in the hope that an assessment of such policies will showcase their merits and this way make the steady-state path easier for policy-makers to consider. Chapter 4 evaluated the energy security benefits of a steady-state energy. While the merits of adopting a steady-state energy policy are clear on the sustainability front, it is far from given that a steady-state energy policy would ensure security of supply at affordable prices. In practice, however, in contrast to the geological, geopolitical and market-related risks of fossil energy, renewable energy presents significant advantages. Renewable energy demonstrates positive attributes such as physical availability of and access to energy, predictability of the energy harvest, and local ownership of energy. Renewable energy systems are also more cost-effective and competitive compared to fossil energy—especially if one internalizes the full costs associated with fossil fuels. Putting the costs of renewable energy in perspective, including indirect monetary benefits and centrality to policy frameworks that prioritize sustainability, dilutes myths of unaffordability in favor of a strong investment case. This is all the more true if due consideration is given to the multiple benefits states stand to gain from moving away from an inherently volatile global fossil energy market. On top of the above, in contrast to the affordable energy prices needed by growth-based polities (who go out of their way in seeking low-cost energy), steady-state energy prices should be high enough to perpetually encourage energy conservation and this way fundamentally reshape economic activity within biophysical limits. Reconsidering the role of energy pricing hence is an essential building block to the establishment of sustainable communities.

Theorizing energy security across its internal dimensions is helpful in providing a comparative assessment of the advantages and downsides of conventional and steady-state energy policies. Energy security, however, also extends to broader issues and characteristics of the global society of states, namely conflict, geopolitics, and development. Chapter 5 assessed the virtues of—and the risks inherent in—the switch to a steady-state energy policy across the geopolitical and developmental fronts. The wide-ranging risks associated with the transition to a steady-state world are hard to overestimate, and include potentially the collapse of resource-endowed states, a last wave of petro-wars, and perhaps even instability to the point of breakdown of the international order in some regions. Massive economic disruption emanating from scores of fossil stranded assets is also very likely to ensue, and could go as far as threaten a new global financial crisis. Such major geopolitical and economic ramifications call for, and can only be successfully tackled with, collective approaches and radical understandings regarding the role of energy and the price of conflict. In all, the fossil divestment is certain to precipitate variable shocks in the global society; or, perhaps a more proper way to put it, the fossil divestment will accelerate processes already under way, and in doing so hasten the collapse of unsustainable regimes, structures and patterns of regional order, and global economic practices. The waning importance of oil and gas is certain to reshuffle geopolitics and the global balance of power, creating winners and losers—albeit at a still uncertain rate of change contingent on a number of variables and hence still blurry.

On the bright side, the broad adoption of steady-state energy policies would curtail the importance of fossil fuels in conflict zones where oil and gas interests are implicated. The advent of large-scale renewable energy deployment, moreover, is unlikely to reproduce the competitive dynamics of the geopolitics of fossil energy. For this reason, while the transition process may be bumpy and hazardous, a renewable energy powered world enjoys a more promising end-state. Local renewable energy systems, at the same time, present a very close fit for the Global South's energy needs and thus carry significant potential for combating energy poverty and serving as a developmental springboard. Furthermore, the divestment of the fossil industry will eliminate the vicious link between oil, authoritarianism, and underdevelopment in favor of comprehensive and multivalent benefits for the populations of resource-endowed states. In this context, a post-carbon, renewable energy powered-world is much more conducive to developmental goals and welfare prospects in the Global South.

This book prioritizes analysis on the Global North for a number of reasons. Firstly, in practical terms, the Global North's excessive historical emissions account for the bulk of the climate change problem. Secondly, the countries of the Global North have reached a stage of development at which they can marshal massive monetary, technological, and scientific resources to adjust societal lifestyles within sustainable carbon footprints. Thirdly, for these reasons, the Global North holds a moral obligation to lead the way in climate change mitigation (Held and Fane-Hervey 2011). Fourthly, since countries of the Global North account for the majority of fossil energy imports, they have the practical wherewithal to stem effective demand, instigating a large-scale divestment of the fossil sector and speeding-up the transition to clean energy systems. Fifthly, climate change action lies to their enlightened self-interest. Averting climate change, allowing sufficient emissions leeway for developing countries, boosting the developmental potential of the Global South, and creating a more amiable global terrain works to the benefit of the established Western states who can afford and preserve substantial welfare levels. This is even more so if one contemplates the likely present scenarios for the near-term collapse of mini-states, countries, or whole regions for a host of political and ecological reasons, a developments that are bound to negatively impact the Global North in multiple ways (Odum 2007).

This having been said, as we saw in the Introduction, the stabilization of the global temperature is realistically unfeasible without the contribution of the Global South. Their role lies principally in greening their growth, gearing it to developmental purposes in efficient ways, and averting significant ecosystem losses (such as deforestation, extensive pollution, and imperiled biodiversity). A parallel check on the immense demand for energy needs to account for its two main drivers: consumption-led amenities and industrial-led demand related to economic growth (Sovacool and Drupady 2016: 11). While the latter needs to be streamlined into developmental outcomes and controlled by tools such as sustainability audits, standards, and regulations, the former must be circumscribed to amenities rather than luxuries—again through proper policy schemes such as taxation, regulation and so on.

In this context, the Global North has every reason to assist the Global South's transition to low-carbon, clean energy systems. While the bulk of policy proposals prescribed in this book regard and target the Global North, explicit mention has also been made to developing countries in many cases. In these, we argue that developing states should choose to implement novel policies by channeling their limited resources (monetary, bureaucratic, political, technological, etc.) to support energy transitions away from the business as usual, unsustainable practices associated with fossil fuels. In this understanding, investments in renewable energy generation are preferable to rigid expenditures for fossil energy imports; designing a decentralized energy architecture is a superior solution to extensive, centralized energy grids; and tax systems and accounting indices can be reshuffled to cater to sustainability goals. This argumentation is directed more towards the direction of policy rather than its feasibility which, at least in the near term, will remain to varying degrees contingent upon support from the Global North.

In all, the strongest candidates for adopting a steady-steady energy policy come from the Global North. The EU's rich record of experimentation with novel approaches, as well as its modest record of infusing sustainability consideration across core policies, underpin such hopes. Furthermore, while the incumbent U.S. president has been overtly hostile to climate change mitigation policies, climate causes and decarbonization policies in the United States have traditionally and systematically eschewed top-down approaches for the bottom-up. Bottom-up initiatives at the state, city and local community levels are invaluable in fostering reference points for steady-state dynamics and best practices for blueprints to cross-load and cross-fertilize policies across the United States and at a global level. On both sides of the Atlantic, moreover, vibrant civil societies constitute an important contributing factor for scaling-up of decarbonization policies (Jörgens et al. 2017: 312; Heinberg 2011). Prominent soft global players with benevolent international branding such as Norway, Canada, Australia, and Japan are also well positioned to entertain a radical switch in energy policy. Together, the Global North has both the wherewithal and a host of good reasons to shift the locus of its policy, propeling a decisive acceleration in climate change mitigation efforts.

This book endeavors to map a forward-looking energy policy that can live up to the climate change challenge. Bringing forward an in-depth analysis of the potential energy security, geopolitics, and development benefits—beyond climate imperatives—it put forth the case that pursuing a ground-breaking energy policy is overall advantageous and thus merits increasing consideration by policy-makers. Future research focused on case studies that showcases optimal ways for different political units to move in this direction is very much in demand. By setting out conditions for successful policy implementation—and suggesting energy policy designs customized to the strengths of different political entities, assets, and respective positions in the global system—this imperative for the research agenda carries the potential to provide lucid analysis and strong grounds for policy shifts towards the steady-state paradigm. Providing well-grounded recommendations on the mix of renewables, the architecture of power markets, role of community energy, and trade with regional partners, among others, would provide policy-makers with a roadmap to transform energy systems consistent with pressing climate imperatives.

Quantitative research that shows opportunities to monetize the benefits emanating from climate change mitigation action at the national/local levels; assesses the profitability of investments on renewables compared to fossil energy; and compares and contrasts hard and soft transition pathways in particular cases are indispensable and very welcome. Customized analyses comparing and contrasting growth-driven versus steady-state energy policies—factoring-in the cumulative benefits of the latter for different political entities—are essential to illuminating precise options for the energy transition in different circumstances.

Policy-making contours and processes in the energy realm represents another welcome research domain. As the realization of a steady-state energy policy runs up against vested interests and a dominant fossil industry, energy transitions will necessitate sidelining the latter's influence (Jörgens et al. 2017: 294). Empirically-informed studies on what policy measures and processes offer opportunities to enable more conducive conditions for the fertilization of steady-state energy policies can render the feasibility of a switch in energy policy clearer—and hence more realizable.

Finally, but importantly, the world is experiencing low growth conditions. A handful of scholars see this as a feature of the future rather than a temporary situation (Gordon 2016; Piketty 2014). More broadly, traditional growth models seem to fail political, economic, and social goals and aspirations, especially in the Global North (Rodrik 2011; Piketty 2014). Adjusting to low growth conditions highlights the need to re-consider domestic policies and global governance structures that constitute relics speaking to past, rather than present and future, needs. Delving into the wealth of alternative ideas in ecological and steady-state scholarship, and the ways in which these ideas can feed into the global monetary-economic-trade-politics nexus, constitutes an enormous—and challenging—research agenda for a new working socio-economic paradigm to improve wellbeing in the twenty-first century. Although this agenda may not hold climate change considerations at its heart, it may encourage more sustainable modes of living by means of undermining growth's central role and encouraging much-needed re-distribution—itself an enabling and facilitative factor of sustainability—across the global, national, and local levels.

Policy Agendas: Past and Future

While climate change mitigation through the overhaul of the global energy system is now feasible (Stirling 2016: 86–7), climate change paradoxically remains low on the (global) political agenda, and subject to issue cycling (Kuzemko et al. 2015: 23, 163). Within a tumultuous global political setting, states and international institutions remain preoccupied with a number of evolving crises of all sorts that deflect attention, energy, and time from humanity's gravest current challenge (Kuzemko et al. 2015: 23). At the same time, governments themselves precipitate crises and contribute to a treacherous and malevolent global terrain amid adversarial international relations—responsible in most cases for problems and policy obstacles.

To begin with, the backlash seen in the rise of populist politics, defined as politics dominated by the separation and antagonism between the 'pure people' on the one hand and the 'corrupt elite' on the other (Mudde 2004: 542), threatens Europe with the establishment of illiberal democracies and a subsequent diminishing urgency to combat climate change. In case such voices become further empowered and dominate political life in European member-states, even today's relatively modest climate agenda is set to substantially suffer. Populism is a threat to the EU's climate and energy policy (and the EU project that drives, even if modest, climate change mitigation efforts) in two main ways.

Firstly, populist parties from both the Right and the Left have either joined mainstream political parties in coalition governments as junior partners, or are themselves the majority governing party. In the majority case, they work directly to co-shape the governmental agenda, thwarting climate-related issues. In general, core features of ultra-right-wing and radical leftist populist parties revolve on an emphasis on the self-versus-other debate/dichotomy, the provision of short-term goods to fortify electoral appeal, and the establishment of a clientelistic state in the making (Kriesi and Pappas 2015). Their political stance is underpinned by a simplistic, linear, monolithic, and mechanistic understanding of the social world (Beinhocker 2017; Sierakowski 2016). In this context, populist parties, particularly on the right of the political spectrum, reject claims on global public goods and international goals since these do not fit their narrow nationalistic agendas, goals, and ambitions. Due consideration for climate issues is starkly missing from their policy agendas. A number of central European states, led by Hungary's Prime Minister Viktor Orbán, have embraced a narrow nationalistic and overtly xenophobic sentiment that undoes the normative foundations upon which European integration has been built and casts doubt on entrenched EU policies, including supranational energy and climate policy. Poland has been the most vocal among them in energy and climate affairs, having lobbied intensely to water down EU climate goals, prioritizing both the option to retain a high share of domestic coal in its energy mix and domestic shale gas exploration (Judge and Maltby, 2017: 21; Jankowska and Ancygier 2017). These measures resonate powerfully with public sentiments regarding indigenous economic growth, energy independence from Russia, and security of supply (Keay and Buchan 2015).

While ultra-right-wing populist parties make no secret of their indifference to international issues and global public goods, populist parties of the radical Left retain their internationalist pretenses and rhetoric. In practice, though, these concerns hardly manifest themselves in the policies of these parties—let alone structure the orientation and essence of their strategy and policies while in office. Greece's majority governing radical left populist party, for example, has unreservedly succumbed to the rhetoric of its populist right-wing junior partner (Mudde 2016). In all, the electoral and political ascendance of populist parties across the political spectrum only serves to weaken efforts at effective EU energy and climate policy, and global governance on climate issues.

Secondly, the growing appeal of populist parties pushes mainstream parties to adapt to the former's agendas so as to retain the electorate's allegiance and support. This is true of a wide array of issue-areas, such as migration and terrorism, and points to a broader tendency: mainstream parties increasingly venture onto populist party terrain, in effect squeezing and manipulating governing priorities ahead of the next round of elections (Polakow-Suransky 2017; Kriesi and Pappas 2015; Mudde 2016).

The success of populist parties in manipulating the public sphere, shaping the policy agenda, and influencing government policy choices is exemplarily manifest in the recent dramatic twist in British politics. Under pressure from the rising populist UK Independent Party, former Prime Minister David Cameron took the short-sighted and imprudent decision—as evidenced by his subsequent defeat, self-ousting, and political marginalization—to call a referendum on British membership in the EU. British national politics has since been mired in division and controversy regarding the country's place in the EU. The Brexit vote ensures that British politics will remain for the near future absorbed with figuring out the UK's future relationship with the rest of Europe, inevitably pushing other policy issues (including the combat of climate change) further down the policy agenda (Fischer and Geden 2016). The Brexit vote jeopardizes, secondly, the perpetuation and advancement of EU energy and climate policy in the wake of the Paris climate deal. This is because Britain has been one of the principal proponents of an ambitious climate and energy policy in the Union. Its emphasis on market liberalization was pivotal for the establishment of the EU's emissions trading system (ETS), as was the early British political consensus by the 2000s on the need to address climate change on driving the EU's green agenda both domestically (EU-wide), as well as internationally (Solorio and Fairbrass 2017). As one of the EU's most influential members, Britain had the wherewithal to push EU energy and climate policy in promising directions. In the political setting of the post-Brexit era, however, a backlash to EU climate and energy policy becomes more likely, especially amidst growing voices within the EU for a shift towards cheap coal and less ambitious climate targets (Jörgens et al. 2017). In addition, British energy and climate policy will be no longer embedded in a strong supranational regulatory framework, nor in pan-European schemes with established goals regarding energy efficiency, penetration of renewables in the energy mix, and emissions reductions (Fischer and Geden 2016; Bros 2017). Interestingly—and this is indicative of the sluggish uploading of climate issues in the policy agenda in general—the policy debate surrounding Brexit hardly touched upon the crucial issues of energy and climate parameters.

The U.S. presidential election of November 2016 provides another illuminating example. The popularity of the ambiguous and provocative Donald Trump serves as the perfect illustration, and success, of the politics of discontent, marking the waning currency of political correctness and the pursuit of alternative voices in the most decadent parts of the political spectrum. Trump's eccentric personality and political positioning oriented the focus of the two dominant parties—and their leaders—around issues of corruption, Islamic terrorism, foreign policy vis-à-vis Russia, the right to possess guns, racism, and migration (Patterson 2016; Drew 2016). As a result, this has been the first electoral contest in a number of yeaers where climate issues hardly registered in the public debate. Neither of the two candidates, moreover, seemed under any circumstances keen to embrace a green agenda, let alone a radically green one. This attests to a broader political issue. Although the process to nominate party flagbearers is long and multifaceted, no contender was compelled to present convincing pathways to climate change mitigation, as this remains a marginal issue within the contours of both parties (The Guardian 2016). To add insult to injury, Trump's electoral victory represents a watershed for U.S. climate policy. With the new administration denigrating climate change and pulling out of the Paris agreement, this effectively damages the U.S. status as a major climate stakeholder. On a positive note, this shift may be temporary as a reflection of the incumbent's eccentric personality and limited to only as long as Trump remains in the White House.

While Western democratic states are embroiled in a downward spiral, Russia is pursuing its resurgence into the global system as a traditional great power. Its foreign policy resembles that of the previous centuries, with emphasis ostensibly placed on territorial gains, control of protectorates and puppet states, and asymmetrical regional integration schemes which foster domination over its near abroad. Russia's annexation of Crimea and adventurism in eastern Ukraine testify to its anachronistic thinking (Biersack and O'Lear 2014; *Strategic Comments* 2014). In tune with its failure to establish and set in motion a diversified economy, Russia has remained indifferent to both adopting an active climate policy or pushing for the establishment of a global carbon market from which it stands to benefit. To the contrary, it remains locked-in to the most damaging anti-climate policies of war, invasion, increased budgetary strains for the military-industrial complex, and intense fossil energy extraction even under adverse geological and climate conditions (Khrushcheva and Maltby 2016; Bradshaw 2014; Proedrou 2017a, b).

Russia's adventurism has extended to the Middle East through its involvement in the Syrian crisis. Seen from this angle, Russia's first out-of-area (meaning out of its near abroad) military campaign since the dissolution of the Soviet Union can be equated with Western—especially American—adventurism in the post-Cold War era (Baranovsky 2015). This adventurism constitutes a grave anti-climate policy, since military campaigns generate significant, unaccounted for, emissions (Brauer 2009). An end to incessant political and military hostility throughout the perpetually turbulent Middle East (and elsewhere), in this context, is indispensable for global climate efforts to bear fruit at some point.

Iran's foreign policy, finally, is indicative of the fundamentally flawed character and trajectory of foreign policy around the world. Not only is Iran a pillar of polemical Middle Eastern politics—notably its ongoing friction with Saudi Arabia, proxy wars, intervention in the Syrian crisis, in Iraq, in Yemen and elsewhere, and covert support for the expansion of the Shiite variant of Islam (Aras and Falk 2015)—but it also embodies the resurrection of anachronistic and counter-productive energy policy. In order to breathe new life into its ailing religious-political establishment, Iran signed a deal with the international community regarding its nuclear program that allows it to terminate its self-inflicted thirty-five years isolation and rejoin the global market. The most important component of this foreign policy shift is the resumption of massive oil and gas exports in order to increase cash flows and strengthen the country's enfeebled economy and foreign policy vulnerabilities (Katzman 2016). This was a desperate card to play, however, amidst low international energy prices and the determination by its fervent rival Saudi Arabia to maintain current oil production levels in order to undercut competitor market share, including and primarily targeting Iran (Fattouh et al. 2016). In general, making use of the country's reserves and exhausting its natural resources wealth is a rather shortsighted move (Odum 2007: 386). Alternative theorizations are emphatically missing from Iran's domestic and foreign policy deliberations, leaving it with the sub-optimal policy of drilling fast and selling cheap. In climate terms, this constitutes nothing sort of a grave development since it will contribute to further distortions of supply-demand dynamics in the global energy market, further pushing beyond limits to resource scarcity and aggravating climate change even further.

The above illustrates the myopic and distorted prioritization of issues within current political contours and the fixation on traditional policies. While it makes sense to mobilize political attention and resources on evolving crises, disregarding the issue of climate change (or postponing difficult decisions for the future) is a self-defeating policy in light of the urgency of the challenge. The world does not have the luxury of addressing numerous unfolding crises at the expense of confronting climate change. To the contrary, climate change must be placed, and cemented, at the top of the policy agenda. In this context, climate and energy policy must work in a horizontal way, exploit convergence across sectors where possible, provide conducive (rather than inimical) ground for the resolution of competing global problems with appropriate structured policy responses. Policymakers need to explore, study, scrutinize, and assess the impact on climate and energy policy on geopolitical, economic, social, political, normative, and ideological issues—designing their policies accordingly. Nexus thinking (Bradshaw 2014: 192) with climate considerations topping the agenda is very much in want. This unconventional assumption is the single most important contribution of ecological economics in the conceptualization of, and the scholarly debate on, policy-making for the twent-first century.

Beyond Metrics: Building Sustainable Livelihoods

This book has emphasized the primacy of carbon metrics, green audits, carbon pricing, and the downscaling of carbon equivalent emissions in the fight against climate change. This is necessary so that humanity tilts back to sustainable modes of living. Three caveats, however, are important when thinking of carbon metrics (Moreno et al. 2016). Firstly, it is important to keep in mind that all metrics are nothing more than abstractions, seemingly objective and reliable but in fact only providing shortcuts to an understanding of reality. It is hence important to scrutinize the origins, history, effects, and surrounding politics of the carbon metrics abstraction. For one, carbon metrics obscure the fact that greenhouse gas emissions are made up of multiple gases, variations of which differ crucially in their contribution to the rise of the global temperature with different properties in the time they need to evaporate and to their interaction with local ecosystems and economies. As such, it is important to differentiate among the various gases concentrated in the atmosphere, and to delve into the variable, multiple synergies, and outcomes they co-produce (Moreno et al. 2015). The much needed policy emphasis on the eradication of black carbon provides an exemplary case in point. Black carbon is the outcome of incomplete combustion of coal and wood, a notorious practice that takes place for practical reasons in impoverished regions of the Global South. Taking into account black carbon's onerous impact on climate change, as well as its short evaporation time, marshalling policy resources to accelerate and scale-up the energy transition in the Global South would effectively stem the production of black carbon, delivering startling ecological outcomes beyond significant developmental benefits (Sovacool and Drupady 2016: 59–61). Such a suggestion also ties in with the ecological economics principle of adjusting policy priorities to ecological system needs.

Secondly, and associated with the point above, carbon metrics equate gases stemming from pollutants such as fossil fuels with gases emanating from biological processes involving land, plants, and animals. This emphasis on net emissions' reduction helps to mask other related effects and adverse consequences, and subsequently obscures promising alternative policy trajectories to sustainable livelihoods (Moreno et al. 2015).

In the same context, thirdly, the focus on excessive emissions has been traditionally translated in policy-making contours as a problem demanding specific sets of policy tools: end-of-pipe measures, emerging carbon markets, and offset schemes that would compensate for increased emissions. While such policy schemes provide flexibility and can be at times constructive, they have dominated climate policy to an extent that they have disguised and displaced other policy measures such as fossil energy production curtailment at home. This lies in convenient conformity with vested political and corporate interests, and the Global North-Global South cleavage. At the same time, it also sits well within the entrenched contours of the global political economy that has been underpinned by neoliberal security, the ideological dominance of market solutions, and expansive international trade (Moreno et al. 2015; Moreno et al. 2016; Dalby 2015).

As a result, while carbon metrics provides a working reference unit and benchmark goal, overreliance on carbon metrics hinders broad economic transformations as an adverse effect. It has thus undermined political communities' freedom and flexibility not only to define climate problems in an integrated way but explore alternative pathways to sustainability (Dalby 2015; Moreno et al. 2015; Moreno et al. 2016). A good case in point regards the linkages between food production, human diet and health, and emissions. Increased dependence on meat and dairy in the Global North, in particular, places great stress upon the food industry, stockbreeding and ecosystems, as well as on human health and the atmosphere (Brown and Sovacool 2011: 33–9). Nevertheless, the implementation of substantial nutritional changes as a response to rising health costs, impoverishing ecosystems and adding to runaway climate change, remains a marginal issue on the political agenda; the Global North hence remains locked-in this adverse nexus.

The 'gas first policy' to which we referred in Chap. 4, to take another example, eloquently exemplifies the restrictiveness—and the inherent trappings inherent— of the carbon metrics-dominated approach. In particular, gas is preferable to coal and oil; it therefore makes much sense to boost its market share as a transition fuel. To the extent, though, that this becomes a dominant aspect of energy policy and marginalizes other much cleaner energy schemes, as well as related research and investments, this policy becomes counter-productive. In the same context, emphasis is placed on emissions reductions emanating from the switch from coal to gas rather than on assessing the scale of emissions reductions that will accrue from more ambitious energy policies—sweeping social transformations and startling green technological innovations.

As Moreno et al. (2016) succinctly argue 'instead of changing our economic system to make it fit within the planet's natural limits, we are redefining nature so that it fits within our economic system – and, in the process, precluding other forms of knowledge and real alternatives'. We hence need to

> pursue proven solutions – leaving fossil fuels in the ground, moving away from industrial agriculture toward agro-ecology, creating no-waste economies, and restoring natural ecosystems … If carbon metrics continue to shape climate policy, new generations will know only a carbon-constrained – and, if they are lucky, a low-carbon – world. Instead of pursuing such a simplistic vision, we must pursue richer strategies aimed at transforming our economic systems to work within – and with – our natural environment. For that, we will need a new way of thinking that spurs active engagement to reclaim and conserve the spaces where alternative approaches can grow and flourish. (Moreno et al. 2016)

Informed by such a groundbreaking mindset, we have to imagine holistic ways of social transformations (Stirling 2014), leading to

> radically more prominent and dynamic diversities of cultures, institutions, practices – and metrics – constituting far richer pluralities of social values than the money or material consumption on which current capitalist appropriations depend. Indeed, by opening up wider political spaces, this plurality itself is a driver of potentially empowering disruption. (Stirling 2016)

Successful social transformations are contingent upon finding a working balance between the four principal factors that determine the carrying capacity of each political community and the global society by and large (Daly 1996: 121):

- Its welfare level, which is defined by the relation between its economic size and its population
- The degree of equality stemming from the distribution of wealth
- Technological progress and development, and in particular the focus of technology's use and applications
- The extent and nature of trade linkages with third countries.

The first two points address interlocking challenges to the welfare level. More specifically, the spectrum of sweeping climate change jeopardizes the established amenities and comfortable way of life in the Global North, as well as the prospects for the elevation of welfare standards in the Global South. Organizing the energy system(and broader economic system) in line with ecological needs and limits, therefore, is central in any attempt to maintain or even increase welfare. The debate initiated by peak-oil theory, the de-growth movement (and other grassroots movements embracing a simpler, post-carbon way of living), and ecological economics is often mired in pessimism, gloom, and dire perspectives on what lies ahead (Heinberg 2011). There is no reason for this prognosis; opportunities exists for prosperous transitions (Odum 2007).

A key parameter in this equation is the size of the global population. The more the population grows, the further the strains imposed on climate and pressure on contemporary welfare standards. In this context, policies need to be designed taking in due consideration the projected increase of global population and implications such as demand for increased food and water supplies. Policies to meet these demands have yet to be designed, thus posing a crucial test to the global society's resilience and flexibility to cater for constantly evolving challenges (Bradshaw 2014; Brown and Sovacool 2011).

The current state of wealth distribution constitutes a huge impediment to attaining this goal. Overconcentration of resources in the hands of the top one percent and the sub-optimal recycling of wealth to broader populations projects the sad image of a highly fragmented world where the notions of global public goods, global spaces, and global equality are deprived of the space they deserve (Daly and Farley 2004). In practical terms, this extremely uneven distribution remains a profound structural barrier to the designation of sustainable policies and the trickling down of welfare and sustainability to broader populations. Instead of resources put to good use on a massive scale in research, investments, and innovation schemes in order to revolutionize humanity's modes of living and minimize its ecological footprint, wealth is increasingly held in complicated financial schemes or spent on activities of secondary importance at best (Stiglitz 2010).

The only sound argument regarding overconcentration of resources is that it can yield economies at scale with unprecedented results. While in theory, only a tiny amount of global resources has been devoted to clean energy research and development in practice. Technology, however, is the x-factor of our era (Ridley 2011; Simon 1996; Daly 1996). The extent to which technological innovations will lead to novel clean energy systems will determine how fast and efficiently the human ecological footprint comes down, thus creating more space for people's amenities. The task of the state is to steer all aspects of economic activity precisely towards such innovations. This is easier said than done, however, since not only does technological innovation work in multiple directions, but its use often varies widely. The gravest danger lies in the perpetuation of technological advances that enable the extraction of extreme energy and the astute meddling with ecosystems' cycles. Steering technological innovation towards sustainable paths via multiple policy tools, therefore, and ensuring that it does not lead to a proliferation of anti-climate policies, represents a keystone for the transition to sustainable systems.

Fourthly, the role of trade remains pivotal in connecting not only various national and supra-national economic systems but also—and most importantly—their societies. Free trade has been transposed from a policy tool used by states to improve economic conditions into indisputable dogma. Its unsustainable character, nonetheless, together with its distorted rules of the game and significant downsides, calls for substantially revisiting free trade. The trade regime is in dire need of new rules: free trade in ideas, shared knowledge, and the enhancement of open-source, collaborative projects—the fruits of which can trickle down to everyone. Lastly, trade in a steady-state world can only be carried out within biophysical monetary units. This will enable humanity to constantly monitor, check, and adjust the size of the global economy so that it remains within biophysical limits. Whether humanity wins the existential battle implicated by climate change hinges upon this fundamental question in the very end.

At a domestic level, societies are encouraged to choose and democratically agree on these recurrent questions: the ratio of collective welfare to overall population; the extent of inequality; the resources marshalled to bring forth technological innovation and the types of innovation singled out as priorities; and the extent of trade with third countries (Daly 1996). These are the fundamental issues that need to be placed at the core of political deliberations and which will define the fortunes of national and local communities, as well as their interaction in terms of power and ideas.

References

Aras, B. and Falk, R. 2015. Authoritarian 'Geopolitics' of Survival in the Arab Spring. *Third World Quarterly,* 36: 2, 322–336.

Baranovsky, V. 2015. From Kosovo to Crimea. *The International Spectator,* 50: 4, 275–281.

Beinhocker, E. 2017. It's Time for New Economic Thinking Based on the Best Science Available, Not Ideology. A New Narrative for a Complex Age. *Evonomics* [Online]. Available: http://evonomics.com/time-new-economic-thinking-based-best-science-available-not-ideology/ [Accessed on 30 March 2017].

Biersack, J. and O'Lear, S. 2014. The Geopolitics of Russia's Annexation of Crimea: Narratives, Identity, Silences, and Energy. *Eurasian Geography and Economics*, 55: 3, 247–269.

Bradshaw, M. 2014. *Global Energy Dilemmas*. Cambridge: Polity Press.
Brauer, J. 2009. *War and Nature: The Environmental Consequences of War in a Globalized World*. Lanham: Rowman & Littlefield.
Bros, T. 2017. Brexit's Impact on Gas Markets. *The Oxford Institute for Energy Studies, Energy Insight*, 2, 1–7.
Brown, M. and Sovacool, B. 2011. *Climate Change and Global Energy Security: Technology and Policy Options*. Cambridge, MA: MIT Press.
Dalby, S. 2015. Climate Geopolitics: Securing the Global Economy. *International Politics*, 52: 4, 426–444.
Daly, H. 1996. *Beyond Growth: The Economics of Sustainable Development*. Boston, MA: Beacon Press.
Daly, H. and Farley, J. 2004. *Ecological Economics. Principles and Applications*. Washington: Island Press.
Drew, E. 2016. Trump's Long Game. The New York Review of Books [Online]. Available: http://www.nybooks.com/daily/2016/05/06/trumps-long-game-becoming-general-election-candidate/ [Accessed on 11 June 2016].
Fattouh, B., Henderson, J. and Sen, A. 2016. Saudi-Russia Production Accord: The Freeze before the Thaw?. *Oxford Institute for Energy Studies, Oxford Energy Comment*, 1–10.
Fischer, S. and Geden, O. 2016. Brexit: Impacts on Europe's Energy and Climate Policy. *CSS Analyses in Security Policy*, ETH Zurich, 1–4.
Gordon, R. 2016. *The Rise and Fall of American Growth: The US Standard of Living since the Civil War*. Princeton: Princeton University Press.
Heinberg, R. 2011. *The End of Growth: Adapting to our New Economic Reality*. Canada: New Society Publishers.
Held, D. and Fane-Hervey, A. 2011. Democracy, Climate Change and Global Governance: Democratic Agency and the Policy Menu Ahead, in D. Held, A. Fane-Hervey and M. Theros (eds), *The Governance of Climate Change. Science, Economics, Politics & Ethics*. Cambridge: Polity Press, 89–110.
Jankowska, K. and Ancygier, A. 2017. Poland at the Renewable Energy Policy Crossroads: An Incongruent Europeanization?, in I. Solorio and H. Jörgens (eds), *A Guide to EU Renewable Energy Policy. Comparing Europeanization and Domestic Policy Change in EU Member States*. Cheltenham: Edward Elgar, 183–203.
Jörgens, H., Öller, E. and Solorio, I. 2017. Conclusions: Patterns of Europeanization and Policy Change in the Renewable Energy Policy Domain, in I. Solorio and H. Jörgens (eds), *A Guide to EU Renewable Energy Policy. Comparing Europeanization and Domestic Policy Change in EU Member States*. Cheltenham: Edward Elgar, 289–314.
Judge, A. and Maltby, T. 2017. European Energy Union? Caught between Securitisation and 'Riskification'. *European Journal of International Security*, 2: 2, 179–202.
Katzman, K. 2016. Iran's Foreign Policy. *Congressional Research Service*. 27 June.

Keay, M. and Buchan, D. 2015. The Energy Union: A Problem of Governance. *The Oxford Institute for Energy Studies, Oxford Energy Comment*, 1–6.
Khrushcheva, O. and Maltby, T. 2016. The Future of EU-Russia Energy Relations in the Context of Decarbonisation. *Geopolitics*, 21: 4, 799–830.
Kriesi, H. and Pappas, T. 2015. *European Populism in the Shadow of the Great Recession*. Colchester: ECPR Press.
Kuzemko, C., Keating, M. and Goldthau, A. 2015. *The Global Energy Challenge: Environment, Development and Security*. London: Palgrave Macmillan.
Moreno, C., Chassé, S. and Fuhr, L. 2015. *Carbon Metrics: Global Abstractions and Ecological Epistemicide*. Washington: Heinrich Böll Stiftung North America.
Moreno, C., Fuhr, L. and Chassé, S. 2016. Beyond Carbon Metrics. Project Syndicate [Online]. Available: https://www.project-syndicate.org/commentary/climate-change-alternative-approaches-by-camila-moreno-et-al-2016-03 [Accessed on 12 April 2016].
Mudde, C. 2004. The Populist Zeitgeist. *Government and Opposition*, 3: 4, 542–563.
Mudde, C. 2016. *On Extremism and Democracy in Europe*. London andNew York: Routledge.
Odum, H. 2007. *Environment, Power and Society for the Twenty-First Century. The Hierarchy of Energy*. New York: Columbia University Press.
Patterson, T. 2016. News Coverage of the 2016 General Election: How the Press Failed the Voters. *HKS Working Paper No. RWP16-052*, 1–21.
Piketty, T. 2014. *Capital in the 21st Century*. Cambridge: Harvard University.
Polakow-Suransky, S. 2017. Is Democracy in Europe Doomed?. *The New York Review of Books* [Online]. Available: http://www.nybooks.com/daily/2017/10/16/is-democracy-in-europe-doomed/ [Accessed on 18 October 2017].
Proedrou, F. 2017a. Why Russian Gas Diplomacy Fails: The Geopolitics-Energy Nexus in Ukraine and Turkey. *Asia Europe Journal*, 15: 1, 21–37.
Proedrou, F. 2017b. Russia's Structural Power in Europe: Deficiencies and Potential of its Energy Strategy. *Europe-Asia Studies* (forthcoming).
Ridley, M. 2011. *The Rational Optimist: How Prosperity Evolves*. New York: Harper Perennial.
Rodrik, D. 2011. *The Globalization Paradox: Democracy and the Future of the World Economy*. Cambridge: Cambridge University Press.
Sierakowski, S. 2016, The Illiberal International. *Project Syndicate* [Online]. Available: https://www.project-syndicate.org/commentary/hungarian-polish-nationalist-axis-by-slawomir-sierakowski-2016-09?barrier=accessreg [Accessed on 30 March 2017].
Simon, J. 1996. *The Ultimate Resource 2*. Princeton: Princeton University Press.
Solorio, I. and Fairbrass, J. 2017. The UK and EU Renewable Energy Policy: The Relentless British Policy-Shaper, in I. Solorio and H. Jörgens (eds), *A Guide to EU Renewable Energy Policy. Comparing Europeanization and Domestic Policy Change in EU Member States*. Cheltenham: Edward Elgar, 104–120.

Sovacool, B. and Drupady, I. 2016. *Energy Access, Poverty, and Development: The Governance of Small-Scale Renewable Energy in Developing Asia*. London and New York: Routledge.

Stiglitz, J. 2010. *Freefall: America, Free Markets, and the Sinking of the World Economy*. New York: Norton.

Stirling, A. 2014. Transforming Power: Social Science and the Politics of Energy Choices. *Energy Research & Social Science,* 1, 83–95.

Stirling, A. 2016. Outgrowing the Twin Simplifications of Growth and Degrowth: Part 3. *STEPS Centre. Paths to Sustainability* [Online]. Available: http://steps-centre.org/2016/blog/outgrowing-the-twin-simplifications-of-growth-and-degrowth-part-3/ [Accessed on 30 January 2017].

Strategic Comments. 2014. Russia's Motives in Ukraine. *Strategic Comments*, 20: 4, viii–ix.

The Guardian. 2016. Why Has Climate Change Been Ignored in the US Election Debates? *The Guardian* [Online]. Available: https://www.theguardian.com/us-news/2016/oct/19/where-is-climate-change-in-the-trump-v-clinton-presidential-debates [Accessed on 12 May 2017].

Index[1]

[1]Note: Page number followed by 'n' refer to notes.

F. Proedrou, *Energy Policy and Security under Climate Change*,
https://doi.org/10.1007/978-3-319-77164-9