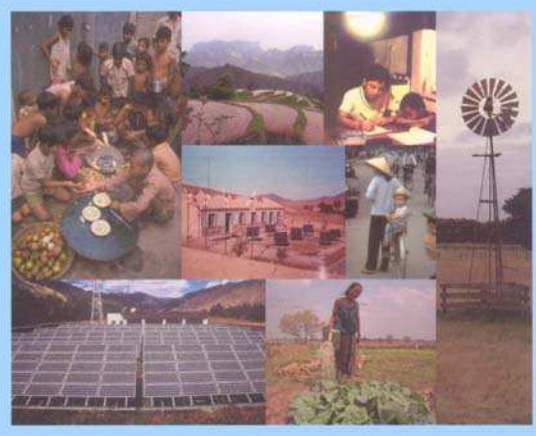
ENERGY SERVICES FOR SUSTAINABLE DEVELOPMENT IN RURAL AREAS IN ASIA AND THE PACIFIC:

Policy and Practice

Energy Resources Development Series No. 40



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ECONOMIC AND SOCIAL COMMISSION FOR ASIA AND THE PACIFIC

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FOREWORD

Over the years, the Asia-Pacific region, as the world's largest region – both in area and in population – has been holding its lead in global economic growth. The primary energy demand is expected to grow as industrialization proceeds and living standards improve. It is predictable too, that over the next two decades, sustained economic growth in the ESCAP region will require energy services in an order of magnitude much larger than that of today.

However, the region is vulnerable to fluctuations in global energy prices, as about 40 per cent of its energy needs are met by imported oil. The situation in rural areas is even more critical as local demand for energy outstrips availability and the vast majority of people depend on non-commercial energy supplies. Energy is needed for household uses, such as cooking, lighting, heating; for agricultural uses, such as tilling, irrigation and post-harvest processing; and for rural industry uses, such as milling and mechanical energy and process heat. Energy is also an input to water supply, communication, commerce, health, education and transportation in rural areas. The challenge of meeting energy needs for rural people in developing countries in Asia and the Pacific transcends electricity.

It is estimated that more than a billion people in rural areas of the Asia-Pacific region lack access to modern energy services. In South Asia, only 30 per cent of the rural population has access to electricity compared with 68 per cent of the urban population. It is obvious that objectives of many Millennium Development Goals (MDGs) may not be met unless rapid progress is made in extending efficient and affordable energy services to the poor in support of relevant activities.

In order to share the experience and information on policies and practices to support sustainable energy development in rural areas in Asia and the Pacific, ESCAP organized the Ad Hoc Expert Group Meeting on Energy Services for Sustainable Development in Rural Areas, at Bangkok from 27 to 29 September 2004.

Furthermore, for the fifth Ministerial Conference on Environment and Development (MCED) in Asia and the Pacific, which was held at Seoul, Republic of Korea, from 24 to 29 March 2005, the theme was "Achieving Environmentally Sustainable Economic Growth (Green Growth) in Asia and the Pacific" with a focus on how economic growth can support countries in achieving the MDGs, in the areas of poverty

eradication, and improvements in health, education, housing and nutrition. MCED endorsed the concept of "green growth" through enhancing eco-efficiency as the strategy to address the growing pressure on environmental sustainability resulting from rapid economic growth. Recognizing the close links between the provision of energy services, poverty reduction and sustainable development, was identified as one of the priorities for this region enhanced utilization of locally available energy resources with emphasis on improving ecological efficiency.

This publication is focused on in-depth analysis of issues, policies and mechanisms in widening access to energy services in support of achieving sustainable development goals in rural areas in Asia and the Pacific. It is largely based on materials and papers presented at the expert group meeting. Case studies throughout this publication provide examples of what has been successfully achieved and what needs to be improved.

The first chapter is the introductory part focusing on energy and MDGs, with emphasis on the emerging paradigm for the linkage between energy and poverty reduction as well as the role of women in energy systems.

Chapter two focuses mainly on an overview of the rural energy situation in this region. Based on the pattern and trends of the supply and consumption of electricity and other forms of energy, it elaborates on important energy services to the rural community and the challenges and opportunities for sustainable energy development in rural areas in this region.

Chapter three explores policy options and the policy framework in support of widening access to safe, reliable, affordable, convenient, socially acceptable and environmentally sound energy services for sustainable development and poverty eradication in rural areas. A variety of policy instruments to expand energy services to rural areas are discussed. It is argued that policy options should create an enabling environment including policy and programme formulation, innovative financing, pricing and subsidies. It also outlines policy directions and options as well as some country strategy frameworks that policymakers may apply based on their own country context.

Chapter four discusses institutional aspects for enhancing access to energy services in rural areas. The variable institutional options including decentralized institutional reform, promotion of a participatory

process and stakeholder involvement in the planning and policy formulation process are discussed. It emphasizes the importance of the institutional mechanism and a coordinated approach with clearly defined roles for each stakeholder/institution to provide rural energy services.

Chapter five identifies and analyses the features and factors of delivery mechanisms for increased access to energy services in rural areas. Mechanisms aimed at enhancing energy services to rural areas should be flexible enough to support a range of options. Country experiences and different models have been used to elaborate the different options. Selected completed case studies from the EGM are presented in the annex for further reading.

Chapter six summarizes the main points on energy services for rural sustainable development discussed in the pervious chapters.

Finally, case study on rural energy development in Nepal is presented in the annex as an example demonstrating the process in applying various technologies and policies in rural communities.

The ESCAP secretariat hopes that the readers would find this publication useful and informative.

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ACKNOWLEDGEMENTS

The ESCAP secretariat would like to take this opportunity to express its sincere appreciation to the experts who attended the Ad Hoc Expert Group Meeting on Energy Services for Sustainable Development in Rural Areas for their contribution.

Those experts were: Mr. Mahbubur Rahman (Bangladesh), Mr. Peceli Nakavulevu (Fiji), Ms. Akanksha Chaurey (India), Ms. Tri Mumpuni (Indonesia), Mr. Asfaazam Kasbani (Malaysia), Mr. Namjil Enebish (Mongolia), Mr. Bikash Raj Pandey (Nepal), Ms. Carmencita A. Bariso (Philippines), Ms. Anoja Wickramasinghe (Sri Lanka), Mr. Chavalit Pichalai (Thailand), Mr. Tjarinto S. Tjaroko (ASEAN Centre for Energy), Mr. S. Kumar (Asian Institute of Technology), Mr. Alan Dale Gonzales (EC-ASEAN COGEN Programme), Mr. Brahmanand Mohanty, Mr. Conrado Heruela, Mr. Kamal Rijal (UNDP), Mr. Zhijun Chen and Mr. Wim Polman (FAO).

ESCAP also wishes to acknowledge the valuable contribution made by consultants Ms. Soma Dutta from India and Mr. Li Junfeng as well as Mr. Simon D.B. Taylor from Chinese Renewable Energy Industries Association for preparing and presenting the background papers at the EGM.

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ABBREVIATIONS

ADB	Asian Development Bank
APEC	Asia-Pacific Economic Cooperation
ASEAN	Association of Southeast Asian Nations
CBO	Community-based organization
DOE	Department of Energy, Philippines
EGM	Expert group meeting
ESCAP	Economic and Social Commission for Asia and the Pacific
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross domestic product
LPG	Liquefied petroleum gas
MCED	Ministerial Conference on Environment and Development in Asia and the Pacific
MDGs	Millennium Development Goals
MNES	Ministry of Non-conventional Energy Sources, India
NDRC	National Development and Reform Commission, China
NGO	Non-governmental organization
PV	Photovoltaic
PPP	Public-private partnership
R&D	Research and development
RESCO	Rural Energy Service Company
SHS	Solar Home System
SOE	State of the Environment in Asia and the Pacific
TERI	The Energy and Resources Institute
UNDP	United Nations Development Programme
WB	The World Bank
WSSD	World Summit on Sustainable Development
5P	Pro-poor public private partnership

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CHAPTER 1

THE NEED FOR A PARADIGM CHANGE

1. Energy and the Millennium Development Goals

Currently, some 2.4 billion people in developing countries lack modern fuels for cooking and heating and about 1.6 billion people do not have access to electricity. In South Asia, only 30 per cent of the rural population has access to electricity compared with 68 per cent of the urban population. Energy services fail to meet the needs of the rural poor in most of the developing countries in the Asian and Pacific region. The MDGs are a set of time-bound, measurable goals for combating poverty, hunger, disease, illiteracy, environmental degradation and gender inequality: all these goals require or relate to energy services. The MDGs may not be met unless rapid progress is made in extending efficient and affordable energy services to the poor in support of productive economic activities or social development (table 1-1).

2. Changing the paradigm

Energy services for poverty reduction are less about technology and more about understanding the role that energy plays in people's lives and responding to the constraints in improving livelihoods. In the past, dissemination programmes have tended to concentrate on the supply of energy, such as electricity or petroleum, or on energy technologies, such as solar equipment or improved stoves. The required paradigm shift is from technology-driven energy use to a development-focused framework. Energy needs should be considered within the overall context of community life, and energy policies and projects should be integrated in a holistic way with other improvement efforts relating to health, education, agriculture and job creation. Policies, programmes and projects should start from an assessment of people's needs rather than a plan to promote a particular technology. The needs of different rural communities vary widely, and finding appropriate technologies and effective implementation strategies can be very site-specific.

Table 1-1. Energy services and the MDGs

MDGs	Links of Energy Services
1. Eradicate extreme poverty and hunger	Energy inputs such as electricity and fuels are essential to generate jobs, industrial activities, transportation, commerce, micro-enterprises and agriculture outputs. Most staple foods must be processed, conserved and cooked, requiring heat from various fuels.
2. Achieve universal primary education	To attract teachers to rural areas electricity is needed for homes and schools. After-dusk study requires illumination. Many children, especially girls, do not attend primary schools in order to carry wood and water to meet family subsistence needs.
3. Promote gender equality and empower women	Lack of access to modern fuels and electricity contributes to gender inequality. Women are responsible for most household cooking and water-boiling activities. This takes time away from other productive activities as well as from educational and social participation. Access to modern fuels eases women's domestic burden and enables them to pursue educational, economic and other opportunities.
4. Reduce child mortality	Diseases caused by unboiled water and respiratory illness caused by the effects of indoor air pollution from traditional fuels and stoves directly contribute to infant and child disease and mortality.
5. Improve maternal health	Women are disproportionately affected by indoor air pollution and water- and food-borne illnesses. Lack of electricity in health clinics, illumination for nighttime deliveries, and the daily drudgery and physical burden of fuel collection and transport all contribute to poor maternal health conditions, especially in rural areas.
6. Combat HIV/AIDS, malaria and other diseases	Electricity for communication such as radio and television can spread important public health information to combat deadly diseases. Health-care facilities, doctors and nurses, all require electricity and the services that it provides (illumination, refrigeration, sterilization etc.) to deliver effective health services.

Table 1-1. *(Continued)*

MDGs	Links of Energy Services
7. Ensure environmental sustainability	Energy production, distribution and consumption has many adverse effects on the local, regional and global environment including indoor, local and regional air pollution, local particulates, land degradation, acidification of land and water, and climate change. Cleaner energy systems are needed to address all of these effects and to contribute to environmental sustainability.
8. Develop a global partnership for development	The World Summit for Sustainable Development called for partnerships between public entities, development agencies, civil society and the private sector to support sustainable development, including the delivery of affordable, reliable and environmentally sustainable energy services.

Source: United Nations Department of Economic and Social Affairs, "The Energy Challenge for Achieving the Millennium Development Goals" (New York, United Nations, 2005) (available on line at http://esa.un.org/un-energy).

Two crucial aspects to which traditional energy policies have paid inadequate attention are the role of energy as an input to development, reflected in the integration of energy and development policies, and the crucial role that women play in energy systems, especially rural ones. It may be said that women's energy needs have been left out of energy planning because they do not fit into the traditional energy paradigm. In conventional thinking, energy consists of fuels such as oil, coal and natural gas, to be used in large-scale, capital-intensive technology projects run by experts for the purpose of providing energy for economic growth. However, in reality, even basic decisions to build hydro dams or improve the fossil fuel distribution system or investigate the feasibility of small-scale alternative energy sources have gender implications. For example, large-scale expansion of the electrical grid without support for domestic connections may bypass poor women. On the other hand, support for village-level initiatives focused on renewable energy sources may provide women with both new energy services and employment.

Dependence on imported fossil fuels leaves many countries vulnerable to supply disruptions and the accompanying economic and development impacts. Increased use of efficient and renewable systems improves energy security, by boosting resource productivity, avoiding excessive dependence on imported fuels, developing local sources and diversifying energy portfolios and suppliers.

While Governments and utilities continue to extend the grid to remote areas of countries, the utilization of renewable energy technologies in meeting the suppressed demand in remote rural areas is also an unavoidable option. However, further penetration of power generated from renewable energy resources requires a strong framework and clear guidance.

The emerging paradigm for energy calls for a focus on poverty and livelihood issues, including income-generating activities related to the productive use of energy in rural areas with adequate access to financing.

CHAPTER 2

ASIA AND THE PACIFIC TODAY: ENERGY POVERTY AND FAST ECONOMIC GROWTH

While it is accepted worldwide that energy is a basic need for survival and a key input to social and economic development, about 2.4 billion people in developing countries still lack access to clean, affordable and reliable sources of modern energy, and the majority of these people live in the Asian and Pacific region.

An amount of energy roughly equivalent to 7 per cent of the world's electricity production today could cover basic human needs. In an age of apparently advanced technological and management skills, the world has failed in this relatively modest challenge.

While energy services are directly associated with the quality of life and level of development, the amount and quality of energy consumption has a co-relation with poverty, deprivation, social seclusion, access to knowledge and achievements, health, livelihood and security. The wider disparities in various regions, countries and communities are also correlated with the disparities in gaining access to energy services.

Nearly 50 per cent of the world's population still relies on the traditional fuel source – the direct combustion of solid biomass for fuel. The continued dependence on biomass combustion, without technological improvements, makes people face irrecoverable costs that lead to a deteriorating quality of life for women, children, families and communities.

Strikingly, traditional biomass fuel use in rural areas by the poorest sectors makes it clear that the majority of people in many countries have not been able to access better energy carriers to meet their needs, and few institutions have taken the lead in providing energy services to these sectors.

To ameliorate the situation, the world leaders at the World Summit on Sustainable Development agreed "to improve access to reliable and affordable energy services for sustainable development, sufficient to facilitate the achievement of the MDGs, including the goal of halving the proportion of people in poverty by 2015, and as a means to generate other important services that mitigate poverty...".[1]

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[1] United Nations, *"Report of the World Summit on Sustainble Development: Johannesburg, South Africa, 26 August – 4 September 2002"* (New York, United Nations, 2002) (United Nations publication Sales No. E.03.II.A.1).

Traditionally, energy policies have focused on the supply of energy, such as electricity or fossil fuels, or energy technologies, such as solar energy equipment or improved stoves. It is important to realize that the traditional supply-side approach to energy development and the narrow top-down supply mechanisms have not been able to address rural development issues.

Essentially, the new paradigm for energy implies a shift from technology-driven energy use to a development-focused framework. Energy needs should be considered within the overall context of community life, and energy policies and projects should be integrated in a holistic way with other improvement efforts such as job creation, infrastructure development, communication development, health, education, market stimulation and agriculture. Policies, programmes and projects should start from an assessment of people's needs rather than a plan to promote a particular technology. The needs of different rural communities vary widely, and finding appropriate technologies and effective implementation strategies can be very site-specific.

The challenge here is to widen the horizon of energy supply and make adjustments by linking it to areas with multiple potentials to promote energy services. It is important to note that the existing institutional mechanisms in many countries are focused on sectoral development and are not structured to promote interlinkages or have the capacity to adopt a holistic approach for integration.

Appropriate policy supported by adequate institutional mechanisms is necessary to enable access to energy services within the context of overall social and economic development. A focus on decentralized regional frameworks, supporting local institutions, can create enabling conditions to stimulate a local market. Inadequate energy markets threaten economic growth and keep living standards low.

This would support the development of local entrepreneurs to deliver rural energy services. The provision of energy could stimulate other business opportunities, also enabling competition which would provide incentives for businesses to initiate cost savings, produce good quality products and new market ideas.

This challenge looks formidable, yet to meet the basic cooking needs of 2.4 billion people would correspond to no more than 1 per cent of global commercial energy consumption.[2] To provide basic electricity

[2] Amulya K.N. Reddy 1999. "Goals, Strategies and Policies for Rural Energy", *Economic and Political Weekly* 34 (49):3435-3445. As quoted in: United Nations Development Programme, *World Energy Assessment: Energy and the Challenge of Sustainability* (United Nations publication, Sales No. 00.III.B.5).

needs of off-grid households and enterprises is often financially viable and certainly technologically achievable. Increased use of efficient and renewable systems improves energy security by boosting resource productivity, avoiding excessive dependence on imported fuels, developing local sources and diversifying energy portfolios and suppliers.

The challenge of funding sustainable energy development can be met only through close partnerships between the public and private sectors and collaboration among partner organizations. The necessary increase in the transfer of resources from developed to developing countries can be promoted through the participation of new partners in the process and through creating an environment conducive to investment and partnerships. The transfer of proven technologies and knowledge among developing countries and from industrialized to developing countries will also be needed to support local entrepreneurship, realize local employment potential and decrease the continuing reliance on outside assistance.

1. Fast economic growth and increasing energy demand

1.1 Demographic patterns and development trends

The Asian and Pacific region is the largest in the world both in area and population but the level of economic and social development varies widely. The total population of the Asian and Pacific region in 2005 was approximately 3,954 million, which is expected to increase by 417 million people by 2015.[3]

Despite widespread poverty, uncertainty and other recent problems, the region is currently growing faster than any other in the global economy, with the average economic growth rate being between 4.0 and 6.5 per cent from 2000 to 2003.[4]

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[3] United Nations, World Urbanization Prospects: The 2001 Revision (United Nations publication, Sales No. 02.XIII.16).

[4] ESCAP, "Review of the state of the environment in Asia and the Pacific 2005 (E/ESCAP/SO/MCED(05)/1).

Table 2-1. Population data

Countries	Total population Mid-2005 (Millions)	Rate of natural increase rate (%)	Urban population (% of total population)	Urban population growth rate (%)	Rural population (% of total population)	Rural population growth rate (%)
Cambodia	13.3	2.2	15	5.0	85	0.7
Lao People's Democratic Republic	5.9	2.3	19	5.6	81	0.5
Nepal	25.4	2.2	14	5.4	86	0.4
Myanmar	50.5	1.8	29	3.1	71	0.6
Pakistan	162.4	2.4	34	4.3	66	0.6
Sri Lanka	19.7	1.3	30	2.3	70	0.6
Thailand	65	1.0	31	2.3	69	0.4
Viet Nam	83.3	1.6	26	2.0	74	0.8

Source: Population Reference Bureau, "2005 World Population Data Sheet of the Population Reference Bureau" (Washington, D.C., Population Reference Bureau, 2005).

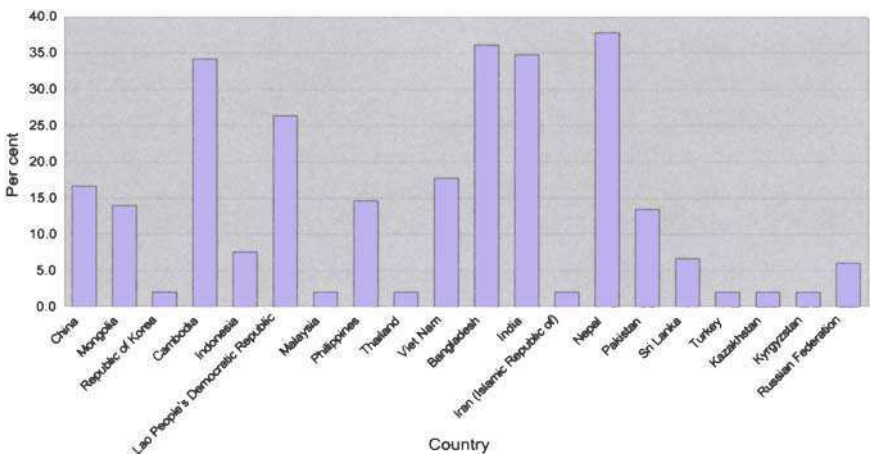
Food and Agriculture Organization of the United Nations, *Selected Indicators of Food and Agriculture Development in Asia-Pacific Region 1994-2004* (Bangkok, FAO, 2005).

For some countries, recent economic growth has been dominated by the expansion of the export-oriented industrial and manufacturing sectors. However, agricultural production has also grown substantially in many countries. Production in the region's agricultural sector increased by about 62 per cent from 1990 to 2002 compared with increases in global agricultural production of 27 per cent. This has placed increasing pressure on available natural resources, resulting in a deteriorating environment.

With approximately 3 billion people, representing 46 per cent of the global total, populations are vast. The rural areas of the ESCAP region are generally characterized by a high population growth rate, inadequate infrastructure and social amenities, low levels of economic activity and income, and concentrated poverty. For example, about three quarters of the total population of Bangladesh, China, India, Indonesia, Nepal, Papua New Guinea, Sri Lanka and Thailand live in rural areas.

Extreme poverty is widespread throughout the region and, although the proportion of people below the poverty line had been declining in East and South-East Asia, the overall trend in poverty reduction has recently worsened. Population growth is adding to the absolute number of poor, with around 22 per cent of the region's population estimated to be living on less than US$ 1 per day. This equates to 767 million people or two thirds of the world's poorest. Of this figure, 450 million were in India, 225 million were in China and about 55 million more were in South-East Asia.[5]

Figure 2-1. Percentage of population living on less than US$ 1 a day (1990-2002)



Source: Human Development Report, UNDP, 2004.

Recently, steady migration to urban areas has slowed population growth in rural areas and increased the incidence of urban poverty as people are unable to find employment opportunities in cities.[6] Far from easing rural energy poverty, this trend is likely to reinforce policymakers' preoccupation with urban issues, while increasing competition for rural energy supplies continues. By 2025, it is estimated that the majority of the world's population will be urban, but 60 per cent of the poverty will

[5] Asian Development Bank, *Fighting poverty in Asia and the Pacific: Poverty Reduction Strategy* (Manila, ADB, 2004) and ESCAP, *Asia-Pacific Economic and Social Situation – 1998.*

[6] ESCAP, *Asia-Pacific Economic and Social Situation – 1998.*

still be rural. For this reason, the MDG target of halving the proportion of people living on less than a dollar a day and who suffer from hunger by 2015 may not be achieved unless rural poverty issues are urgently addressed.[7]

1.2 Greening consumption and production

Energy is an essential engine for strong economic growth, affecting all dimensions of sustainable human development. Commercial energy use is growing at a rate of about 1.7 per cent in industrialized countries and 3.8 per cent in developing countries. During the period from 1990 to 2002, electricity consumption in developing Asia leapt by 7.3 per cent per year and oil rose by 5.5 per cent. The region's projected growth is expected to account for 42 per cent of global primary energy demand growth between 2002 and 2030 and for nearly a third of the global energy market by 2030.[8]

Energy demand growth is estimated to outpace increases in indigenous energy supply, which will affect international energy prices, trade and investment flows. The region will likely remain the world's largest coal market, accounting for around 80 per cent of the growth in global coal demand up to 2030.

Though electricity consumption will grow substantially in developing Asia, it has been estimated that electricity access will remain scarce in poor areas, especially in South Asia. An estimated 1,600 gigawatts (GW) of new generating capacity is needed, at a cost of around US$ 1,450 billion (year 2000). Dependence on traditional biomass and waste is still high in some countries and in 2002 accounted for around 76 per cent of the region's residential energy use. Though it is likely that some households will switch to other fuels such as kerosene and liquefied petroleum gas (LPG) as their income grows, without strong government intervention, traditional biomass and waste use in the residential sector will not start to decline before 2015.[9]

Figure 2-2 shows the per capita energy use for various countries throughout the region. The total energy use in some countries is significant. However, the per capita energy use for these countries is often much lower due to a large population and unmet demand.

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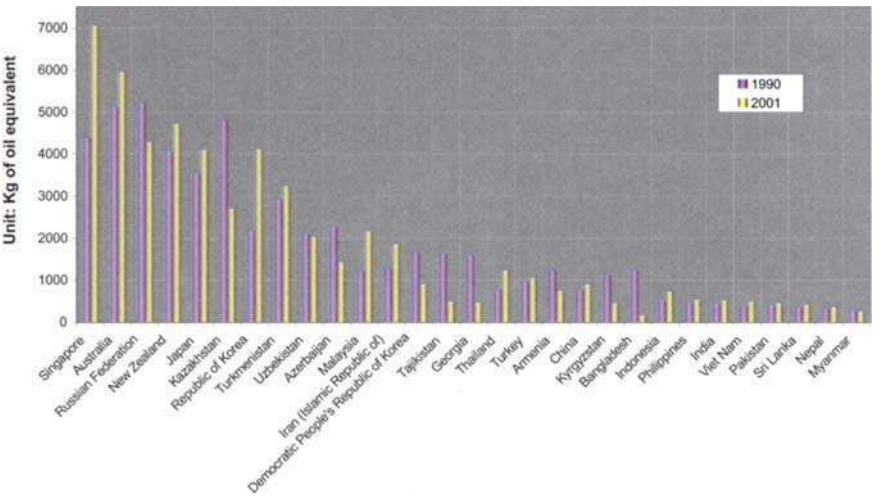
[7] Report of the Secretary General on promoting an integrated approach to rural development in developing countries for poverty eradication and sustainable development (E/2003/51), 2 April 2003, para. 1.

[8] International Energy Agency, *World Energy Outlook 2004* (Paris, IEA, 2004).

[9] Ibid.

Figure 2-2. Per capita energy use in Asia and the Pacific[10]



In most developing countries, energy intensity in production and consumption is higher than in industrialized countries, resulting in the unnecessary erosion of financial and natural resources. It is generally accepted that approximately two thirds of the primary energy supply is lost at various stages of conversion, transmission and distribution under conventional electric power generation technologies. On the electric power supply side, there is enormous scope for efficiency gains at each stage of the supply chain, from generation to transmission and distribution.

In the region, 80 per cent of total energy consumption comes from fossil fuels used in conventional ways, which have significant impacts on the local and global environment. However, the use of modern renewable energy technologies is growing in the region, with some Governments recognizing the benefit of renewable energy for rural electrification.

[10] World Bank, *World Development Indicators* (Washington, D.C., World Bank, 2004).

Figure 2-3. Energy use in Asia and the Pacific[11]

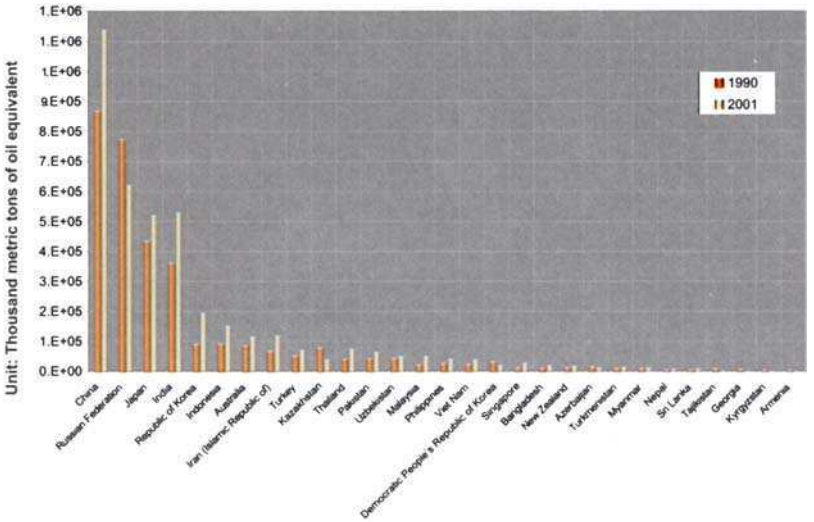


Table 2-2. Modern renewable energy use in selected South-East Asian countries[12]

Country	Current installed capacity (MW)					Percentage share of renewable energy in total energy mix – 2000	Planned installed capacity for 2001-2010 (MW)	Investment required 2000-2010 (Million US$)
	Biomass	Mini/ micro hydro	Solar	Wind	Total			
Cambodia	n.d.	18.00	0.02	n.d.	18.02	0.0	449	674
Lao People's Democratic Republic	n.d.	203.00	0.04	n.d.	203.04	56.0	134	201
Myanmar	n.d.	340.00	0.24	n.d.	340.24	27.4	40	60
Viet Nam	n.d.	200.00	0.11	n.d.	200.11	22.5	20	30

n.d. = no data available.
Energy generation is mainly for power production.

[11] Ibid.

[12] Association of Southeast Asian Nations Energy Center, "Energy Statistics" www.aseanenergy.org.

2. The other picture: Energy poverty and stagnation for rural communities

2.1 Low and unsustainable energy consumption

The priority for the poor is meeting basic human needs such as food, health services, education, housing, clean water and sanitation. Although not recognized explicitly as being one of the basic needs, energy is clearly necessary for the provision of nutritious food, clean water, light and a place to live. Low energy consumption is not the sole cause of poverty, but the lack of energy correlates closely with many poverty indicators.

Currently, many of the region's poorest people rely on biomass collection to provide their energy needs for cooking and heating, a task primarily undertaken by women. Women and children usually form the majority of poor people in any community. In fact, 70 per cent of the 1.3 billion people living in poverty are women.[13] The most obvious burden is that as fuel resources become increasingly scarce, women must walk longer distances and invest a greater portion of time each day in gathering fuelwood and water. For example, in the Himalayan foothills of Nepal, a journey to gather firewood and fodder which took an hour or two a generation ago now takes a whole day. An increase in time spent in fuelwood collection implies that women may now have less time for other livelihood activities.

A more serious and long-term implication of fuel shortages is that as the daily search for fuelwood, fodder and water becomes more difficult, children are taken out of school to help their mothers. More often than not, it is the girls who are deprived of education in order to look after younger siblings and assist their mothers, perpetuating the cycle of illiteracy and poverty. In the southern State of Tamil Nadu in India, a major reason for keeping girls aged 10 to 12 out of school is to help the mothers collect cow dung.[14] Access to a reliable modern energy supply will free women and girls from this chore, providing time for activities such as education and income generation.

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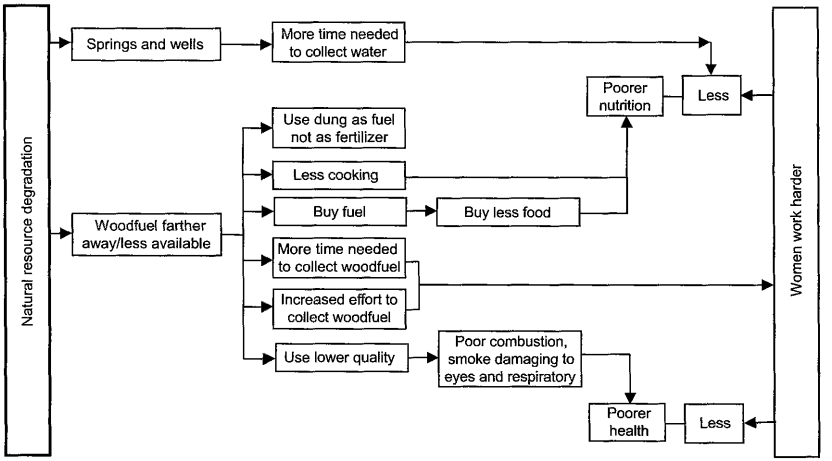
[13] Joy S. Clancy and Margaret Skutsch, "The Gender – Energy – Poverty Nexus: Finding the energy to address gender concerns in development" (United Kingdom Department for International Development, 2004).

[14] Mencher, J. 1989. "Women's work and poverty: women's contribution to household maintenance in two regions of South India," in D. Dwyer and J. Bruce, eds. *A Home Divided: Women and Income Control in the Third World.* (Stanford, Stanford University Press, 1988) pp. 99-119.

Figure 2-4. Natural resource degradation and women's workload



Source: Adapted from Dutta 2002.

Many of the core conditions of poverty, such as poor health, lack of potable water, sanitation and illiteracy, stem from inadequate community services, some of which cannot be dealt with at the household level. However, energy services can support the development of these community services.

For example, energy access can help to create an environment conducive to teaching and learning by providing access to clean water, sanitation and heating/cooling of educational facilities. Energy provides an opportunity to use teaching aids such as computers, printers, overhead projectors and science equipment and can bridge the "digital divide" by allowing distance learning. The availability of lighting enables education beyond daylight hours and street lighting can improve safety.

Education facilities open up opportunities for education on sex and maternal health, and medical facilities can significantly improve maternal and child health. The laborious task of gathering fuel can affect women's bodies, particularly when pregnant, and women and children are often at risk from falls, assault and snakebite.

Indoor air pollution is a major attributable factor for ill health in rural communities. Major reasons for indoor air pollution are inefficient burning of inferior fuels such as cow dung, agricultural residue, coal and

fuelwood, along with poor ventilation systems inside houses. According to The Energy and Resources Institute's study, particulate matter concentrations in kitchens as a result of burning biofuels are 30 times higher than WHO standards and indoor measurements of other pollutants have been more than 10 times that outdoor of levels. Women, children and older persons, who spend most of their time indoors, are severely affected. In recent studies, exposure to these pollutants has been linked to several adverse health effects including acute respiratory infection, chronic obstructive lung disease, pregnancy complications, and eye diseases. About 40 per cent of the global infantile mortality caused by pneumonia occurs in Bangladesh, India, Indonesia and Nepal; many of these deaths are caused by pollutants from burning traditional fuels.[15] In India, household solid fuel use is estimated to cause about 500,000 premature deaths a year in women and children under five. There are indications that tuberculosis and blindness may be associated with indoor air pollution.

The following table explains the burden of disease linked to indoor air pollution in India and the State of Andhra Pradesh.

When considering these issues in the context of the MDGs, the supply of alternative energy services could positively benefit maternal health and reduce child mortality. Modern fuel sources are often safer for children, reducing the risk of accidents, or burns from fires. Energy can also be used for space-heating and treating water, both of which contribute to improved health.

Electricity enables health centres to operate at night and retain qualified staff. It can also enable the use of medical and other equipment for sterilization and refrigeration. With refrigeration, vaccines and medicines for the prevention and treatment of diseases and infections can be stored locally.

With respect to environmental sustainability, poor communities are often more vulnerable to global warming because they lack the resources to cope with crises resulting from climate change. Development and environmental opportunities for following a clean energy path, such as through the use of renewable energy, help to alleviate global warming by reducing greenhouse gas emissions.

The local environment may also be improved with modern energy services as the current use of biomass can contribute to land degrada-

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[15] Asian Development Bank, *Asian Environment Outlook 2001* (Manila, ADB, 2002).

tion by exacerbating erosion, reducing soil fertility and contributing to desertification.

Table 2-3. Linkage between the burden of disease and indoor air pollution in India and the State of Andhra Pradesh[16]

	Disease			
	Acute respiratory infections	**Chronic respiratory diseases**	**Lung and related cancers**	**Cardio-vascular disease**
Burden of disease (in hundreds of disability-adjusted life years (DALYs))				
Rural	1,363	217	45	1,411
Urban	444	401	75	19
Rural households: distribution of burden of disease attributable to indoor air pollution				
Median	40 per cent	40 per cent	25 per cent	25 per cent
Urban households: distribution of burden of disease attributable to indoor air pollution				
Median	15 per cent	15 per cent	5 per cent	5 per cent

Energy should be provided in forms that match basic social needs and promote economic self-reliance. Some energy sources, such as fuelwood or biomass, may be adequate for the former, while others such as electricity and liquid fuels may be necessary for the latter. Needs should be translated into end-use activities and for each specific end-use, a specific energy form should be considered according to its efficiency and cost. In the process of matching energy sources to energy needs, environmental harmony should be a decisive factor because of the close synergy between humans and natural resources.

If ensuring basic human needs lies at the core of rural development concern, then a minimum amount of energy should be made available to all rural people. The lasting solution to rural indigence is to strengthen the self-reliance of the people so that they not only escape the hardship of their current conditions, but remain permanently in rural areas with dignity. Providing energy to meet social needs such as cooking, preparing drinking water and providing street lighting is a

[16] Estimates based on Administrative Staff College of India, 1996.

beginning, but it is not enough. Energy should also be made available to create jobs, to generate income and to develop assets as insurance against future uncertainties.

Energy access can contribute to enabling enterprise development and increased productivity through the use of machinery, and reducing the daily grind for survival, such as the drudgery for women involved in fuel collection. Energy services and fuel crops can be provided by local small-scale businesses, creating employment in the local community. These services can also encourage the development of non-farm based enterprises, stimulating the development and expansion of other supporting industries beyond agricultural activities, such as machinery maintenance and women's enterprises.

Without these opportunities, no enduring freedom from want is possible. Thus, minimum energy services should also accommodate a certain level of essential economic opportunities, which would set the rural poor firmly on the road to recovery.

2.2 Stepping up the energy ladder

In the majority of developing countries in the region the pace of the rural energy transition has been slow and uneven. Large energy demand-supply gaps persist in many parts of the same country in spite of advances made in expanding modern energy supply capacity. Even within rural areas, access to such supplies is often restricted to the relatively affluent. These factors have contributed to a high level of human deprivation among rural populations and added to rural-urban socio-economic disparities.

Woodfuel, agricultural residues and animal waste account for 65 to 70 per cent of the energy used in rural areas and more than 25 per cent in urban areas. In some countries, the share of biomass fuels rises to more than 95 per cent in rural areas. Decentralized renewable energy systems meet less than 1 per cent of the rural energy demand.

Energy use can be broken down by household, agricultural and small-scale industrial sectors. Household consumption of energy is around 85 per cent of the gross rural energy consumption, used mostly in traditional and generally inefficient stoves and heating devices. The majority of this energy is in the form of woodfuel and agricultural residues.

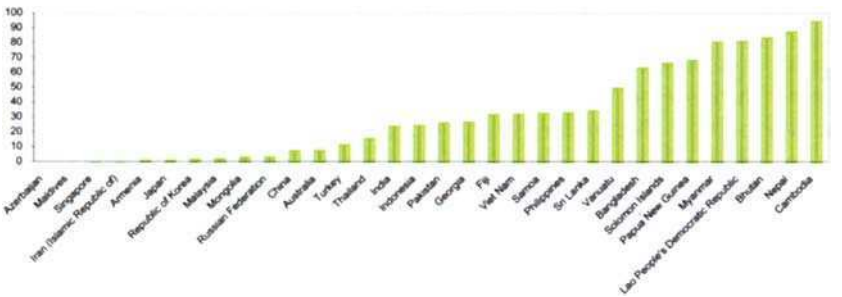
Agricultural activities consume 2 to 8 per cent of the gross rural energy consumption, primarily for powering mechanical equipment and irrigation pumps. Petroleum fuels and electricity supply some power for

this purpose, though the majority of agricultural energy input tends to come from human and animal power, which is not generally included in energy estimates.

Table 2-4. Percentage share of woodfuels in total energy supply[17]

Country	Year data were estimated	Woodfuels	Other biofuels	Other fuels
Cambodia	2000	78.91	1.39	19.70
Lao People's Democratic Republic	1995	97.60	0.00	2.40
Nepal	2000	76.42	9.87	13.71
Pakistan	1996	19.90	16.50	63.60
Sri Lanka	2000	48.45		51.55
Viet Nam	1999	35.77	20.20	44.03

Figure 2-5. Percentage of total woodfuel use

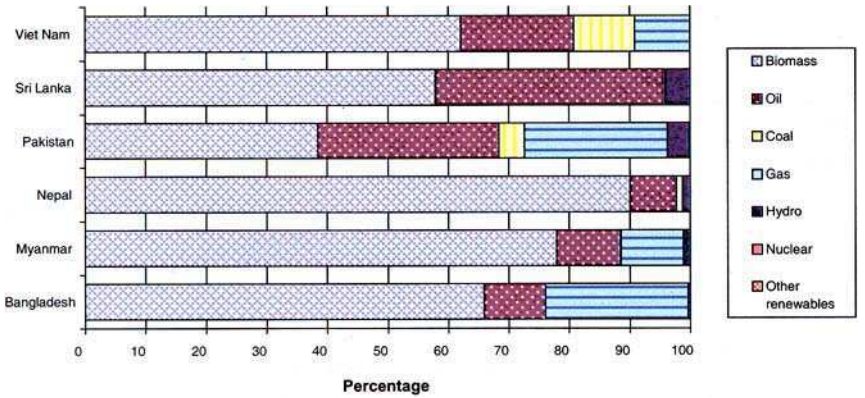


Source: Human Development Report, UNDP, 2004.

Rural industries account for less than 10 per cent of the total energy use and the fuel used is generally wood or agricultural residues, with electricity sometimes providing motive power. Estimates usually exclude the energy required for food processing and transport by agro-industries, which can be up to twice the estimate of energy use for agriculture.

[17] Food and Agriculture Organization of the United Nations, Regional Wood Energy Development Programme in Asia (RWEDP) data base. The figure for Sri Lanka includes both woodfuels and crop wastes.

Figure 2-6. Energy supply mix



Source: FAO-RWEDP Data Base <www.rwedp.org>

Despite its importance to general well-being and a functioning economy, household and family maintenance work tends to be invisible and under-represented in national statistics. In calculating energy expenditures, women's work in carrying loads, pumping water and gathering fuel are not included. Furthermore, research agendas often fail to look at these issues or gender-specific needs.

Religious festivals, celebrations, burials and other occasional functions may also consume large amounts of fuel but be missed by energy consumption surveys.

Rural energy use accounts for a small proportion of the total final energy demand of countries. However, the absence of reliable information on energy for most developing countries makes it difficult to provide a reasonable estimate of the rural energy supply mix among woodfuel, other biomass fuels, fossil fuels and electricity (or other primary fuels and energy sources to produce electricity). This translates into difficulties in obtaining an accurate picture of "costs" and "energy usage".

Table 2-5. Typical end-uses by energy source in developing countries[18]

	Income level		
	Low	**Medium**	**High**
Household			
Cooking	Wood, residues and dung	Wood, charcoal, residues, dung, kerosene, biogas	Wood, charcoal, kerosene, LPG, coal
Lighting	Candles, kerosene, none	Candles, kerosene	Kerosene, electricity
Space heating	Wood, residues, dung, none	Wood, residues, dung	Wood, residues, dung, coal
Other appliances radio/television	None	Grid electricity and batteries	Grid electricity and batteries
Space cooling and Refrigeration	None	Electricity (fans)	Electricity, kerosene, LPG
Agriculture			
Tilling	Human labour	Draft animals	Animal, gasoline, diesel
Irrigation	Human labour	Draft animals	Diesel, grid electricity
Processing	Human labour	Draft animals	Diesel, grid electricity
Industry			
Milling/ mechanical	Human labour	Human labour, draft animals	Grid electricity, diesel, gasoline
Process heat	Wood, residues	Coal, charcoal, wood and residues	Coal, charcoal, wood, kerosene, residues
Cooling/ refrigeration	None	None	Grid electricity LPG, kerosene
Services			
Transport	Human labour	Draft animals	Diesel, gasoline
Telephone	None	Batteries	Grid electricity

[18] World Bank, *Rural Energy and Development: Improving Energy Supplies for Two Billion People* (Washington, D.C., World Bank, 1996), p. 25.

The rural sector of developing countries, and particularly households, generally has the lowest consumption of fossil fuels and electricity. Electricity access for the rural population of Asia is estimated to be 10 to 15 per cent. Kerosene and electricity consumption is mainly for lighting, with a small proportion of the electricity used to operate devices such as radios and televisions.

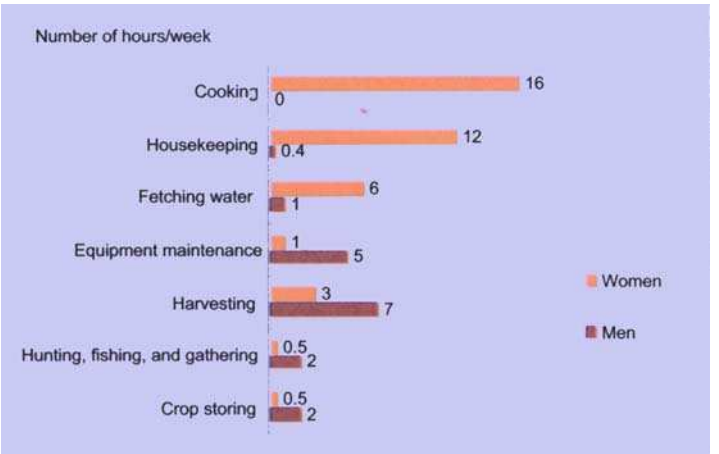
Women and men have different perceptions about the benefits of energy; for example, men see the benefits of electricity in terms of leisure, quality of life and education for their children, while women see electricity as providing the means for reducing their workload, improving health and reducing expenditure.[19] The decision-making structure in rural households is also normally segregated along gender lines.

In households where there are adult men and women, the gender division of labour generally allocates women the responsibility for household energy provision related to their spheres of influence in the household, in particular activities centred on the kitchen. In the case of a traditional mud stove constructed in the home by the women themselves, decisions on where to get the raw material (free of cost) and where to place the stove are all made by women. Despite this, when energy has to be purchased, men enter the decision-making process. In South Africa, it was found that expenditure on batteries was largely so that young men could listen to taped music; in many cases, female members of the household had no access to the equipment and no control over battery purchases.

The evaluation of a rural electrification project in Tamil Nadu showed that men benefited more than women since the electricity was used to run irrigation pumps substituting for oxen-drawn water and the care of the oxen was traditionally a task for men. They gained more free time when the number of draft animals decreased; they used that time for involvement in politics and improving their agricultural methods, thereby increasing their social and human capital. However, electricity did not substitute for any women's tasks.

[19] Joy S. Clancy and Margaret Skutsch, Technology and Development Group, University of Twente, *The Gender – Energy – Poverty Nexus, Finding the energy to address gender concerns in development,* DFID Peoject CNT998521.

Figure 2-7. Gender division of labour in household



Source: James A. Levine, Robert Weisell, Simon Chevassus, Claudio D. Martinez, B. Burlingame, and W. Andrew Coward, "The Work Burden of Women", Science 294 (2001): 812.

Energy supplies need to be pro-poor in design and include people, particularly women, in the decision-making process. Gender differences in household responsibilities, including responsibility for household purchases, translate into energy issues. Women should "make significant decisions relevant to energy, including the purchase of automobiles, houses and major appliances. Because women do most of the laundry, food shopping, refrigeration and cooking, the timing of energy consumption affects (electric power) utility peak loading".[20]

This peak period of electricity demand has serious implications for rural electrification. Many rural areas are characterized by high peaks in the early evening hours though overall consumption is low. This equates to a high investment for the peak capacity and low returns overall.

The World Energy Assessment estimated that between 1970 and 1990, rural electrification programmes reached about 800 million additional people and some 500 million saw their lives improve substantially through the use of better methods for cooking and other

[20] Barbara C. Farhar, "Energy and the Environment: The Public View" (Renewable Energy Policy Project, 1999).

rural energy tasks.[21] Many of the rural electrification programmes were through grid connection; in addition, about 25 million people in least developed countries now utilize renewable energy sources. These services are made up of 1 million solar home systems, 150,000 photovoltaic (PV) and wind-powered clinics and schools, 50,000 domestic wind turbines, 300,000 solar lanterns (in India alone), 150,000 family hydro units (in China and Viet Nam) and hundreds of thousands PV and wind-driven water pumps.[22]

A broad review of regional trends and their likely future directions should consider the following factors:

- Absolute growth in demand
- Shifts and changes in demand patterns
- Absolute declines in supply
- Structural changes in supply mix
- Relative declines in supply as a result of competing demands

The growth of rural energy demand is not only inevitable, but also desirable because rural energy consumption per capita is far below the global average and often barely adequate to meet subsistence needs. At such levels of consumption, the question is not whether rural energy demand will grow, but rather by how much and according to which patterns it should grow.

The average rate of urbanization in the region is slightly less than 1 per cent per annum. Based on this, approximately half the population growth in rural areas would be offset by rural-urban migration or the reclassification of currently rural areas as urban. The energy demand of such newly urbanized populations would increase in volume and require input of modern energy sources. The net effect is estimated to be a higher level of absolute demand growth than may be indicated by population growth alone.

Within rural areas, the demand for modern energy sources is expected to accelerate owing to increased mechanization of agricultural activities, in particular, irrigation, greater use of fertilizers, development of rural industries and an increase in household energy demand for lighting, electrical appliances and higher grade cooking fuels.

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[21] United Nations Development Programme, *World Energy Assessment: 2004 Update Overview* (United Nations publication, Sales No. 04.III.B.6), p. 59.

[22] Greenpeace/The Body Shop, *Power to tackle poverty* (Greenpeace/The Body Shop, 2001).

These factors may contribute to faster growth in the demand for modern energy sources. Thus, while even a conservative estimate based on population growth indicates a doubling of the demand in 35 years, realistically speaking, this period could be considerably shorter.

3. Conclusion

Traditionally, energy policies have focused on the supply of energy or energy technologies to support rural development. However, increasingly, Governments are beginning to realize that the traditional supply-side approach to energy development and the narrow top-down supply mechanisms have not been able to address rural development issues.

Energy services for poverty reduction are less about technology and more about understanding the role that energy plays in people's lives and responding to the constraints in improving livelihoods. The emerging paradigm for energy appears to be more focused on poverty and livelihood issues, developing mechanisms to improve the ability of markets to meet the needs of the poor, experimentation with new financing approaches and increasing collaboration and cooperation among stakeholders.

Appropriate policy supported by strong institutional mechanisms is necessary to enable access to energy services within the context of overall social and economic development. A focus on decentralized regional frameworks, supporting local institutions, can create enabling conditions to stimulate a local market.

The following chapters provide further details on mechanisms and tools for addressing these institutional and policy issues for supporting rural energy access within a holistic development context.

CHAPTER 3

ACTION FROM THE TOP: POLICIES FOR INCREASED ACCESS TO ENERGY SERVICES IN RURAL AREAS[23]

1. Introduction

The dismal status of access to energy services in rural areas as described in the previous chapter calls for action. Without access to appropriate energy services for productive and social activities, rural populations will not be in a position to improve dramatically the quality of their lives. Action so far has been inadequate, and this indicates that conditions in rural areas are not sufficiently conducive for improving access to reliable, affordable, economically viable, socially acceptable and environmentally sound energy services for sustainable development and poverty eradication.

This chapter explores what can be done at the top level, through national policy-making, to enable the development of energy systems in rural areas.

Energy services are an important part of the services and infrastructure needed to generate cash income. Energy is also needed for improving education and health and to facilitate reproductive activities. Energy services are therefore closely linked to improving the quality of life of rural populations and through those improvements to

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[23] This chapter builds mainly on papers prepared for the Ad Hoc Expert Group Meeting on Energy Services for Sustainable Development in Rural Areas, 27-29 September 2004, Bangkok, Thailand.

(a) Li Junfeng and Simon Taylor, "Policy options for increasing access to energy services in rural areas";
(b) Soma Dutta, "Increasing access to energy services in rural areas";
(c) Brahmanand Mohanty, "Enhancing Access to energy services in rural areas: issues and options";
(d) Conrado Heruela, "Implementation mechanisms: enforcement and monitoring";
(e) Akanksha Chaurey, "Linkages between sustainable development and energy services: policies and programmes";
(f) Gayathri Ramachandran, "Integration of energy issues in rural development planning in India".

support long-term, sustainable development of human and natural resources. It is thus clear that one-stringed policies, promoting one fuel or one type of service exclusively, will not bring about the intended benefits. An integrated and holistic approach to rural energy policy formulation and implementation is necessary.

The settlement structures of rural populations call for decentralized approaches that consider and integrate existing structures and ways of life. Energy markets, for example, though often informal, already exist in rural communities, including in settlements without access to modern fuels or technologies. Also, the division of responsibilities between the sexes in many locations means that women manage the energy resource base consisting of bio-fuels and carry the bulk of the associated drudgery and environmental hazards. Policies need to be designed to respond to the needs of all beneficiaries, ensuring that improved access to energy improves the quality of life of women, men and children. The first part of the chapter deals with internalizing a holistic view and a people-centred approach to energy policies.

Considering the need for lighting to extend hours of activity and the need for mechanical power to replace human labour for productivity increases, the provision of electricity must be part of any energy-policy equation. While energy policies have traditionally focused on extending utility grids, it is increasingly recognized that stand-alone or distributed generation systems are well-suited and cost-effective for meeting the electricity demands of remote populations. Policies must therefore be inclusive of a variety of options for electricity provision including grid-connected, distributed, stand-alone, renewable energy based and fossil-based energy.

Energy services for cooking and heating may be met most efficiently through combustion of solid or gaseous fuels or renewable-based technologies such as efficient biomass stoves, solar cookers or water heaters. Any comprehensive energy policy needs to integrate strategies for meeting this part of rural populations' energy needs in the most cost and energy-efficient manner.

Redistribution of wealth through incentives, tax schemes, grants and subsidies is a necessary element in providing energy services for all rural people. Good policies are put in place to manage exactly that. The combined funds available from Government, donors and NGOs are often, in the context of developing countries, far less than those required to provide all people with adequate energy services. Hence, innovative approaches, enabling private sector and community involvement, facilitating investments and enhancing rural populations' ability to pay, are

called for. They need to be duly considered and enabled through appropriate policy frameworks. All these options must be considered by policymakers, and a description of the advantages and challenges related to some of them is provided in the third part of the chapter.

Finally, policies in place in the Philippines, Thailand and Viet Nam are presented as examples of policy-making in practise. China's recently adopted Renewable Energy Law is also attached in the annex for reference.

2. Policy directions

Rural energy planners and policymakers have traditionally adopted top-down approaches, in which energy policies and planning at the national level are aimed at meeting the rural development goal of spurring economic activities as a means of raising living standards. This has generally meant limited, if any, scope for local consultation. As a result, many programmes have failed to address the needs and priorities of rural populations and their livelihood strategies in the broader social, political, cultural and institutional contexts. This has often led to an inability to address inequality issues.

The traditional supply-side approach to energy development and the narrow top-down supply mechanisms have not been able to address crucial development issues or promote energy services. As a result, as is described in detail in Chapter 1, nearly 50 per cent of the world's population still relies upon traditional sources of fuel such as biomass, and its associated inefficient combustion technologies and heavy indoor air pollution. As biomass and traditional technology are the energy source and the technology available locally and within the control of the local populace, this situation is not likely to change without enabling policies and fiscal support.

There is a growing realization that the best information and insights on rural energy issues come from the intended beneficiaries. It is important to build upon existing knowledge and expertise, and improve upon well-tested methods and practices. With detailed and expert knowledge of their local environment, rural people are in a position to contribute meaningfully, finding appropriate solutions to the problems they face. In addition, people-led approaches place ownership and responsibility with the local population, giving them the opportunity to take control of their own futures and increasing the sustainability of the chosen solutions.

Box 3-1. Decentralized and sustainable renewable energy systems in rural areas

The following major constraints have been identified to the development of decentralized and sustainable renewable energy systems in rural areas:

i. Over-emphasis of national energy policy on the expansion of bulk commercial energy supply capacity through centralized systems largely intended to meet urban and industrial needs;

ii. Low priority of energy in rural development in national planning, leading to the lack of fiscal and financial incentives for decentralized renewable energy systems;

iii. Weak technology research, transfer and development policies;

iv. Lack of emphasis on establishing close links between research and development outputs and local manufacturing and fabrication capabilities;

v. Weak institutional structures for implementation of rural energy projects;

vi. Unavailability of reliable information on rural energy needs, supplies and environmental status.

Source: Asian Development Bank. 2000. Review of the Energy Policy of the Asian Development Bank, ADB.

Note: It may be noted that the constraints listed are equally relevant to rural energy systems based on non-renewable energy sources.

A number of countries have recognized the need for integrated and decentralized area-based approaches to address local needs by maximizing the use of locally available natural, human and institutional resources. Special attention is being attached to building institutional capacity for programme formulation and implementation that encourages the involvement of rural communities. Some countries have included such approaches in their policy objectives, but information and institutional constraints hinder implementation on the ground. Some countries depend on external support to launch demonstration and pilot projects designed to test procedures for managing stakeholder involvement at the local level. Other countries have yet to formulate rural energy development policies and lack the capacity for managing decentralized approaches to rural energy development. In most cases, experience from demonstration projects and pilot programmes have failed to resonate in national energy policies, legislation and regulatory frameworks. This has hindered mass-replication of successful interventions and innovation by non-government stakeholders.

A WEC/FAO study[24] refers to three imperatives for addressing rural energy poverty:

- Policymakers need to place more emphasis on rural development and rural energy inadequacy
- Rural populations must form the core of rural energy planning and implementation
- Rural energy development needs to be integrated with other aspects of rural development, including health, education, infrastructure and financing

2.1 A holistic approach

The full economic and social benefits of energy services can be reaped only when other inputs, such as roads, communication, health and education facilities, markets, buildings, equipment and skilled personnel are available. Farmers will be able to benefit from electrification only if they have irrigation pump-sets. Increased agricultural productivity is most useful when farmers have access to markets where they can sell their produce. The absence of roads and poor transportation inhibit the growth of alternative income-generating activities. In addition, time saved from increased efficiency in productive activities is best benefited from if an environment allowing for educational or income-generating activities is in place.

- By exploiting the synergies that exist between the different facets of development policy, it is possible to reap exponential benefits.[25] "Bundling" services such as water, electricity, sanitation and education has disproportionate welfare benefits for local populations. In Peru, for example, the effect of bundling social services is said to be such that the impact of adding a fourth service for rural households is about seven times greater than the addition of the second service;
- The link between energy and other developmental sectors materializes only if (a) the energy sector focuses on working with other sectors to ensure that the poor benefit as much as possible from greater access to energy supplies, and (b) non-energy

[24] World Energy Council/Food and Agriculture Organization of the United Nations, *The challenge of rural energy poverty in developing countries* (London, WEC/FAO, 1999).

[25] Douglas F. Barnes, "Energy and poverty: strategies for assisting the rural and urban poor", (UNDP/World Bank, 2000).

specialists become aware of the role energy plays in achieving the goals of their own sector;

- Traditionally, energy interventions have been planned with the expectation that once energy is infused into a rural economy, it is only a matter of time before social concerns, such as reaching the poorest of the poor, would fall into place. When planning pro-poor energy interventions, it is important to consider how the poor use energy to secure their livelihoods;
- Local governments play a crucial role in the provision of subsidies. This is true even when they have been "rolled back" from directly providing energy services to the poor. However, subsidies should not be considered in isolation from other aspects of government intervention.

2.2 Meeting the needs

Different and unequal roles and responsibilities of men, women and children have consequences for rural energy needs, use and priorities. It is therefore necessary for the differences to be reflected in energy policy. The visibility, power and disproportionate number of men in public office, including in energy policy- and decision-making forums, creates imbalances in policy priorities. Often, men's needs are mainstreamed into energy policies. This combined with a focus on fuels and technologies, results in inadequate focus on the needs of energy users. Often this results in poor energy services for the men, women and children that the policies were originally designed to help.

Major differences in the roles and responsibilities of men, women and children include:

- Rural women (and children) are the primary collectors of wood and residue fuels; they also manage most of the energy used by households;
- Women and men have different degrees of access and control, especially with respect to biomass resources. In spite of the fact that women are closely involved with obtaining biomass resources from the surroundings, they rarely have control over them;
- Women's micro-enterprises, important contributors to household income, are often heat-intensive (food processing), labour intensive; and light-intensive (home-based cottage industries often require work in the evening). Lack of adequate energy supplies for these activities affects women's ability to operate these micro-enterprises profitably and safely.

Addressing the gender dimensions of rural energy necessitates the following actions:[26]

- Specifically address women's needs for labour-saving, time-saving, improved health, security and income-generation through energy inputs. Technologies such as stoves, kilns, grinders, presses and pumps that have a direct bearing on women's workload are always of great importance;
- Require disaggregation of energy use, supply and impacts by gender, and apply gender analytic tools for incorporating gender issues in project design and implementation, as well as establish frameworks through which data disaggregated by sex can be fed into decision-making channels at all levels;
- Prioritize cooking energy needs and issues related to women's health;
- Promote women as energy entrepreneurs, rather than merely the beneficiaries of expanded energy services. Women are ideal candidates to become renewable energy entrepreneurs for household and small-scale industry:
    - The Viet Nam Women's Union has been active in the promotion of solar home systems in rural areas through its extensive network of 11 million members. Many of the local technicians responsible for installing the solar home systems are women;
    - Prokaushali Sangsad Limited is promoting a rural women's micro-enterprise in Bangladesh. The project is located at Char Montaz, an un-electrified island in southern Bangladesh. The rural women are engaged in the construction and sale of fluorescent lamps that use direct current (DC) and rechargeable batteries. The women involved in the project run the manufacturing plant that produces the lamps, and are certified by the local government to run their business as a cooperative. Besides lamp construction, women are also learning about quality control, business development and marketing. If a woman constructs and sells two lamps a day, her daily income increases by 100 Taka (approximately US$ 2);

[26] K.V. Ramani and Enno Heijndermans, "Energy, poverty, and gender: a synthesis", in *Energy, Poverty and Gender* (Washington, D.C., World Bank, 2003).

- Support capacity-building and partnerships of women and men involved in energy. It is hoped that these partnerships will create a critical mass of women and men capable of influencing policies, programmes and practices that affect women and their energy choices. Capacity-building needs to be tailor-made for specific groups.

Income-generation

The energy needs of rural industries, such as lighting, process heat and motive power, have often been neglected in energy interventions. In Bangladesh, for example, where electricity supply is extremely erratic, most independent tailors use manual sewing machines, even though electric ones are available and several times more efficient. Lighting requirements are met by electricity in electrified villages and by kerosene in un-electrified villages. In electrified villages, the poorer households are typically not connected to the grid and rely on kerosene. The principal supply sources for process heat in smithies; brick and charcoal manufacture facilities; and agro-processing are fuel-wood and other biomass. Motive power requirements are met by electricity, where available, and by human labour using mechanical equipment, where it is not.

Modern forms of energy can provide critical inputs for rural agriculture and non-farm enterprises, creating new employment opportunities and supporting value-added activities linked to agricultural production. Small-scale manufacturing, food-processing industries, trading and marketing opportunities are all greatly expanded when energy services are available and have direct positive influences on rural communities. Users of Grameen Shakti solar photovoltaic modules view the extension of working hours as a major benefit, as this has spurred a variety of small enterprises such as manufacturing (saw mills, carpentry), services (television/radio repair shop, barbershop), or home industries such as basket-making, net-weaving and tailoring.[27] Other benefits of improved lighting in small enterprises are better efficiency and quality of work, better working environment and a more attractive and secure environment for customers.

The number of such enterprises today is in the millions. The ability of the poor to generate livelihoods from these is constrained by a combination of factors, of which energy may be one. Some of these challenges include high business and marketing costs because of

[27] Elizabeth Cecelski, *The Role of Women in Sustainable Energy Development* (Golden, Colorado, National Renewable Energy Laboratory, 2000).

long distances, poor transport infrastructure, low literacy rates, poor communications and a lack of trained personnel in addition to poor access to credit, equipment and support services such as access to information on markets, opportunities and training. A good number of these enterprises, especially the home-based ones, are operated by women and tend to be overlooked by agencies because they are informal and difficult to reach. Given the accompanying challenges, it is clearly not sufficient to provide energy inputs alone to rural industries. Policy directions to enhance the contribution of energy services towards livelihood support and enterprise development are as follows:

- Energy strategy formulation must be based on a clear understanding of the lifestyles and livelihoods of rural populations;
- Energy services must pay far greater attention to process heat and motive power, which are the primary requirements for productive activities;
- Since most income-earning activities of the poor are based on human labour, greater attention should be paid to energy services that can directly substitute the extent of labour content in production;
- Innovative financing mechanisms, especially these with a grassroots outreach and those tailored to the repayment capacities of rural populations are required.

Services

More emphasis on energy services is required for public services such as health centres, schools and water supplies. Whether it is refrigeration for storing vaccines, lighting for maternity words, pumping for obtaining drinking water or lighting for evening study, there is no doubt that the impact in terms of quality of life and long-term capacity-building of the poor in remote areas is very significant. Many of the core conditions of poverty, such as poor health, lack of potable water, sanitation and illiteracy, stem from inadequate community services. A number of these services cannot be dealt with at the level of isolated households.

Public services are central to achieving the Millennium Development Goals on health and education, and modern energy will be an essential input to modernizing and expanding service provision. Much more needs to be done to integrate energy considerations into rural development policies.

2.3 Keeping track of progress

Any comprehensive energy policy framework must include a monitoring mechanism, defining objectives, time schedules and procedures for regular monitoring of the impact of policy implementation.

As the ultimate aim is to improve the living conditions of rural populations, monitoring and evaluation frameworks for rural energy policies must be set within the broader context of poverty monitoring and evaluation. This is especially so because energy or electricity is not a sufficient condition to resolve poverty. One of the reasons that needs and interests of the rural poor, and of women in particular, tend to be under-represented in rural energy policies is that the current monitoring and evaluation mechanisms focus on technological success indicators and do not track the development impacts of energy programmes.

Ramani[28] suggests the use of two complementary techniques for use in planning and evaluating the impacts of rural electrification projects, which can be expanded to rural energy projects in general. They include a participatory assessment and a socio-economic impact survey. The techniques are complementary to one another and are based on methodologies that have been developed and applied in existing World Bank projects. They incorporate qualitative methods to acquire in-depth insights from the consumers of energy services and more quantitative household surveys that can examine the patterns and use of energy services.

This approach is based on the assumption that the sustainability of improved rural energy systems and other rural infrastructure projects is positively associated with the degree to which all social groups and the two sexes have access to the service and use it. The approach also implies that a project cannot be considered successful if it does not meet the needs of all population groups and share the costs and benefits of the service equitably among these groups. It further assumes that success and sustainability are positively influenced by institutional and policy environments where gender and poverty issues have been taken into consideration. A set of key variables highlights the major social development issues that affect rural electricity project effectiveness and sustainability:

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[28] K.V. Ramani, M.N. Islam and A.K.N. Reddy, *Rural Energy Systems in the Asia-Pacific: A Survey of Their Status, Planning and Management* (Kuala Lumpur, German Agency for Technical Cooperation, 1993).

- Effectively sustained services
- Equitable access to and use of services
- Improvements in cross-sector social development indicators, such as education, access to health and other social services and security
- Equitable division of burdens and benefits
- Equitable participation in service establishment and operation
- Institutional and policy support for gender and poverty issues

A number of key indicators have been developed against each of the above variables, which offer a set of measurable criteria, both quantitative and qualitative, which could be applied in cross-project or cross-country analyses for further refinement.

3. Available choices

Policies form the basis for establishing regulatory frameworks governing redistribution of wealth in the form of incentive creation for behaviour change. This allows the entrance of stakeholders such as communities, local governments and private entrepreneurs, which are often well placed for designing appropriate and sustainable solutions within the framework provided.

Several demonstration programmes and pilot projects have been carried out during the previous decades to test technologies, participatory approaches and financial, operational and maintenance schemes for developing sustainable solutions to energy service provision in rural settlements. However, long-term solutions require an institutionalization of the lessons learned from demonstrations, and this is where energy policies play an important role.

In addition to introducing incentive-creating fiscal measures, Governments also play a role in establishing or developing institutional frameworks supporting desired developments through advice, training, management, soft lending, research and development. The need for such enabling frameworks is particularly urgent in the case of rural energy development as non-existent markets, the paucity of incentives for private sector involvement and investment and the inability to pay for existing energy options are among the main barriers to development and penetration of appropriate technologies and energy sources. Some varieties of enabling frameworks are:

- **Management and administration:** Government-financed agencies, servicing energy planning, regulation and pricing as well as other services for increasing energy to rural areas. Examples include Indian Renewable Energy Development Agency Ltd. and parts of the Ministry of Non-conventional Energy Sources of India. In China, the Rural Energy Offices have about 100,000 staff at different levels for renewable energy development, the total administration cost of which was about US$ 225 million at the 2000 exchange rate,[29] a substantial subsidy for renewable energy development.
- **Direct cost for research and development:** Renewable energy research and development is supported by many developing countries. In China, for example, the annual budget for promotion of biogas, small hydropower and improved stoves is about US$ 125 million at the 2000 exchange rate.
- **Energy service quality standards:** Standards of the quality of energy services as well as wiring codes at the household level are often set at the levels of industrialized countries. Thus, the cost of expanding energy access to lower-income households can be high. Such standards can be scrutinized to simplify them and suit them to local conditions. Similarly, for low-level electricity consumption, load limiters can eliminate the need for installing consumption-based meters and lower billing and collection costs.

3.1 Sustainable use of local biomass

In some rural areas, energy for cooking accounts for 70 to 80 per cent of total energy consumption and is mainly supplied through wood-based products. Biomass is also a principal supply source for process heat in rural industry and agro-processing.

National energy policies in many cases overlook this aspect of the energy equation, perhaps because of the perception that wood-based energy services are traditional and non-commercial, leading to the assumption that biomass is transitional and eventually will be replaced by other fuels. However, considering the current situation and realizing the potential economic and environmental benefits of utilizing this renewable energy source efficiently, policymakers must realize that biomass is here to stay and focus on creating policy frameworks to meet the energy demand for cooking and process heat in an efficient, clean and cost-effective manner.

[29] 1 US$ = 8.28 yuan.

As the use of fuel-wood has direct impact on forests and on indoor air pollution, energy policies should support sustainable fuel-wood production by local communities and its efficient utilization. Policies for sustainable fuel-wood production may include land-use policy reforms, security of property rights, efficient management of existing forest resources, promotion of alternate energy resources such as crop residues and animal wastes. To alleviate wood shortages, fuel-wood plantation projects should be supported, including the planting of native species in degraded lands and the introduction of efficient harvesting and delivery systems.

Policies on the efficient utilization of fuel-wood could include promoting the development and marketing of improved stoves. This can be accomplished by supporting training on stove designing and testing along with public campaigns. Such initiatives would likely yield multiple benefits in the form of reduced fuel demand, substantial health benefits and reduced time needed for women to gather firewood; development policies should therefore target rural women to participate in such programmes by assessing their needs and the selection of stoves and arranging the necessary financing. Utilization of biomass for biogas production is another option with large untapped potential.

Charcoal is favoured in many rural households and micro-industries as a cleaner fuel than wood. However, the local manufacturing of charcoal in kilns is inefficient. Government policy could include training and financial assistance to the charcoal producers to develop and adopt more energy-efficient kilns.

3.2 Involving the private sector

So far, energy reforms have made little impact on improving energy services for the poor, having focused on networks serving better-off users, and with scant attention to institutional and market constraints faced by the poor. Key tools that could increase the effectiveness of electricity reforms to serve the poor are institutional in nature, and include choices about market structures, financing and access to credit, pricing and regulation.

The energy supply sectors of many developing countries are in the process of being restructured to attract private capital. A 1998 survey of 115 developing countries however showed that the power sector in these countries is still dominated by State-owned monopolies.[30] A report from

[30] Penelope J. Brook, and John Besant-Jones, "Reaching the poor in an age of energy reform". In *Energy Services for the World's Poor* (Washington, D.C., World Bank, 2000).

the World Bank, however, confirms the view held by many people involved in the practical implementation of rural energy schemes when it says that:

> It is illusory to expect that increasing access to electricity for a significant part of the population traditionally excluded from grid based electricity can be financed only by the private sector.[31]

Inappropriate local involvement in designing and implementing energy reforms runs the risk of failing to protect the interests of the poor. As energy supplies are delivered on a more commercial basis, their availability to poor people may reduce. On the other hand, restructuring may increase the flow of investments into expansion of a country's energy systems. Private sector involvement thus poses a threat as well as an opportunity for poor people.

3.3 Providing electricity to all

In the recent past, there has been an excessive focus on the provision of electricity to poor people, at times to the detriment of other options. However, electricity is arguably the most sought after modern energy service for the rural poor. It is an efficient source of lighting, and the only energy carrier that can drive many modern technologies, such as telecommunications including radio and television.

Distributed power systems

Most rural electrification policies and programmes have focused on connecting rural areas to the grid. However, grid-supplied electricity is not always the least-cost option, so planners need to consider other possibilities.

Extending an electricity grid to households in rural areas can cost seven times more than for grid electricity in urban areas.[32] Promising new approaches to providing electricity services to new rural customers far from the grid are beginning to emerge. Among recent off-grid electricity programmes, most of the successful ones have involved a fund for providing loans and subsidies to rural communities, private entrepreneurs, or non-governmental organizations to develop viable

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[31] World Bank, *Best Practice Manual: Promoting Decentralised Electrification Investment* (Washington, D.C., World Bank, 1999), p. 10.

[32] United Kingdom Department for International Development, *Energy for the Poor: Underpinning the Millennium Development Goals* (Department for International Development, 2002).

business plans for providing rural electricity service.[33] While initial subsidies for establishing electricity service companies can be necessary and appropriate, it is important that businesses maintain financial viability while continuing to serve the rural population.

Although the climate is growing more favourable to decentralized energy supply options, in most countries the existing regulatory framework is a major barrier to such development. Taxes and subsidies often undermine markets, rather than encourage them. Support in the form of training institutions, infrastructure and finance may be non-existent or inaccessible. Competitors may be able to gain privileged access to subsidies that enable them to sell their products below cost. Without changes to this policy environment, the flow of private sector finance and innovation will be restricted. These areas are the focus of much analysis, innovation and reform.

Box 3-2. Rural electrification in the Philippines

Following the passing of the Electric Industry Reform Act, an independent regulatory commission was set up to oversee rural electrification, lifeline tariff for marginalized consumers and a levy for rural electrification in the Philippines. A universal charge on other consumers allows subsidization of lifeline tariffs for the poor and extension of electricity services to rural areas. About 87 per cent of the villages had been electrified by 2002. More recently, the Government has set a target of electrifying the most isolated villages by using renewable energy technologies while seeking to maximize private sector involvement.

Energy services provided through distributed, renewable energy-based systems need particular attention in order to gain scale success. Such schemes can be more cost-effective than extending the electric grid. However, several institutional, regulatory, technical and financial barriers need to be addressed in order to guarantee the full growth of renewable energy-based stand-alone or distributed generation schemes. Electricity regulations formulated by public authorities often do not allow off-grid electricity providers to serve rural customers, discouraging many local initiatives. Also, the market is still limited because of the focus on grid-based solutions and

[33] Jamal Saghir, "Energy and poverty". Paper prepared for the International Energy Forum in Amsterdam on 22-24 May 2004 (Washington, D.C., World Bank, 2004).

biased support to existing players. Moreover, the demand for renewable energy services remains low as end users do not have access to technical and financial information on such options or to financial support for gaining access to the products offered by energy companies.

Box 3-3. India: Electricity Act 2003

In India, the Electricity Act 2003 states that the "government shall endeavour to supply electricity to all areas including villages and hamlets" and the "government shall prepare and notify a national policy, permitting stand-alone system (including those based on renewable sources of energy and non-conventional sources of energy) in rural areas".

Source: The Act may be accessed at the following URL: <http://powermin.nic.in/The Electricity Act_2003.pdf>

Renewable energy schemes are site-specific, being fully dependent on the availability of natural resources (solar, wind, hydro, biomass etc.) there is a risk of energy deficit or surplus situations at the site. Policies for distributed renewable energy-generation schemes should take such uncertainties into consideration, for example by allowing independent power producers to wheel their output through utility grids, standardizing power purchase agreement conditions, storing or banking surplus electricity, net metering or third-party sale.

Renewable energy-based schemes, distributed yet grid-connected, are capable of competing with grid electricity in regions where they help to displace the most expensive fuel in the conventional fuel mix. To create a level plying field, tariff calculations for such systems should be based on the delivered cost of grid electricity at the site.

Extending the grid has traditionally been taken as representative of a national Government's commitment to provide energy services to rural communities, and hence linked to the status and longevity of Governments and to national pride. In spite of it being the largest and top-priority rural energy programme in most developing countries, it does not automatically follow that electricity unequivocally benefits all population segments of rural communities. In fact, studies indicate that rural electrification benefits higher-income segments of populations more than lower-income segments, and that it often exacerbates rural poverty gaps and gender inequities.[34] Barnes and Foley enumerate

[34] K.V. Ramani and Enno Heijndermans, "Energy, poverty, and gender: a synthesis", in *Energy, Poverty and Gender* (Washington, D.C., World Bank, 2003).

the following policy lessons from successful rural electrification programmes:[35]

- **Appropriate institutional structures:** A variety of successful institutional approaches have emerged, including setting up rural electric cooperatives (Bangladesh) and allocating rural electrification to a department of the national distribution company (Thailand). Common factors in successful institutional structures are a high degree of operating autonomy to allow implementing agencies to pursue rural electrification as their primary objective, clear performance-tracking systems, involvement of local communities and good quality customer service.
- **Dealing with the political dimension:** Using public funds for rural electrification often invites political interference at national and local levels. Once technical and financial decision-making in the implementing agency becomes subject to political string-pulling, problems follow such as waste of resources and low staff morale; further, operational ineffectiveness results in destruction of professional discipline. However, the impact does not always have to be negative. For example, in Thailand local politicians were encouraged to raise and contribute funds, so that their constituents could receive electricity before the planned time. It is even more important to ensure that rural electrification planning is transparent and objective, and makes use of clearly defined criteria to rank areas for electrification, so that the decision-making is viewed as fair.

Box 3-4. Draft bill for restructuring the power sector in the Philippines

A draft bill for restructuring the power sector in the Philippines includes an open access provision, which opens up the energy sector to competition both for generation and distribution. Such a regulation creates a new competitive environment, putting pressure on energy companies to improve their services before expanding lines to marginal areas. It also makes mini-grids the most effective means for providing electricity to remotely located villages with sparse populations.

- **Criteria for rural electrification:** Providing electricity supply can make a significant contribution to the development process only

[35] Douglas F. Barnes, *Rural electrification in the developing world: lessons learned from successful programs* (Washington, D.C., World Bank, 1998).

when other necessary conditions are in place. Security of land tenure, availability of agricultural inputs, access to health and educational services, reliable water supplies, and adequate dwellings are some of the most important of these conditions. Successful rural electrification programmes implement a system for ranking or prioritizing areas to be supplied with electricity. Capital investment costs, the level of local contributions, the number and density of consumers and the likely demand for electricity are among the factors normally taken into account. Thailand developed a numerical ranking system taking account of a variety of factors such as level of income, the number of existing commercial enterprises and the Government's plans for other infrastructural investments in the area.

- **Importance of cost recovery:** Cost recovery is probably the single most important factor determining the long-term effectiveness of rural electrification programmes. Most rural electrification programmes have been built with the help of capital obtained at concessionary rates or grants. Provided it is used wisely and operating costs are covered, having access to such concessionary capital need have no ill-effects on the implementing agency or the rural electrification programme. The lesson here is that concessionary capital should never be provided to organizations which are not covering their operating and maintenance costs; it will simply worsen their financial position.

- **Charging the right price for electricity:** Grid electrification makes sense only in areas where there is already a demand for electricity-using services such as lighting, television, refrigeration and motive power. In the absence of a grid supply, these services are obtained by spending money on kerosene, LPG, dry-cell batteries, car battery recharging and small power units, all of which are highly expensive per unit of electricity supplied. Rural electrification tariffs set at realistic levels do not prevent people making significant savings in their energy costs, as well as obtaining a vastly improved service. Charging the right price enables the electricity company to provide an electricity supply in an effective, reliable and sustainable manner to an increasing number of satisfied consumers.

- **Benefits of community involvement:** Rural electrification programmes can benefit greatly from the involvement of local communities, or suffer because of its absence. Setting up a rural electrification committee to represent the local community can do much to smooth the implementation of the programme. The

committee can play a crucial role in helping to assess the level of demand, educate consumers and encourage them to sign up for the supply in addition to conflict resolution functions and even payment collection. In Bangladesh, consumer meetings are held before the arrival of the electricity supply, helping to avoid costly and time-consuming disputes over rights of way and construction damage. Community contributions, in cash or kind, were often the decisive factor in bringing areas within the scope of the rural electrification programme in Thailand.

3.4 Getting the price right

While the ability and the willingness of rural people to purchase modern energy services may be contingent upon their financial resources, their prospects for achieving higher income levels are, in turn, often constrained by lack of appropriate energy services. Energy and rural development may thus find themselves in a state of mutual dependence, and represent one aspect of the poverty cycle that pervades many rural areas. Breaking this deadlock is one of the major challenges faced by third world countries in developing their rural areas. Central to this is making modern energy services affordable to rural populations.

Perhaps one of the most critical issues in rural energy development is the non-monetized nature of many aspects of the rural economy. Because of this some energy supplies, such as fuel-wood and other biomass, are not always commercially traded. Limited cash needs to be spent on a variety of goods and, as energy may be perceived as a free good, it may not enjoy the highest priority. However, it is important to note that a number of studies have shown that rural families depending on traditional energy spend a higher proportion of their income on energy than families with access to modern energy services. Often, when physical access to energy is obtainable, high initial costs in the form of installation or connection prevents all but the most affluent rural households from purchasing the energy services on offer. Unless the energy services provided can immediately serve as a generator of income, it can seldom compete with other, more urgent needs.

3.5 Financing with innovation

Just as is the case with the mutual dependency between making energy services affordable and making energy services available, the pricing of rural energy service must balance affordability. With the willingness of financial institutions to induce the necessary investments,

and the political will to spend public funds to provide energy services for socio-economic development. In most cases, the immediate priority for rural energy policies is to provide a minimum amount of energy to meet people's basic needs, irrespective of their ability to bear the costs of supply and delivery. However, policies need to establish the basis for energy services to be expanded and modified in accordance with changing needs stemming from socio-economic developments.

Innovative financial engineering approaches are required to address the issue of the high up-front costs of distributed solutions to rural energy supply. This can be partly addressed by design innovations. Subsidies designed to benefit poor customers may include strategies to reduce the initial costs and encourage poor customers to adopt efficient equipment and appliances. The Provincial Electricity Authority of Thailand, for example, was successful in expanding grid electrification by standardizing system design and providing a lifeline tariff to the poorest consumers.

Apart from the provision of capital subsidies to lower the initial financial burden, the repayment terms and amortization schedules may be designed to match with the expected revenue generation by the energy service provider. To avoid the high cost structure of the large utilities, Governments should encourage and support private sector independent power producers (IPPs) and rural electricity cooperatives formed under the leadership of local communities and NGOs.

Some Governments have created special funds for accelerating rural electrification and for targeting poor households that cannot afford electricity and that rely on traditional fuels to satisfy their energy needs.

Box 3-5. Sri Lanka: Energy service delivery project

A project in Sri Lanka made two critical investments in market development. First, it supported the creation of the Solar Industries Association, which provides technical advisory and intermediation assistance to manufacturers and interacts with the donors' bank and the national power utility on policy matters such as rural electrification, import duty and taxes. Second, in order to address the lack of awareness, the project regularly executes a generic promotion campaign on SHSs, which targets end-users, government authorities, community-based organizations and micro-finance institutions.

In addition to overall poverty in rural areas, the number and range of "intermediation tasks", low density of demand and remoteness of location raise the costs and reduces profitability of energy supplies to rural areas. Furthermore, a certain amount of "social overhead investment" almost always has to be put in place to support such schemes (training, technical assistance and capacity-building within communities). The burden of these overheads would be particularly high for innovative schemes, though they may eventually be spread across a large number of enterprises.

3.6 Subsidize with caution

The arguments for using money that is supplied at less than full commercial rates of interest are overwhelming if large numbers of people are to be given access to improved energy services. Subsidies are required to enable people with insufficient purchasing power to gain access to electricity and to other more convenient forms of energy. Subsidies provided by the central and local Governments are among the most popular economic incentives for increasing energy availability in rural areas in developing countries.

Governments have sought to promote the provision of affordable modern energy services in rural areas by subsidizing particular forms of energy. Although well intentioned, the majority of energy subsidies have proved to be counterproductive, destroying markets and benefiting people who are already better off.[36] Subsidies on grid-based electricity, kerosene and diesel, have been shown in some cases to stultify innovation, destroy markets and support the already rich.

All Governments provide subsidies, and it is clear that some of these have done more harm than good. The essential question that has emerged from the ideological posturing in recent years is less about the rights and wrongs of subsidies in principle, but rather whether a particular form of subsidy is likely to benefit the intended target group in a cost-effective manner.

Some of the problems commonly faced with energy subsidies are:

- They tend to work against consumers making least-cost choices and in doing so, undermine investors' efforts to provide alternative energy forms;

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[36] United Nations Environment Programme/International Energy Agency, *"Energy Subsidy Reform and Sustainable Development: Challenges for Policy Makers"*, Report on the Energy Subsidy Reform and Sustainable Development: Challenges for Policy Makers Workshop held in Paris, 6-7 November 2000.

- Indiscriminate subsidies tend to undermine the development of commercial markets. The strategy of trying to increase sales through subsidies is unlikely succeed in the long run, as subsidies tend to stultify markets, destroy innovation and benefit those who can already afford the subsidized technologies;
- Because of poor dimensioning, subsidies meant for the poor have often gone to higher income households (kerosene subsidies in Indonesia, power for irrigation in India and so on);
- Widespread recourse to unnecessary subsidies has frequently proved to be fiscally unsustainable.

A reduction or removal of pricing subsidies to overcome these problems is not straightforward however because of potential adverse impacts on the poor. The partial withdrawal of kerosene price subsidies in Sri Lanka and Myanmar, for example, forced people in some rural areas to return to the use of fuel-wood. Both these countries suffer from deforestation and this could have serious environmental implications for them in the long run.

A number of technology-driven schemes currently adopt a strategy of trying to increase sales through subsidies. This is particularly the case with solar PV. It is argued that increased sales will reduce the cost of production and, more importantly, enable the overhead costs of providing technical support and supplying retail credit to be spread over a larger number of unit sales. The danger of such an approach is that public funds intended for social investment are often used to subsidize the costs of these supply options for those who could readily afford to pay the true cost if they genuinely regarded this as a priority area of expenditure. Furthermore, the use of subsidies linked to a particular supplier can "pollute the well" for other entrants to the market.

Box 3-6. China: Subsidy for PV village power programme

In the early 1990s the Chinese village power programme included price subsidies that allowed customers to pay for operating costs only, while investment costs were covered by public funds. Even so, most of the households pay about 2 yuan per kWh in contrast to the grid power sales price of about 0.5 yuan per kWh. As a result, some households in PV-powered villages have turned back to using candles or kerosene.

Energy subsidies should be introduced only with caution and with stated "exit" strategies to ensure that they are well-targeted and remain cost-effective. Government policies to artificially lower energy prices undermine incentives for private investors, local authorities or cooperatives to develop off-grid power projects or other innovative solutions to persistent energy poverty. They also undermine incentives for end-users to invest in more efficient equipment and appliances.

Moreover, such subsidies have been shown to benefit the rich more than the poor. Also, subsidies for the installation of distributed generation units should not make electricity tariffs unrealistically low. Tariffs should cover operating and maintenance costs to avoid deterioration in the quality of service and system failure in the longer run. This is the case for renewable as well as fossil fuel-based energy systems.

Box 3-7. South Africa: Poverty tariff

In 2002, South Africa introduced a "poverty tariff" for the poor; from 20 to 50 kWh per month of electricity are provided free to poor households. A recent evaluation of those households showed an increase in average monthly incomes and addition of lighting in non-electrified rooms and the use of other electrical appliances that they could not afford earlier.

Governments should avoid the practice of uniform electricity pricing by asking the State-owned utilities to cross-subsidize rural electricity consumers through other consumers. This affects the financial viability of local grids and discourages their development. Costs for any financially non-viable electricity supply extension, including those favouring the adoption of renewable energies, particularly those pursued purely for social reasons, should be provided through funds allocated from tax revenues. For example, financial incentives provided by Thai authorities to private producers of various forms of renewable energy is tapped from taxes imposed on oil products.

Where subsidies are necessary, they should be targeted at intended beneficiaries and delivered in an appropriate manner. For example, suppliers may be provided incentives on the basis of services extended to a number of less affluent households. Similarly, lifeline tariffs for grid electricity may be justified for poor households using electricity to meet minimum basic needs. Governments may finance lifeline tariffs through cross-subsidization between small and large consumers. To ensure that lifeline tariffs benefit the poor, related fixed charges and connection fees must be minimized.

In spite of the problems with subsidies, it is clear that Governments need to consider the use of subsidies in order to reach the poorest segments of their populations. The subsidies must be targeted and designed with "eyes wide open" to the inherent danger of market distortion. "Smart subsidies",[37] a response to a realization

[37] The term "Smart Subsidies" was first coined by Charles Feinstein at the World Bank. For more information about what is entails see: World Bank, *Best Practice Manual: Promoting Decentralised Electrification Investment* (Washington, D.C., World Bank, 1999).

that the "devil is in the details" when it comes to appropriate subsidy design, entail the following:

- Follow pre-established rules that are clear and transparent to all parties. Information on the amount of government money spent on the subsidy and on subsidy recipients should be disclosed and cross subsidies should be explicit rather than implicit;

- Incorporate a clear "exit strategy" for subsidies that shows how and when subsidies will no longer be needed. This should prevent consumers and producers becoming overly dependent on the subsidy in question and ensure that costs do not spiral out of control;

- Focus on increasing access by lowering initial costs (technical advice, capital investment) rather than lowering the operating costs;

- Provide strong cost minimization incentives, such as retaining private sector competition;

- Tie operating performance to subsidies rather than investment to make them more effective;

- Subsidize market development or "trail-blazing costs" (marketing, distribution infrastructure, user awareness, appropriate technology adaptation, quality standards and training) instead of hardware because these long-term costs are the crucial barrier in rural areas;

- Remain technology-neutral;

- Cover the whole supply chain including end-use investments, particularly to encourage pro-poor end-uses;

- Only cross-subsidize within a programme to pay for lifeline tariffs and other "pro-poor" recurrent cost subsidies (e.g., enable transfer from richer sections of the community, and commercial users to marginal connections).

4. Policy in practice – examples from Asia

A number of countries have put in place policies and related institutional and regulatory frameworks to further energy development in rural areas. This section gives a brief overview of targets, strategies, or programmes, developed by the Governments of the Philippines, Thailand and Viet Nam, to promote energy service provision in rural areas. China's recently approved renewable energy law is reproduced in its entirety in annex II. Readers may use the information as inspiration for own policy development or analysis.

4.1 A cooperative approach in the Philippines[38]

Regulatory framework

The Government of the Philippines has followed the policy of total electrification since 1960 when Republic Act RA 2217 was enacted into law, creating the Electrification Administration to finance and assist private municipal electric utilities. In 1969, RA 6038 created the National Electrification Administration as the primary agency responsible for executing the rural electrification policy. It also provided for the organization of rural electricity cooperatives to implement electrification targets and operate and maintain the networks.

Energy Resources for Alleviation of Poverty

The Energy Resources for Alleviation of Poverty (ERAP) programme was launched in 1998, aiming at 100 per cent barangay[39] electrification by the year 2008. Later, the O'llaw programme emerged from ERAP in order to accelerate and achieve total barangay electrification by 2006. The O'llaw programme, also called the gift-of-light, gave momentum to renewable-based electrification, particularly solar PV-based battery-charging stations and home lighting systems that focused on providing basic lighting services to households in remote barangays. Micro-hydro systems and hybrids based on combinations of PV-wind-diesel-micro-hydro have also been used for barangay electrification.

Apart from the electrification targets, the most significant component of the O'llaw programme was an attempt to integrate efforts

[38] Asian Development Bank, *Rehabilitation of renewable energy projects for rural electrification and livelihood development in the Philippines* (TAR:PHI 36561) (Manila, ADB, 2004).

[39] Barangay is a local government unit in the Philippines.

by all agencies concerned, namely, the Department of Energy (DOE), NEA, National Power Corporation through its Small Power Utilities Group, the Philippines National Oil Company and NGOs. This programme also encouraged greater private sector participation in rural electrification.

In April 2003, the O'Ilaw programme was transformed into the "Expanded Rural Electrification Programme" to include energized hamlets of energized barangays and to facilitate the implementation of the "Missionary Electrification Development Programme" (MEDP).[40]

At the national level, the Government gives momentum to the development of renewable energy by setting aggressive long-term goals for the promotion of renewables consistent with the energy sector's objectives as laid out in the Philippines Energy Plan 2003-2012. The Renewable Energy Policy Framework of DOE, which provides the blueprint for developing this sector, also pushes for the introduction of a renewable energy bill.

Strategy

Grid extension is mostly unviable for the electrification of barangays characterized by remoteness and low-load density. DOE, having acknowledged the financial and institutional constraints in meeting the national targets of household electrification, has broadened its approach to rural electrification by opening up remote and unviable areas (which distribution utilities and their franchises are unable to serve) to private sector and so-called qualified third parties, an alternate electric service provider authorized to serve remote and unviable areas pursuant to EPIRA.

Further, DOE has issued a policy statement that MEDP projects may receive a government subsidy towards the cost of capital investments, subject to the delivery of the agreed milestones. However, DOE realized that due consideration was not given to economic efficiency, financial prudence and institutional capacity in implementing electrification projects especially as pertains to solar PV. To rectify this problem, DOE through circular No. DC 2004-05-005 adopted a policy for streamlining and rationalizing the grant of subsidies in the electrification of missionary areas using solar PV systems. It also proposes the

[40] MEDP is a five year electrification plan of the Philippines DOE. It includes capital investment and operations regarding capacity additions in existing missionary areas and the facilities to be provided in other areas not connected to the transmission system.

integration of livelihood programmes in the missionary areas to address sustainability issues.

4.2 Productive use of tax revenue in Thailand[41]

Recognizing that most renewables, under current market conditions which favour large fossil fuel-based energy systems and do not consider the environmental costs of energy production and use, the Energy Policy and Planning Office, Thailand, embarked on the comprehensive Energy Conservation Programme (ENCON) established under the Energy Conservation Act of 1992. Under ENCON, the Energy Conservation and Promotion Fund was established to provide financial support to introduce and promote new and renewable energy technologies. The capital for the fund was initially secured through the existing Oil Fund. Levies from petroleum producers and importers, power surcharges, as well as remittance rates from consumer petrol prices, ensures continuous capital inflow to the Fund.

ENCON provides a variety of financial support schemes, including non-binding grants for government agencies and non-profit organizations that manage the funded renewable energy projects, as well as investment subsidies for the private sector as project counterparts.

The Energy Conservation Act states that ENCON should contribute to saving energy through awareness-raising, and the adoption of energy-efficient technology. In addition expected to promote sustainable use of natural resources and protect the environment, and promote the development of renewable energy sources. The main features and target groups of each three main programmes under ENCON are shown in table 3-1.

The Voluntary Programme shown in table 3-1 involves the provision of financial assistance by the ENCON Fund to support the utilization of renewable energy, mainly in rural areas. The programme has three subprogrammes: (a) Renewable Energy and Rural Industry, (b) Industrial Liaison and (c) Research and Development.

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[41] Based mainly on:

(a) Rene T. Anderson's "Sustainable Energy Policy in Thailand" PhD thesis
(b) Pongpisit Viseshakul, *Financial support to promote biomass-based power generation in Thailand. A case study of stakeholders involvement* (2003).

Table 3-1. Main features of programmes and target groups under ENCON

Programme and target group	Procedure	Implemented by
1. Compulsory Programme Designated factories and buildings New factories and buildings Government buildings	Appoint energy manager Conduct assessment study Identify ENCON project Apply for subsidy Contract for execution	Department of Alternative Energy Development and Efficiency (DEDE)
2. Voluntary Programme Renewable Energy and Rural and Small Industry Industrial Liaison Research and Development	Open tender procedure Voluntary application Contract implementing organization Support of groups	Partnership between government institution and NGO
3. Complementary Programme Public relations Training and education Management and monitoring	Terms of reference Tendering by invitation Contract with private sector	Energy Policy and Planning Office (EPPO) and DEDE

The Renewable Energy and Rural Industry Subprogramme focuses on opportunities to develop fuel substitution and on the introduction and dissemination of renewable energy technology, especially technology that uses renewable energy sources more efficiently, by providing full operational cost for project owners and granting financial support in the form of interest subsidies for project participants.

Successful projects under the subprogramme include biogas production and energy conservation in the tobacco-curing industry.

The Industrial Liaison Subprogramme has funded many small and large scale demonstration projects. Its efforts include information dissemination for proven technology, and application of the results from research projects, emphasizing the application of technology to small industries. The subprogramme also indirectly enhances the capacity of industry to produce energy-efficient equipment.

The Research and Development Subprogramme aims at developing new or improving existing technologies, with support to small-scale demonstration projects as well as information dissemination. The Fund has supported more than 50 R&D projects for energy technology development and conservation undertaken by various government agencies and academic institutions.

Completed projects include the design of a programme for energy conservation in buildings, information dissemination on energy-related research and environment in Thailand and the development of an energy-saving brick kiln.

Management arrangements

The promotion of renewable energy is implemented by EPPO under the Voluntary Programme. Project proposals requesting financial supports from the ENCON Fund are invited from government agencies, universities, research institutions and non-profit organizations. The Fund Committee delegates power to the Subcommittee on the Voluntary Programme to screen and make decisions on whether to allocate financial support to the proposals submitted.

The organizations are evaluated for their capability to manage the project's proposed activities on the basis of their proposed plan of operation, the proposes project's efficiency in terms of energy conservation and the capability of the organization to achieve the declared goals, with low risk in terms of management and proposed technology.

There are two types of financial support for the implementation of the Voluntary Programme:

- Non-binding grants for government agencies and non-profit organizations to cover operational costs for managing, administration, marketing, maintenance and after-sales services of the funded renewable energy project
- Investment subsidies for the private sector as investors to entice them to invest in renewable energy projects

The amount of subsidy for project counterparts is calculated using the following criteria:

- Projects must have an economic internal rate of return greater than 9 per cent
- For each renewable energy project, financial support from the Fund will be provided to increase the financial internal rate of return to 5 per cent points above the equivalent rate of the minimum retail rate of the Krung Thai Bank.

In addition, financial support to be granted for each project must follow the rules that are listed in table 3-2, unless approval has been granted by the Fund Committee for exception.

Table 3-2. Financial support from the ENCON Fund

Investment range (millions of baht)	Financial support (%)	Maximum support per investment range (millions of baht)	Maximum total support for the project (millions of baht)
0-2	60	1.20	1.20
2-5	45	1.35	2.55
5-10	32	1.60	4.15
10-20	22	2.20	6.35
20-50	12	3.60	9.95
Over 50	–	0.05	10.00

In sum, the investment subsidy that the Fund can currently provide for investors who wish to invest in renewable energy projects cannot exceed 60 per cent of the investment cost. The current practice shows that the Fund has been providing financial support of about 35 to 45 per cent of the investment cost. The rest is to be borne by investors.

Small Power Producers Programme

The Voluntary Programme during its second phase from 2000 to 2004 expanded to include the Small Power Producers Programme using renewable energy, including solar energy, wind energy, biomass and municipal and agricultural wastes. The Small and Medium-sized Enterprise (SME) Programme was also added to provide financial support for energy utilization audits and analysis, improvement and installation of high-efficiency electric equipment and appliances in order to increase energy efficiency in SMEs.

Small Power Producers (SPPs) are small power-producing units using renewable energy, waste or residues as fuel. The category also includes cogeneration units. The cogeneration system increases efficiency in the use of primary energy and by-product energy sources, and helps to reduce the financial burden on the public sector with respect to investment in electricity generation and distribution.

The main objective of the SPP Programme is to develop renewable energy-based power generation, in particular biomass energy. Using biomass agricultural residues for cogeneration enables factories to be self-sufficient in electricity and process heat, while eliminating the problem of waste disposal.

In Thailand, biomass is mostly used as a fuel in rural households. Several agricultural residues have also been used as fuels in rural industries. However, a large part of biomass residues are used in an inefficient manner through open burning or dumping. It has been estimated that about 13 million tons of bagasse, 5 million tons of rice husk, and 1.7 million tons of tapioca residues, are produced each year in Thailand. The associated estimated potential for power generation from biomass is about 1,518 MW.

EPPO announced in 2001 that the ECON Fund would use a bidding process to pay within five years a subsidy of up to 0.36 baht per kWh of electricity to new SPPs that use renewable energy as input. SPPs would be allowed to generate and sell electricity to the Electricity Generating Authority of Thailand (EGAT) and also directly to local consumers. Of the 43 projects competing, 31 were selected for support. In total, they accounted for a capacity of 511 MW and 2,991 million baht in subsidies.

In 2003, 50 SPP projects have distributed 3,468 MW power through the EGAT system.

Public participation

EPPO uses a public participation approach to formulate policies. A series of brain-storming sessions and seminars are conducted to determine contents of policies. Policies are then reviewed and endorsed by the relevant working groups, subcommittees and committees. This process is designed to be inclusive consisting of stakeholders, government officials, experts and scholars, and is usually chaired by the Director of EPPO or the Minister in charge of EPPO. Policies that affect a wide range of people or are considered to have great impact on socio-economic development and the environment, will be forwarded for approval to the National Energy Policy Council, which is chaired by the Prime Minister. The National Energy Policy Council is a political body comprising 10 ministers.

The implementation of SPP projects is carried out in a different manner from other renewable energy projects because of its potential for having a negative impact on communities and local environments. EPPO requires public hearing for all projects subsidized by the ENCON Fund. SPP owners must disseminate information concerning plants and their potential impact on local communities and their environments. They also must organize forums for discussion with local stakeholders, in which EPPO staff participate. Statistical surveys are conducted to assess acceptance by people living within 10 km of planned SPPs, with

priority attached to concerns raised by people living within a 3-km radius from the plants.

EPPO uses the information provided by SPPs together with survey results to decide whether a subsidy should be awarded to a specific SPP.

After commissioning SPP project, a tripartite committee is established to monitor impacts of the plant with regard to the environment and health, to solve any conflicts and to compare performance of the plant with the plans. The tripartite committee consists of representatives from communities surrounding the plant, the owner(s) of the plant and local authorities. The provincial governor appoints committee members. The committee may hire experts or consultants to conduct environmental monitoring. It meets at least once a month and has the authority to advise SPP on how to reduce impacts, or decide to close down the plant if necessary.

4.3 Integrating energy and rural development in Viet Nam[42]

In Viet Nam, the part of the energy sector policy focusing on rural and remote areas is closely connected to the following goals set out in plans for development of agriculture and rural areas:

- Increase living standards and alleviate hunger and poverty
- Enhance structural changes in agriculture, integrating agricultural production with agro-industries and other non-farm activities
- Enhance local and national markets
- Build capacity in rural areas
- Facilitate more rational labour distribution
- Generate opportunities for employment in rural areas
- Reduce rural-urban gaps
- Adopt family planning to lower population growth rates

Within these goals, the 2010 targets for agricultural and rural development have been set as follows:

[42] Based on a paper prepared by Vu Cong Lan, Vu Van Thai and Pham Thi Sam for the Expert Group Meeting on Integration of Energy and Rural Development Policies and Programmes, 25-27 June 2003, Bangkok, Thailand.

- Annual growth in agricultural GDP of around 4 per cent
- Agricultural GDP at 16-17 per cent of total GDP
- GDP from livestock at 30 per cent of total agricultural GDP
- Annual growth of rural industry and services of 10-12 per cent
- Total food output of 40 million ton (expressed in rice-equivalents)
- nual rice export of about 4 million ton
- Attainment of live animal weight of 3 million ton per year
- Total value of exported products from agriculture, forestry and aquaculture of US$ 8 billion to 9 billion per year
- Re-attain a stable and sustainable national forest cover rate of 43 per cent
- Average per capita GDP of US$ 1,000 per year in the rural areas
- Rural education up to national standards
- Truck roads to the headquarters of all communes
- Electricity provided to all communes
- Access to fresh and clean water for all rural people
- Elimination of all life threatening diseases

Energy is recognized as a main input to ensuring that these ambitious targets are met. This is reflected in the current policy direction for the energy sector as follows:

- To reform the energy sector with regard to institutional structure, regulation, pricing and financing and marketing
- To diversify energy supplies through development of indigenous energy resources and expansion of regional energy cooperation
- To ensure adequate energy supplies to meet the energy demand for socio-economic development and population growth
- To promote energy conservation and efficient use of energy, and reduce negative environmental impacts of energy production and consumption
- To promote exploration and utilization of natural gas, in particular for electricity production, to increase power generation efficiency and stability
- To promote energy trade through power and gas pipeline interconnections with neighbouring countries, and to consider the introduction of nuclear power in the future

- To diversify ownership in the energy sector, encouraging participation of public and private sector stakeholders
- To encourage the study and use of new and renewable energy, focusing on islands, remote and rural electrification in order to support the industrialization of rural and mountainous areas and upgrade the productivity and living standards of people living in these areas

Under the third of the above-mentioned objectives, the Government intends, by the year 2005, to provide electricity to 90 per cent of all rural households with 95 per cent of communes to be connected to the national grid. The remaining 5 per cent (about 400 communes) are planned to be supplied with electricity from off-grid systems, namely, renewable energy and hydro-diesel hybrid systems.

Institutional set-up

Viet Nam's Ministry of Industry is responsible for formulating national energy policy. Policies and programmes are prepared at the central level and then disseminated and implemented at both the central and lower levels, including provincial, district and commune/village levels. While policies apply nation-wide, adjustments or amendments are allowed to tailor the policy implementation to locale-specific conditions.

Local authorities (Provincial People's Committees) are responsible for sector planning, including energy, agriculture and rural development. Normally, authorities use professional consultants from energy and agricultural sectors in the planning process.

According to Government Decree No. 45/2001/ND-CP, "Supply electricity to rural and mountainous areas and islands", dated 2 August 2001, State, central and local authorities are to jointly invest in rural electrical networks under different schemes of management and ownership. Investors and local landowners may borrow funds at lower interest rates than usual State development loans or credit. The Government specifies the tariff ceiling for rural customers, and the Provincial People's Committees set the price for specific areas. Organizations that buy electricity from the national grid to distribute to households are exempt from tax or have their tax reduced.

Roles and responsibilities for rural electrification are shared as follows:

- The National Assembly allocates budget for ministries and provinces

- The Ministry of Industry manages overall planning, provides guidance and supervises implementation
- The Ministry of Finance prepares an annual investment plan and defines the State budget and mobilizes and provides soft loans or credits
- Provincial People's Committees prepare investment plans and manage rural electrification programmes in their territories
- The State Bank instructs commercial banks to provide soft loans for the poorest households

NGOs, research institutions, women's groups, community groups and business associations are also involved in implementing national energy development policies and programmes. Some of the more active stakeholders include the Viet Nam Women's Union, the Youth Union, the trade unions, the Committee for Ethnic Minorities and the Union of Science and Technology Associations.

Box 3-8. Participation in formulation of policy: Viet Nam Women's Union

In the process of suggesting policies to relevant organizations or submitting recommendations to the Government to support energy for rural families, the Viet Nam Women's Union has taken the following actions:

- Conducted a survey and studied the energy situation in rural areas in order to identify difficulties and barriers to rural energy and people's needs and expectations. Based on this information gathering, it offered suggestions to the Government;
- Organized workshops with participation by NGOs and governmental organizations to explain the difficulties of rural energy and attract support to the cause;
- Recommended action to the Prime Minister's Office and other related government branches, and followed this up with lobbying for the approval of these recommendations.

In addition, pilot projects, different methods of energy conservation and the adoption of new technology have been experimented with. Successful trials have been forwarded to the Government for inclusion in policies related to meeting the energy needs of rural women, men and children.

These stakeholders participate in seminars to provide comments and suggestions to policy makers, and express their ideas through

written communication. They also play a role as members of appraisal groups/committees, and provide technical and socio-economic information, which the Government needs in order to formulate and supervise appropriately the implementation of its agricultural and rural development plans and targets.

5. Conclusion

Based on the discussion above, it is clear that a sound policy framework for improving access to reliable energy services should include policies of financing, smart subsidies, pricing and private participation.

Financing is a key form of intervention in a bid to increase the access of rural people to energy services. For instance, many renewable technologies best suited to provide energy services to remote rural areas use non-monetized fuel, but have a prohibitive initial capital cost. At the same time, many developing country Governments are actively promoting the replacement of fuel-wood by subsidizing other energy sources. However, the success of such fuel substitution programmes basically depends on two factors largely beyond government control: economic growth and the corresponding increase in personal incomes that would permit consumers to switch fuels. The substitution process in many countries is hampered by high fuel import costs resulting from the inefficient procurement of quantities.

Subsidies are a conventional means of overcoming financial obstacles, but this approach presents various difficulties. The welfare objectives embodied in subsidies for rural electricity, or commonly used fuels such as kerosene, LPG and diesel, are often unmet. This is because these energy sources are frequently diverted to unintended uses, or are disproportionately used by more affluent members of society, who could afford the unsubsidized cost of these forms of energy.

A reduction or removal of pricing subsidies to overcome this problem is, however, not straightforward because they have potentially adverse impacts on the poor. The partial withdrawal of kerosene price subsidies in Sri Lanka and Myanmar, for example, forced people in some rural areas to return to the use of fuel-wood. Both these countries suffer from deforestation and this could have serious environmental implications for them in the long run.

Private sector participation is always the most important option for making energy access able to rural people, and in most developing countries, private investment is crucial for ensuring an energy supply to rural people.

CHAPTER 4

HOW TO MAKE IT WORK: INSTITUTIONS ON ACCESS TO ENERGY SERVICES IN RURAL AREAS[43]

1. Introduction

This chapter reviews how Institutions play an important role in the determination and effectiveness of policies and programmes designed to improve access to energy services in rural areas. The key institutions that would be involved in improving the energy access of rural people include the central and local Governments, the rural communities, NGOs and the private sector as well as international organizations.

Institutional mechanisms are a prerequisite for improving access to reliable, clean and affordable energy services for economic and social development in rural areas. The involvement of stakeholders with different capacities is also essential. Providing energy services to rural areas calls for a coordinated approach with clearly defined roles for each of these stakeholders.

Providing energy services, as has been described by Reddy (2000),[44] introduces a move towards a new approach to energy. It recognizes that the satisfaction of social needs is best achieved by treating neither energy supply nor energy consumption as ends in themselves. By focusing on energy and social issues Reddy explained that "what human beings want is not oil or coal, or even gasoline or electricity per se, but the services that those energy sources provide.

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[43] This chapter builds mainly on papers prepared for the Ad Hoc Expert Group Meeting on Energy Services for Sustainable Development in Rural Areas, 27-29 September 2004, Bangkok, Thailand:

(a) Anoja Wickramasinghe, *"Mechanisms for enhancing access to energy services in rural areas: institution building and decentralization"* (2004);
(b) Bikash Pandey, *"Financing mechanisms for enhancing access to energy services in rural areas of Nepal"*; and
(c) Soma Dutta, *"Stakeholders' involvement: issues for consideration"*.

[44] A.K.N. Reddy, "Energy and social issues", in *World Energy Assessment* (New York, United Nations Development Programme, 2000).

Thus it is important to focus on the demand side of the energy system, the end uses of energy, and the services that energy provides". Rural areas, which often lack energy options and services, have not been able to explore the range of energy possibilities owing to the lack of institutional mechanisms, support systems integration and inadequate investment. This has resulted in serious consequences for the poor, especially women in areas with acute poverty. In addition, it forced many people to live in improper housing to depend on biomass for generating energy to provide basic food and nutritional requirements.

The institutional mechanisms for enhancing access to energy services in rural areas from the perspectives of sustainable development should include a wide range of considerations.

(a) Mechanisms for promoting modern energy services for people who rely on traditional biomass fuel for cooking

(b) Mechanisms for integrating multiple discipliners related to sustainable development in providing modern energy services

(c) Mechanisms to involve all stakeholders and to share responsibility for providing energy services with focus on addressing all the areas of concern with local roots. This effort should ensure that no sectors remain isolated in the process of implementing MDGs

(d) Policy frameworks promoting a participatory process to formulate energy policies that are responsive to crucial local issues

(e) Local institutions with the capacity to implement policies and programmes with internal monitoring and evaluation mechanisms

These mechanisms do not exist in many countries; even if they exist they have not mandated the undertaking of the broader challenges listed above. In order to improve access to affordable and reliable energy sources many structural adjustments are needed. They must, however, take into account the contextual realities of the individual nations with regard to energy systems, poverty, socio-economics, resource options and political circumstances.

New initiatives aimed at providing access to energy services for those without access to modern fuel are a challenge that cannot be achieved without proper implementation and institutional mechanisms.

The challenge is to reform and improve the existing institutional structure in order to widen the horizon of energy supply and make adjustments by linking it with all possible areas to promote energy services to achieve the MDGs. The existing institutional mechanisms in many countries are focused on sectoral development, and are not

structured to promote interlinkages, nor do they have the capacity to adopt a holistic, integrated approach. Moreover, increasingly the task of providing energy services is being left to the private sector, which to some extent has resulted in increases in the price of commercial energy, thus exacerbating rural energy service shortages in many areas.

2. Reforming institutions

The main constraint in defining and implementing energy policy in order to satisfy the need for widening access to energy services, appears to be the compartmentalization of the energy subsectors.

The coordinating functions of the Energy Ministries have in general become ineffective but have not been taken over by more innovative entities. Public authorities in charge of energy policies need to consult with the major actors so that the latter could express their needs and expectations, and explore suitable and relevant energy solutions.

In recent years, perceptions of the role of national and international institutions have changed, not just in relation to rural energy development, but also in the broader context of development. This has to do with a number of important global trends, namely, marketzation (and liberalization) of the economies, the emergence of sustainable and human development concepts, and revolutionary changes in information and communication technology. These led to a re-evaluation of the way national and international institutions are organized, their roles in the development process, and their interaction among themselves and with the ultimate beneficiaries of development.

Within the Asia-Pacific region, the following important shifts are being considered, or are already in motion, in the context of rural energy development:

(a) It is felt that the structured centralized planning approaches of government agencies and State-owned institutions have largely failed to redress rural energy demand-supply gaps. In particular, the inability of these institutions to introduce and successfully operate small-scale, decentralized energy services in rural areas has been a caused for concern. The proposed solution to these problems envisages greater decentralization of the planning process in favour of local authorities and the informal sector, and the use of innovative project-delivery mechanisms that need not necessarily involve established energy utilities

(b) Consistent with changes that are occurring in mainstream rural development approaches, much greater importance is being given

to the role of NGOs and community-based groups. Partly in response to external pressures, but perhaps also because of experience, Governments have sought to empower such organizations to operate in areas traditionally viewed as public sector domains. The ability of these organizations to mobilize and sustain participation of beneficiary groups in rural energy programmes is being increasingly accepted as a vital pre-condition for the success of most rural development efforts

(c) In line with global shifts towards greater reliance on market mechanisms, the private sector is perceived to have considerable potential to cater to rural energy consumers. This has special relevance for the promotion of decentralized renewable energy options, which are developed, manufactured and marketed mostly by the private sector. Accordingly, increasing importance is attached to encouraging private sector participation in rural energy supplies

(d) The influence of environmental agencies, which have long played a minor role in energy decisions, has strengthened in recent years. As a result, their active involvement in rural development, forestry and rural energy programmes is on the increase

(e) The idea that donor agencies and financing institutions should work together more closely is gaining ground. Many donors have begun to target their technical assistance more carefully in order to induce investment by national and international financing institutions. Development financing institutions are being increasingly called upon to assume a more proactive role to bring about desirable development changes, as opposed to the conventional modality of responding to government initiative. In the rural energy context, a number of them have sought to enhance their renewable energy portfolios through the addition of decentralized renewable energy financing and other aspects of rural energy development.

The aforementioned trends reflect some crucial role reversals. On one hand, Governments and public sector entities, which have traditionally been charged with developmental rather than commercial missions, are being called upon to adopt a more business-like approach. On the other, profit-driven private sector firms are being induced to view developmental activities as viable business propositions and to acquire a greater sense of responsibility to contribute to broader development goals. These changes signify the convergence of interests long perceived as being at odds with one another.

The climate for institutional change is more positive now for the government-enabled, market-based approach to rural energy development. However, given the diversity among developing countries in the region and the general caveat of institutional change, these trends are by no means widespread. Some countries have moved ahead rapidly but, even in these cases, institutional change may have occurred only in certain areas perceived as immediate priorities. In many other countries, entrenched institutional interests, coupled with the lack of clear political direction, have proven less eager to break away from familiar set ups. Notwithstanding these dissimilarities, it should be recognized that the region as a whole is undergoing a major transformation in terms of its global economic and political roles.

2.1 Process for rural energy planning

Generally, the energy planning process is centralized, focusing on establishing consensus on policy decisions, setting up standard guidelines for planning at lower levels of Government and mobilizing adequate human and financial resources to achieve targets. All aspects related to identification of needs, assessment of energy resources and the choice of technology should be carried out in a decentralized manner, with the active participation of the local stakeholders, including the target beneficiaries. Such a "people-centred approach" will ensure that genuine constraints to the desired energy services of communities are identified, and efficient and cost-effective solutions are proposed, enabling rural populations to improve their lives.

An overall vision of local needs is indispensable, as this is the objective of the intrasectoral and geographical analysis. Each intrasectoral team needs to identify these needs for example, health centres, schools and small enterprises, so that the coordinating team could envisage the potential synergies by identifying local energy sources and linking them with local needs. Finally, institutional resources such as local entities which could assure, local implementation are defined. There is a risk of rushing to implement pilot operations and dispersing the responsibilities and the modes of financing that do not adequately reflect the local reality.

The sectoral implementing bodies such as ministries and national agencies, should give way to local implementing bodies when the latter show their capability to assume responsibility. This has two advantages: benefits derived from the economies of scale owing to the grouping of several priority installations in the same geographic zones. The second advantage is that local implementing bodies could more easily prioritize services to other clients in the locality who can afford to pay for the

energy service. Thus "energizing" a given zone would depend on the dynamism and the capacity of the local implementers and actors. This approach would enable the development of an energy strategy that responds well to the immediate needs of priority programmes.

Rural energy planners and policymakers have generally adopted a top-down approach in which energy policies and planning at the national level are aimed at meeting the rural development goals of spurring economic activities in order to improve living standards, without providing any mechanism for consultation with rural people. As a result, many programmes have failed to understand the needs and priorities of rural populations, their livelihood strategies, the broader social, political, cultural and institutional contexts; as a result, they overlooked the issue of inequality. There is now a growing realization that the best information and insights on rural energy issues come from the intended beneficiaries. Possessing extensive knowledge of their environment and relevant expertise, rural people are capable of contributing meaningfully and finding appropriate solutions to the problems they face. It is important to build upon existing knowledge and expertise, and improve upon well-tested methods and practices. Moreover, a people-led approach makes the local population more responsible and gives them the opportunity to take greater control of their own futures.

A limited number of countries and organizations have recognized the need for integrated and decentralized planning and area-based approaches to address local needs by maximizing the use of locally available resources. Special attention is being drawn on diversifying the institutional base for project formulation and implementation by involving rural communities. The ESCAP secretariat launched a project entitled "Increased access of rural populations to clean and affordable energy services" in 2002 in an effort to introduce a holistic and integrated approach for integration of energy and rural development policies and programmes.

Many countries have set similar policy objectives but their information base and institutional structures are not yet mature and the planning and implementation mechanisms are in the gestation phase. These countries have often depended on external support to successfully launch demonstration and pilot projects, with limited involvement of local stakeholders including rural communities and non-governmental organizations. Yet another category of countries includes those that have yet to formulate rural energy development policies and lack the information base or institutional structure to address the rural energy development issues in a decentralized manner.

Box 4-1. ESCAP initiative on capacity-building on the integration of energy and rural development policies and programmes

Provision of energy alone cannot guarantee rural development; rather it functions as a catalyst for development when other facilities and activities are in place. ESCAP has been promoting integration of energy and rural development by implementing since 2003 the project "Capacity-building on integration of energy and rural development policies and programmes". The project emphasizes the identification of energy needs in rural development activities in the areas of agriculture, education, infrastructure, financing and health, and the extent to which such concerns are integrated into current rural development policies and programmes. It aims to promote rural energy development through capacity-building on integration of energy and rural development issues, stakeholder involvement and facilitation of information exchange among stakeholders. The project is developed to enhance national capacities to identify linkages between energy and rural development to promote long-term, integrated and well-coordinated rural energy policies and programmes. Selected participating countries including the geographical areas "South Asia" (Bangladesh, Nepal and Sri Lanka) and "Mekong" (Cambodia, Lao People's Democratic Republic, Myanmar and Viet Nam).

At the same time, recognizing the gender bias of rural energy poverty, importance will be attached to reflecting gender issues of projects to ensure that policy interventions will benefit rural women as well as rural men.

Guidelines have been developed on the integration of energy and rural development policies and programmes which have been used for guiding the implementation of the integration concept at national level by the national team consisting of representatives from Government, private sector, NGOs and academia.

The national team is an informal group that takes a leading role in mobilizing stakeholder involved in energy and rural development at the country level and in carrying out regional and national-level project activities, such as the development of national training courses and materials, organization of national training, building country strategies for integrating energy issues into rural development and the identification of opportunities for gender-sensitive capacity development.

A regional workshop will be organized at the end of project implementation in order to exchange information, share experience and promote the concept to other countries in the region.

While the institutional structure for rural energy planning (or a close alternative) is essential to pursue the planning approach, the emphasis is not so much on the structure itself, but rather on the principles under which any such structure would be established and become functional. The following requirements are relevant in this context:

(a) Rural energy policy formulation and planning at the national level should be recognized as activities addressing a major priority for development. They should be given a separate identity in any institutional structure;

(b) Because rural energy development affects, and is affected by, the policies and plans of a variety of sectoral agencies, it is best guided by collective bodies functioning under the national development planning agency independent of any sectoral interests. In particular, such bodies should not be located under conventional energy planning agencies, but should include them as equal contributors to a nationwide effort;

(c) Rural energy policy formulation should be separated from rural energy planning in terms of levels of representation. Bodies for the former should be at the highest level of Government, represented by ministers or other high officials. Bodies for the latter should be of a more technical nature and should consist of analysts and technical personnel reporting to such officials;

(d) At the state/province, district, county, block, or sub-district levels, a similar collective identity should be given to rural energy planning. The institutional structures at these levels should closely correspond to those at the national level. They should involve NGOs and private sector organizations;

(e) National research and training institutions should be made a part of the formal institutional structure for rural energy planning. Their skills and capabilities should be used as direct inputs for planning decisions;

(f) The role of government bodies in any institutional structure should be to coordinate and facilitate, rather than to determine and impose. In other words, the views of those who have a concrete stake in rural energy development owing to investment or contribution of skills should be given due importance and the bureaucratization of committees or collective bodies created to induce such stakes should be strictly avoided. To the extent possible, such bodies should consist of individuals based on their experience and the process of appointing them should be transparent and publicly accountable.

2.2 Framework of institutions

Creating enabling conditions

It is the basic function of Government to create enabling conditions, provide a framework for the development of energy services, determine which organizations are involved in the planning and implementation of such services and act as a catalyst for the kinds of change that are expected from stakeholders. Enabling conditions can be created with Government playing a proactive role as follows:

- Strengthen institutional capacity of stakeholders to support renewable energy development
- Use appropriate financing and subsidies to enable low-income households or entrepreneurs to invest in modern energy services
- Include low-income people as active stakeholders in energy planning to meet their needs on a long-term basis
- Develop appropriate technologies, with community involvement, to suit local cultural needs
- Set in place technical standards for quality assurance for technologies to ensure reliability and consumer confidence
- Engage NGOs and other civil society groups in advocacy and dialogue

National Governments must spearhead policy analysis and application in the following areas:[45]

- Develop appropriate tariff and connection policies, including for decentralized systems, credit and leasing
- Assessment of the impacts associated with the restructuring the power sector on rural access to energy services
- Demand analysis, including analysis disaggregated by sex
- Financing and institutional mechanisms, including micro-credit, rural energy service companies, NGO-based approaches and private participation in the provision of small-scale energy infrastructure
- Productive uses of energy
- Institutional coordination of complementary infrastructure

[45] K.V. Ramani and Enno Heijndermans, "Energy, poverty and gender: A synthesis", in *Energy, Poverty and Gender* (Washington, D.C., World Bank, 2003).

Involving local institutions

Local participation makes projects responsive to local needs. It also generates a sense of ownership that is a critical ingredient for the success of projects in the long term. NGOs and community-based organizations can effectively perform the following functions in rural energy service provision:

- Acting as intermediaries and points of contact between communities and implementing agencies
- Serving as the primary forum for local community participation
- Ensuring that poor communities are represented in policymaking at all levels
- Providing reliable information on the local conditions within the community, including early warning signals in case of crises
- Facilitating information exchanges at the grass-roots level and international knowledge-sharing
- Performing functions such as the identification of beneficiaries for loans, conducting credit checks and mediating for loans

Engaging with rural communities as partners

Communities need to be involved in the planning process to ensure that energy services are appropriate, socially acceptable and sustainable. Rural communities, in particular women, must have their opinions heard and addressed if energy policy and services are to meet their needs and provide long-term solutions. If the primary stakeholders are involved in the design and implementation of development initiatives they are much more likely to bring prolonged benefits. Local communities possess invaluable local expertise that should be taken into account in defining and implementing any energy project. Projects characterized by high levels of community engagement and involvement in infrastructure investment decisions will typically generate a greater sense of community empowerment, ensure that improvements are tailored to a community's specific needs and create a much higher probability that improvements will be maintained by the community after installation.

Box 4-2. China's experience with integrated rural energy planning

Starting in the 1980s, the Government of China began rural energy development in an integrated way that focused on renewable energy utilization. The main areas of work were in promoting energy-efficient stoves, rural biogas digesters, fuel-wood forests and solar energy. As a result, the coverage of energy efficient stoves in China's rural areas is currently over 95 per cent and biogas work has moved from merely resolving energy needs to being a key component in the development of ecological agriculture, rural sanitation and income generation in rural areas. The Government has been investing over yuan 1 billion annually in the building of rural biogas digesters, with emphasis on providing these subsidies to biogas work in China's western regions, the country's most undeveloped areas, thus benefiting the development of renewable energy and helping to alleviate poverty in China's rural areas.

The principle of "suiting local conditions, developing diverse energy resources, utilizing energy resources in an integrated manner and striving for economic returns" has existed in rural energy development for 20 years.

In order to fit in with the development of rural energy resources, central departments and agencies under the State Council and local governments have successively set up institutions and agencies for rural energy management and technical extension. During the periods of the Sixth and the Seventh Five-Year Plans, trial projects of integrated rural energy development were successfully carried out in 18 counties, covering an area of over 30,000 square kilometers and touching the lives of 10.8 million people. During the Eighth Five-Year Plan period, China, by launching the "100-County Project", integrated 138 rural energy development counties and promoted rural energy development in an all-round way.

The Government attaches great importance to rural energy development and goals have been clearly specified in "China Agenda 21" and the National People's Congress had adopted the Ninth Five-Year Plan, in which its commitment to "speed up the commercialization process of rural energy industry, popularize firewood and coal-saving stoves along with coal for domestic use, set up an energy industry, improved service systems and encouraged the use of small hydropower stations, wind energy, solar energy, geothermal energy and biomass energy in light of local conditions". Thus, the rural energy development programme has benefited most of the rural population as the following indicators suggest:

- 97 per cent of the households have been connected with electricity
- more than 10 million biogas digesters installed to service gas for cooking and other energy services in rural areas
- 95 per cent of household have been supplied with energy saving stoves or improved stoves for fuel-wood saving

2.3 The way to decentralization[46]

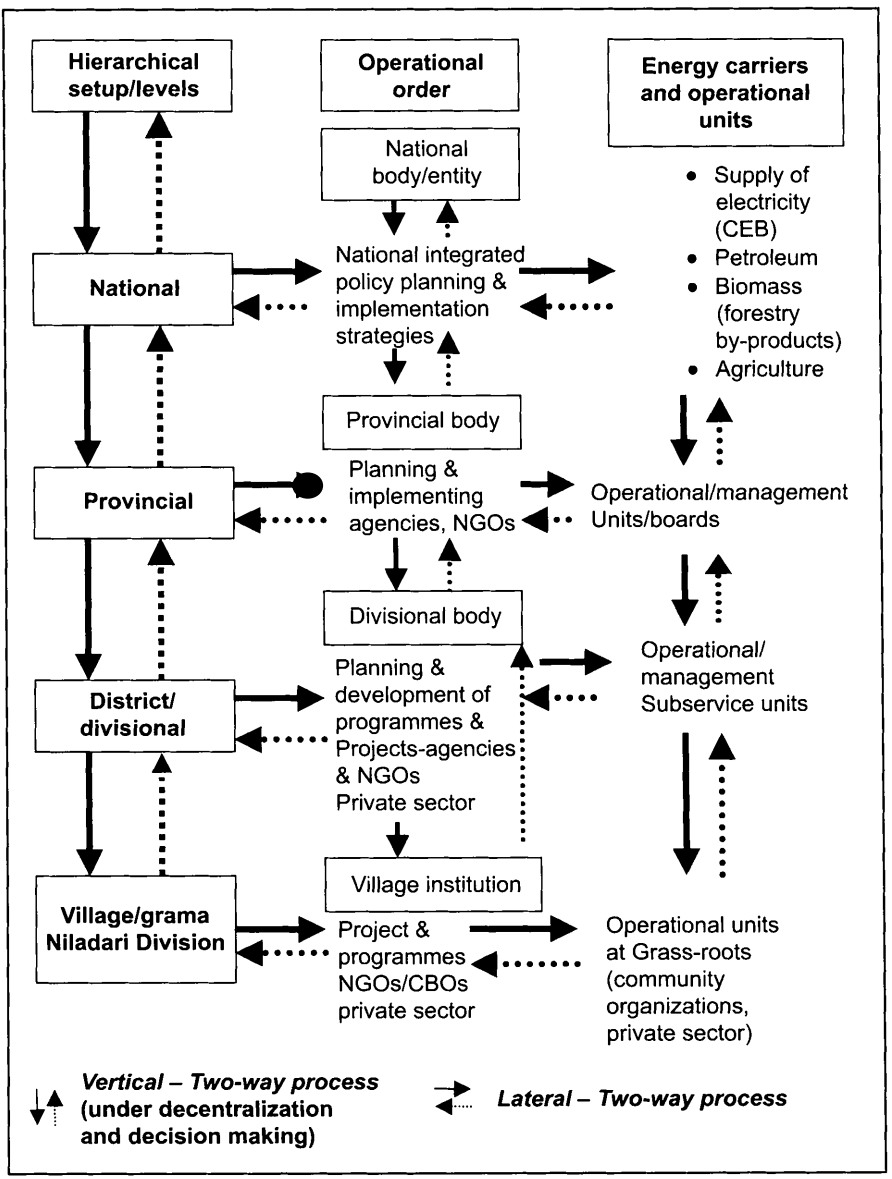
One of the major developments concerning energy services for rural development is that planning and institutions must be decentralized and rural people must be drawn into the decision-making process so that decisions can be better informed and reflect rural people's needs. Many studies show that no institution has a monopoly on knowledge or insights. Decentralization of institutions for widening energy services to reach underserved areas and sectors is an effective strategy recognized by more and more people. Strengthening of implementation mechanisms also depends heavily on decentralized planning, operations and diffusion of services. Existing administrative divisions, including those at the national, provincial, divisional and village level, are adequate to facilitate this process.

For instance, since the 1970s with the decentralization of administrative structures in Sri Lanka more and more local efforts have been promoted to increase the efficiency in energy services. Efforts to make electricity accessible to rural populations have been largely effective with 44 per cent of the rural population having access to electricity in 1990. By 2000, 63 per cent of the rural population had gained access to electricity. It is important to note that the national efforts have focused on providing electricity for lighting, communication and refrigeration. Providing safe and clean technology options for cooking fuel and fuel for village and cottage-based industry has not been a priority. The decentralized mechanisms employed to provide access to energy have been established with a focus on regional development and decentralization of political and administrative responsibilities. It has enhanced local participation in making decisions and implementation. This has promoted local options and concentrated on providing grid connections to rural areas through locally initiated projects and programmes. The institutional mechanisms with vertical linkages in the hierarchy have been designed to funnel national investments to reach the grass-roots level. At each level provincial, district, divisional and village, the service requirements have been expanded in relation to projects, NGOs and CBOs (see figure 4-1). The emergence of local operational projects and programmes has shifted the energy paradigm, diverting national centralized efforts in rural electrification. Power generation by exploiting local potential and mobilizing local resources has also created energy entrepreneurs and partnerships among stakeholders. Private investments on mini

[46] Anoja Wickramasinghe, Mechanisms for enhancing access to energy services in rural areas: institutional-building and decentralization (2004).

and micro-hydropower projects and newly established dendro-energy project are examples.

Figure 4-1. Decentralized institutional framework linking hierarchical mechanisms in Sri Lanka



Decentralization includes decentralized energy-generation technologies such as small-scale hydropower generation through mini/micro hydropower projects at the village level, photovoltaic/solar home systems, wind power generation, bio-power generation using producer gas, dendro-power generation using fuel-wood and agro-residues. These are some of the technological interventions and energy options initiated to enhance accessibility to energy services for rural populations. Decentralization with the involvement of local agencies, NGOs and the private sector has diluted centralized energy generation and management. For example, 144 village/estate-hydro schemes, 35,000 solar home systems, 25 wind battery charging systems promoted off-grid systems in Sri Lanka in 2002. The policy on grid connected small power generation proved favourable to dendro-energy development.

The State policy on private sector involvement and releasing of marginal lands for energy plantations is intended to enhance access to energy through diversifying energy supply with local options. It is also intended to relieve pressure arising from the escalating price of LPG used for cooking. It is hoped that it will improve the environment through promoting green cover. Private sector involvement is also expected to replicate community electrification and it has been designed to empower local communities.

The advantage of promoting decentralized mechanisms is also related to building local capacity and promoting technological improvements to match national strategy throughout the country. For example, the pilot project on forestry and bio-energy was initiated with the objective of providing energy to the national grid. The operational responsibilities are divided between Ceylon Tobacco Company and Lanka Transformers Limited. Local participation is encouraged through establishing linkages between feedstock/biomass suppliers and the energy plant. It is expected to have infusions of about a SL Rs 20 million into the rural economy. Institutional mechanisms designed to promote biomass farming/energy farming and the involvement of intermediaries would enhance energy-based income-generation for local communities through which their poverty could be alleviated while enhancing their capacity to use clean energy.

The off-grid services to meet rural household needs also have been promoted through local mechanisms on dendro-energy interventions. The off-grid system is designed to meet local needs and also the empowerment of local communities. The micro-hydro initiatives and development of technology to use local materials are success

stories associated with local resource-based strategies for efficient energy services. For instance using paddy husks for local industry such as brick kilns, the use of agro-residues and the production of residue/clay-mixed bricks designed to save clay have been successfully employed.

Implementation mechanisms of solar home systems, village hydro, wind home systems, biomass dendro-power generation and biogas are meant to enhance the access of rural people to clean and affordable energy services.

3. Involving the right people

The current pattern of energy supply and consumption, in particular of commercial energy, is unsustainable owing to inefficiencies and poor management. On the other hand, many rural people who do not have access to modern energy rely heavily on biomass, which, though renewable, is used inefficiently, leading to stress on locally available natural resources.

Meanwhile, public authorities in charge of energy policies need to organize consultations with the major stakeholders so that the latter could express their needs and expectations, and explore suitable and relevant energy solutions. It is heartening to note that a number of countries in the region are taking measures to enhance the access to energy services in rural areas, through the involvement of stakeholders[47] in formulating and implementing relevant policies.

The involvement of stakeholders, including beneficiaries or clients, policymakers, private and civil society entities, as well as academia, is key to securing access to energy services for rural people. In addition to ensuring that the needs of beneficiaries are met in an appropriate manner, such an approach may also make use of the experiences, expertise and resources of civil society, the private sector, financial institutions and academia.

Involving stakeholders is seen as an effective tool to address sustainability issues related to energy policy formulation and implementation of related programmes and projects.

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[47] ESCAP, Guidelines on Strategic Planning and Management of the Environment Sector (New York, United Nations, 2002) (ST/ESCAP/2211).

3.1 Stakeholder involvement

Many agencies, sectors, investors, NGOs and community-based organizations have to play prominent roles in providing energy services for sustainable development in rural areas. Benefits include higher-levels of ownership and enhanced transparency and accountability. The main justifications for dedicating resources for advocating multi-stakeholder involvement includes the following:

- Decisions will benefit from a wider field of expertise and creativity
- All are allowed to focus on their core competence
- Relationships will be based upon mutual trust and recognition
- A wider choice of options will lead to more sustainable outcomes
- Short-term costs of involvement will be outweighed by long-term benefits of fair and lasting solutions
- Less monitoring costs and risk of failure
- More cost-effective solutions and predictable outcomes

Yet, involvement of stakeholders in promoting energy services for sustainable development is complex. The first reason is that the integrated the approach is a relatively novelty in the energy paradigm. The second is that there is no such enabling framework to bring in multiple stakeholders to one platform. The third is that knowledge and understanding of strategic planning is limited. The fourth is that the existing decentralized framework has very little capacity to undertake these tasks.

Under these circumstanced, the institutional mechanisms must be promoted for preparing State policy frameworks to facilitate stakeholder involvement, coordinate activities and also to help implementation. There are three aspects related to this.

- The first aspect is the involvement of stakeholders with different capacities (information-gathering, analysis, consultation, participation, investing;
- The second is their involvement at every level from the defining of vision and objectives, developing programmes, implementation, monitoring and evaluation and redesigning strategies to promote the accessibility of rural people to energy services;

- The third aspect is the involvement of political and administrative bodies from the national level to the provincial, divisional, village/ community levels. At every level it is essential to have their commitment, contribution, responsibility and decisions integrated into energy development.

In order to effectively enhance access to energy services for sustainable development in rural areas, extensive interventions at the policy as well as operational level are required. Stakeholder involvement has to form the central part of policy and strategy formulation as well as project design. While entities which have a stake in policy formulation may not necessarily coincide with those that have a stake in project design and implementation, it is important to recognize the interrelationships among stakeholders to ensure that operational activities support policy implementation and vice versa. From this it becomes evident that the process of involving stakeholders needs to be managed effectively in order to realize the potential benefits.

Stakeholders can be involved at different levels, for example, as entities for gathering, processing or disseminating information or in consultations or in hearing processes. At a high level of involvement, a stakeholder can participate in the decision-making process on equal footing with the responsible unit (which is, by definition, itself a stakeholder). Some stakeholders even hold ultimate decision-making power. Often, academia is involved at a low level for gathering, analysing and disseminating information. Other stakeholders, such as utility associations, unions and national non-governmental organizations, may be invited to consultative meetings, where their views may influence final decisions. At the policy level, government ministries responsible for planning, financing, environmental and social issues, need to participate in formulating energy policies in order to ensure coordination and proper consideration of their concerns. At the programme and project levels, communities, local governments and other local entities, as well as financial institutions should be involved to ensure effective implementation of activities. Other national Government entities would be expected to be involved at a lower level.

Table 4-1 is an illustration of different stakeholders, with an indication of their level of involvement depending on the nature of their activity.

It should be noted that the actual identification of stakeholders and their level of involvement will depend on the expected outcome.

Table 4-1. Stakeholders and their level of involvement in energy services in rural areas

Activity	Stakeholders	Level of involvement
Formulating energy policy to widen access energy services in rural areas (incl. setting national priorities; social, economic and environmental goals; legal framework; financing, subsidies and trade policy; environment and social advocacy)	Ministry of Energy	Responsible unit
	Ministry of Rural Development (Agriculture)	Medium
	Ministry of Planning	High
	Ministry of Finance	High
	Ministry of Environment	Medium
	Ministry of Science and Technology	Medium
	Ministry of Commerce	Low
	Ministry of Forestry	Medium
	Provincial government	Medium
	Academic institutions	Medium
	Utilities	High
	NGOs	Low
	Local communities	Low
	Private sector	Low
	Donor community	Low
Programme on increased utilization of renewable energy (including technology priorities; incentive systems; R&D; awareness-raising and advocacy; monitoring and assessment; consumer participation and partnership etc.)	Ministry of Energy	Responsible unit
	Ministry of Rural Development (Agriculture)	High
	Ministry of Planning	Low
	Ministry of Finance	High
	Ministry of Environment	Medium
	Ministry of Science and Technology	High
	Ministry of Commerce	Low
	Ministry of Forestry	Medium
	Provincial government	Medium
	Academic institutions	Medium
	Utilities	Medium
	NGOs	Medium
	Local communities	Medium
	Private sector	Medium
	Donor community	Medium

Involving relevant stakeholders throughout the process of rural energy policies and planning is very important to broaden the support for policy and activities, to avoid conflicts and to generate as much support as possible for the implementation of the plan over time. Experiences around the Asian and Pacific region show increasing stakeholder participation, notably of the private sector and non-governmental organizations. The rest of civil society is less involved in many countries in the region but is keen on getting involved. The importance of the participatory processes is generally well understood, but traditional

administrative and political entities are reluctant to open up policy development and decision-making to a wider, but more unfamiliar (and perhaps less manageable) public.

In order to strengthen national capacity by taking full advantage of stakeholder involvement, it is necessary not only to promote it through proper legislative acts but also to ensure that an appropriate framework has been established. An enabling environment to ensure collaborative working arrangements at the institutional level needs to be formulated. Governments need to create an enabling environment, in which all stakeholders including the private sector can pursue their objectives, including adequate returns on rural energy investments. The nature of the role of different stakeholders is described below.

3.2 The role of Government

The basic function of the Government is to create enabling conditions, provide a framework for the development of energy services, determine which organizations are involved in the planning and implementation of such services, and to play a catalytic role in bringing about the kinds of change that are expected from all stakeholders. The ultimate responsibility for rural energy development lies with government agencies. Under this approach, this is a responsibility which Governments have to share with other stakeholders in the development process by facilitating and enabling rather than determining and imposing. In the majority of the developing countries in the region, this responsibility requires relinquishing many functions traditionally exercised as a part of government decision-making. In general, the Government should play the following role in rural energy development:

(a) Develop long-term strategies for rural energy development, and a set of developmental criteria to measure the contribution of rural energy systems to economic advancement, human well-being and environmental sustainability in rural areas;

(b) Formulate an policy framework that engenders increasingly liberalized rural energy markets, covering such aspects as investment incentives, pricing, taxation, market infrastructure development, consumer information and education, technology transfer and development of local manufacturing capabilities;

(c) Select and apply appropriate instruments to implement policies, accepting as a basic condition that the effectiveness of such instruments must be monitored and appropriate changes made when necessary in keeping with the pace of rural energy development;

(d) Integrate rural energy plans with national energy plans and the rural development plan through appropriate coordination among the planning agencies concerned;

(e) Mobilize the necessary funds including international funding sources for direct governmental and private investment in rural energy development;

(f) Identify appropriate institutions and develop their infrastructure and human resource capabilities to undertake rural energy planning, programme/project formulation and implementation and follow-up;

(g) Empower rural communities, NGOs and community-based organizations to play a direct role in the rural energy development process at the planning as well as the implementation stages;

(h) Provide a legal framework and commensurate monitoring and enforcement mechanisms to ensure environmental accountability of all rural energy market players, including both public and private entities;

(i) Monitor and evaluate the development of rural energy systems.

Box 4-3. Main functions of the Indian Ministry of Non-conventional Energy Sources

The Ministry of Non-conventional Energy Sources is the nodal agency of the Government of India for all matters concerning the promotion of renewable energy. India's policy framework to promote the utilization of renewable energy includes a national target of 10 per cent renewable energy share equivalent to 10,000 MW generation capacity to be added before 2012[a]. The Ministry has formulated a policy for integrated development of the renewable energy sector with the following objectives:

(a) Meeting minimum energy needs through renewable energy

(b) Providing decentralized energy supplies to agriculture, industry, commercial and household sectors in rural and urban areas

The Ministry has nine regional offices, three specialized technical institutions and one non-banking financial company under its administrative control. It coordinates the Remote Village Electrification (RVE) programme, which uses renewable energy technologies for electrifying about 18,000 villages termed unviable for grid extension[b,c].

According to the 2001 census, about 43.5 per cent of households have an electricity connection. The majority of the rural population still has no access to electricity and depends on kerosene lamps and lanterns for lighting. By focusing on non-electrified remote villages and remote hamlets of electrified villages, the RVE programme is aimed at bringing the benefits of electricity through renewable energy technology to people living in the most deprived regions of the country. The programme covers:

Box 4-3. *(Continued)*

(a) Surveys and studies for firming up electrification plans

(b) Installation and commissioning of appropriate systems from a selection of SHS, solar PV mini-grids, biomass gasifier power plants, small hydropower plants and hybrid systems

(c) Up-grading/renovation of existing systems including intensification of household coverage

(d) Monitoring and evaluation of individual projects

(e) Training and capacity-building at all levels

The programme is implemented through State energy development agencies, State electricity boards, corporate entities for power generation, cooperatives, NGOs and village-level governing bodies. Central financial assistance of up to 90 per cent of the capital cost is provided as grants to implementing agencies. The remaining 10 per cent is covered by users or local developmental funds. So far, about 1,560 remote villages and 316 remote hamlets have been electrified under the RVE programme.

Recently, the Ministry launched a village energy security programme that focuses on demonstrating sustainable approaches to village energy using biomass-based options.

Rural Electricity Supply Technology Mission

In order to ensure a holistic and an integrated approach to providing electricity for all by 2012[d], the Rural Electricity Supply Technology Mission was established in 2002. The Mission's objectives are:

(a) To identify and adopt technological solutions

(b) Review legal and institutional framework and make changes, if necessary

(c) Promote, fund, finance and facilitate alternative approaches in rural electrification.

(d) Coordinate with various ministries, apex institutions and research organizations involved in rural electrification to meet the national objectives.

The implementing authority for the Mission is the Rural Electrification Corporation, which is also implementing a recently launched scheme called the Accelerated Rural Electrification Programme, popularly known as the one lakh villages, one crore households programme[e]. The scheme is aimed at electrifying 100,000 villages in the next two years with a special focus on 6 priority states. The definition of electrification used under this scheme is that a minimum of 10 per cent of households in a village must be connected for the village to be considered electrified.

Box 4-3. *(Continued)*

Electricity Act

The Electricity Act 2003 (EA) contains several provisions to promote the accelerated development of renewable energy-based power-generation. For example, Section 4 of the EA states that "The Central Government shall, after consultation with the State Governments, prepare and notify a National Policy permitting stand alone systems (including those based on renewable sources of energy and non-conventional sources of energy) for rural areas". Further, Section 14 states that "... where a person intends to generate and distribute electricity in a rural area to be notified by the State Government, such person shall not require any license for such generation and distribution of electricity, but he shall comply with the measures which may be specified...."

Note: (a) Ministry of Non-conventional Energy Sources, Renewable Energy in India – Business Opportunities (New Delhi, Government of India, 2004).

(b) Chaurey Akanksha, "Developments with photovoltaic research and applications in India", paper presented at the 14th PV Science and Engineering Conference, January 2004, Bangkok, Thailand.

(c) Ministry of Non-conventional Energy Sources, Annual Report 2003-2004 (New Delhi, Government of India).

(d) Mission: Power for all by 2012 – Village electrification to be completed by the end of the Tenth Plan, by 2007; access to all households to be provided by the end of the Eleventh Plan, by 2012; at least one unit of electricity per day to be provided to all households below the poverty line; and State governments to prepare and notify a rural electrification plan for meeting the above goals.

(e) 1 lakh = 100,000; 1 crore = 10 million.

3.3 Research institutions

Research and development is an essential requirement for rural energy policies and programmes because of the reliance on technologies which are not only new to rural areas but often also the country itself. Rural energy planning and implementation activities also need country-specific (and location-specific) research inputs because of the wide variations in socio-economic conditions and agro-ecological conditions in each country.

Rural energy activities in the developing countries of the region are largely the function of universities, other academic institutions and

selected specialized institutions. Most of these operate with government funding. The limitations of R&D work carried out in these institutions include the lack of focused, long-term research programmes, the ad hoc nature of research, availability of funds and insufficient links with government-initiated rural development programmes at the planning and implementation stages. Thus, while important contributions are made as an outcome of developing country research in specific areas, these contributions are not mainstreamed into rural energy development efforts. Furthermore, the relevance of having close interactions between technology research institutions in developed countries is not well-recognized and, consequently, technology transfer issues tend to get neglected.

One positive aspect is that participation by local institutions makes projects responsive to local needs, it also generates a sense of ownership that is a critical ingredient for the long-term success of projects. NGOs and community-based organizations can effectively perform the following functions in rural energy service provision:

- Acting as intermediaries and points of contact between communities and implementing agencies
- Serving as the primary forum for local community participation
- Ensuring that poor communities are represented in policymaking at all levels
- Facilitating information exchange at the grass-roots level, international knowledge-sharing and providing reliable information on the local community, including early warning signals in case of crises.

Training institutions should not be neglected because of the human resource intensity of rural energy development efforts in developing countries. In the present context, training efforts are carried out mainly by research institutions to disseminate their research and by government agencies and/or technical consultants for specific projects. While these efforts are meritorious, they nevertheless suffer from many of the constraints encountered by research programmes. In general, most developing countries in the region lack a long-term human resource development programme commensurate with the direction of their rural energy development efforts. Training activities, which are subject to funding constraints, are undertaken at random, often with different agencies duplicating one another's efforts. Since conventional approaches to rural energy development depend mostly on government agencies, interdepartmental transfers of government functionaries are

routine and they denote a loss of training. No country in the region has a clear notion of training needs for rural energy development.

With the anticipated scaling up of rural energy development efforts, it is necessary to assess national training needs, develop appropriate training capabilities and undertake a major human resource development programme. While specialized institutions for this purpose would be welcome, many existing institutions could be equipped to perform the work with equal effectiveness, building upon their available infrastructure and past experiences.

3.4 Rural communities as partners

Communities need to be involved in the planning process, to ensure that energy services are appropriate, socially acceptable and sustainable. The participation of rural communities in rural energy development is important at all times. Communities need to be involved in the planning process to ensure that energy services are appropriate, socially acceptable and sustainable. Local communities possess invaluable local expertise that should be taken into account in defining and implementing any energy project. Most decentralized rural energy projects and many traditional energy projects cannot be undertaken without the direct involvement of rural communities. Rural communities, in particular women, must have their say in the prioritization of energy options if energy policy and services are to meet their needs and provide long-term solutions. If the primary stakeholders are involved in the design and implementation of development initiatives they are much more likely to bring prolonged benefits.

The concept of "people's participation" is, however, subject to certain conditions. First, participation can take place only when the capability to participate exists. Imparting such capabilities (for example, confidence in certain technologies) is a function of all rural development agencies. Second, participation has the greatest chance of success when it is voluntary. Adequate information on the rural energy programme or project concerned should be made available to communities beforehand and appropriate social organizations should be developed by external agents to channel ensuing participation in an organized manner. Third, while participation can occur in many ways, an important requirement of rural energy development is that communities not only take part in programmes and projects, but also make concrete financial commitments to them. Most success stories of rural energy projects are associated with community commitment in terms of investment, or in-kind contributions of a substantial nature.

Projects characterized by high levels of community engagement and involvement in infrastructure investment decisions will typically generate a greater sense of community empowerment, ensure that improvements are tailored to a community's specific needs, and create a much higher probability that the improvements will be maintained by the community after installation.

As rural energy markets develop, a variety of technological options should become available. Communities will be expected to exercise the appropriate choices best suited to their special needs. Furthermore, they will be expected to pay for energy services at market prices. These requirements deviate from community participation under conventional approaches to rural development whereby technological choices are made by external agencies and the technologies are often provided free of cost to users.

3.5 Involving NGOs and community-based organizations

Traditionally, NGOs in rural development are firm believers of direct action and skeptical of government planning. Their emergence reflects in many ways a sense of disillusionment with the effectiveness of governmental delivery mechanisms. In recent years, the attitudes of NGOs and governments have changed; each is increasingly aware of the need for complimentarily efforts. In the context of rural energy development, the most important NGOs are those based in rural communities, community-based organizations because they are closest to the rural people, have their confidence and are in a better position than any other organization to mobilize community participation in rural energy projects. The importance of NGOs has gained international recognition, with a number of donor agencies having become far more willing to provide direct funding to them as opposed to their earlier policy of dealing with Governments alone.

Having limited financial means for investment and infrastructure for providing maintenance services, the Governments in many developing countries cannot provide energy to communities that have poor or no access to modern energy services. They need to involve local authorities and communities to ensure that energy services are suitable, affordable, socially acceptable and environmentally sustainable. To achieve this, a bottom-up approach appears more appropriate for grasping the energy needs of the community and to focus on meeting those needs rather than being driven by pre-defined solutions.

"EnPower" is a typical example of the type of toolkit one can employ for needs assessment.[48] Placing the community at the centre of the process, this toolkit helps a community to voice its needs and preferences, on which basis the energy needs and availability are assessed and best compromise solutions retained to ensure sustainable energy services for poor communities.

There have been reports of project failures because of the lack of local skills and knowledge to adapt and maintain new technologies. Hence, Governments should encourage the involvement of local communities and NGOs to facilitate enterprise development by strengthening the local capabilities to assemble, supply and service the energy supply sector, and create economic opportunities through the creation of energy sector jobs.

3.6 Private sector

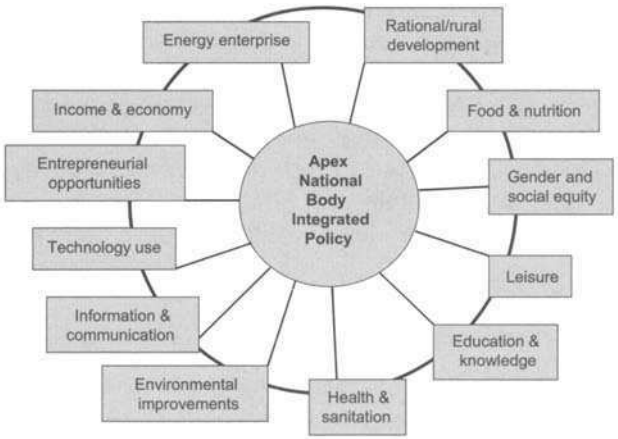
There are moves in a number of countries to enhance the role of the private sector in the energy sector. Indian has actively sought to promote private energy enterprises using decentralized technologies for rural energy development. Technologies such as solar photovoltaic lighting systems are sold in the open market in Sri Lanka. Companies selling biogas equipment operate in Nepal and rural energy service companies are promoted in China. These developments are of considerable interest in this approach since the entry of the private sector into rural energy markets is a fundamental requirement for the success of the approach. Public-private partnership is also being introduced to increase energy services in rural areas.

3.7 Role of coordination or intermediary bodies

Although conditions tend to vary among countries, it is essential to have a national entity or an apex body to facilitate energy services for sustainable development. A possible model is given in figure 4-2.

[48] Gill Wilkins, Development of an Energy Appraisal Tool for Poor Communities: The EnPower Toolkit (London, Government of the United Kingdom) available online at <www.etsu.com/energy_voices>.

Figure 4-2. Apex body with multiple service output



Box 4-4. Improving access to electricity through pro-poor public-private partnerships (Indonesia)

In Indonesia 48 per cent of the population (approximately 100 million people) still lack access to electricity. Most of these people live in rural areas, making rural electrification a priority for the Government. After researching and reviewing various possible rural electrification models, ESCAP, in consultation with the relevant government agencies, community-based NGOs and other stakeholders, implemented a pro-poor public private partnership to implement a micro hydropower project in Cinta Mekar Village in Segalaherang Subdistrict, Subang District in West Java Province.

Objective of the project: To mobilize private sector involvement through public-private partnerships in an effort to provide sustainable electricity to the poor along with financial resources for social infrastructure.

Demonstration hydropower plant in Cinta Mekar village: This project is being implemented by a cooperative venture between the public and private sectors, built on the expertise of each partner, that best meets clearly defined public needs through the appropriate allocation of resources, risks and rewards.

Capacity-building: Assistance has been provided to the relevant government agencies in its efforts to establish an institutional mechanism for mobilizing and allocating financial resources for rural electrification projects accessible to, among others, public-private partnership projects.

Achievements of the demonstration project are: (a) a partnership to develop, operate and maintain a mini-hydropower plant; (b) a sustained source of income for the community; (c) an implemented social development plan; and (d) improved village infrastructure.

In order for the multiple institutions to perform their tasks in synergy regional or national intermediary bodies must play a strong coordinating role. The coordinating institution at the intermediary level provides a link between the national and local levels, ensuring that plans and policies match the needs of consumers, owners and suppliers. Intermediaries may be NGOs, government bodies or private concession holders contracted by the Government. For example, Intermediate Technology Development Group, which has successfully played this role in countries such as Sri Lanka and Zimbabwe, identified the following functions that an intermediary-level institution could perform effectively:

- Provision of appropriate guidance and support for policy formulation
- Advice on development of a national rural energy strategy
- Development of networks within the sector to guide communities on sources of advice, expertise and equipment
- Support and advice to manufacturers and suppliers
- Facilitating financing
- Exchanging and brokering information
- Providing simple guidelines for working out energy service needs and presenting the technical options available with their costs, benefits, advantages and disadvantages
- Facilitating community planning and participation
- Identification of training requirements, running training courses for manufacturers, developers, operators, local government and communities
- Setting the framework for tariff options

3.8 Encouraging strategic alliances between stakeholders

It is quite clear that identifying stakeholders and positioning them in local organizational profiles helps to integrate interested parties. In the long run, markets for energy services will only be sustainable if they allow private firms to make profits beyond the short term. As the rural poor have a low ability to pay and long-term off-grid service costs are unknown, market entry in rural off-grid markets is still considered a high risk. One way of reducing the risks and meeting the specific requirements of local markets is to form strategic alliances, wherein

organizations with complementary capabilities combine their strengths to meet the challenge.

Partnerships thrive on a mutually profitable arrangement wherein each partner focuses on its core strength area. Some issues to consider in the creation of strategic alliances include the following questions: Do the partners have similar priorities? What checks and balances regulate the partner's responsibilities? Is there sufficient trust between the two organizations to risk the brand equity of either organization? Are both organizations equally apt at reducing costs?

A good example of a successful partnership is the marketing of solar home systems in Viet Nam. The Viet Nam Women's Union, a women's NGO, in partnership with the Solar Electric Light Company (SELCO), a commercial company, and the Vietnam Bank for Agriculture and Rural Development (VBARD), a development finance institution, has been disseminating solar home systems in Viet Nam since 1995. The arrangement makes use of a credit scheme through which the Union markets SELCO's systems and administers consumer loans provided by the Bank to make the systems affordable, while SELCO provides systems and is responsible for service. The Union is responsible for marketing and providing support services, while SELCO is responsible for supplying products, installation, training technicians, carrying out maintenance service and repossessing the system in cases of default on payment. The financial institution looks after payment, collection and credit management, thereby minimizing the transaction costs for the Union and SELCO. This strategy enables each party to focus on its area of strength.

Another example of a successful partnership is that of SELCO in India. SELCO, which operates in South India, has links with banks such as the Syndicate Bank and rural development banks such as the Malaprabha Grameen Bank[49] to lend its customers funds for the installation of solar home systems. The solar lighting schemes of these banks offer three-to-five-year loans to consumers for 90 per cent of the solar system costs at interest rates of 12 to 12.5 per cent (priority sector lending rate). By doing so, SELCO has effectively outsourced payment, collection and credit management to the banks, thereby minimizing its own transaction costs. The specific advantages of this arrangement are ready financing and the familiarity of villagers with bank procedures;

[49] Malaprabha Grameen Bank is a rural development bank with the highest loan recovery rates in India.

customer confidence because of the involvement of a local bank assuming the responsibility for credit management, and faster loan-processing because of the presence of local branches in villages.

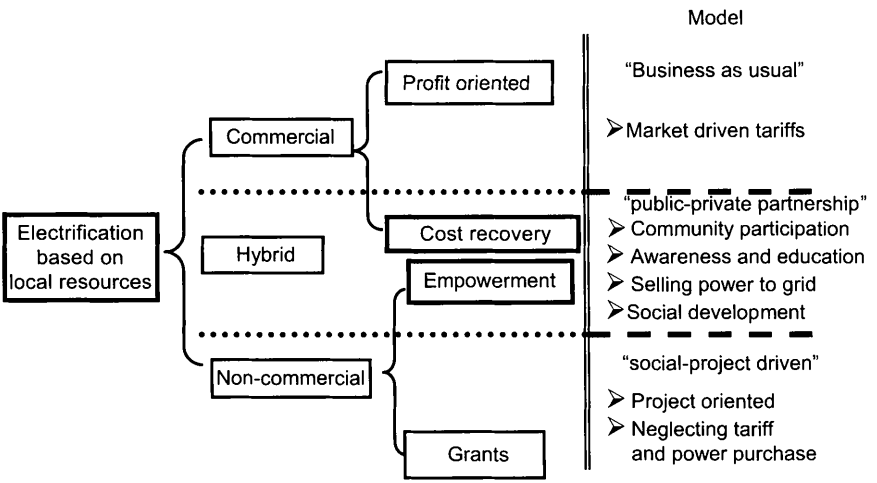
Stakeholders involved in providing services to the rural energy sectors are beginning to understand the merits of networking. Emerging partnerships involve technology vendors, local institutions such as NGOs, which understand the local markets and customers, and financing institutions that specialize in credit management.

4. Stimulating the market

It is a challenge to gain access to energy in developing countries, where nearly 2 billion people lack electricity or access to modern fuels such as oil and gas. Meanwhile, energy markets do not function properly in many developing countries, particularly in rural areas. Inadequate energy markets threaten economic growth and keep living standards low. Although electrification is the traditional means for providing reliable electricity supplies, in many cases extension of distant grids would not be cost effective for rural areas. However, there are a number of promising alternatives for increasing energy supplies even in very remote areas, ranging from more efficient use of traditional fuels to advanced technologies based on renewable energy sources. A key component for stimulating the market is to promote public participation and to rationalize the institutional framework which supports market development.

Rural energy markets, especially rural electrification, could be segmented into several parts based on the following characteristics: purely commercial, semi-commercial where public-private partnership type of projects may be appropriate and social projects where the strong presence and support of government agencies would be crucial. The segmentation of energy markets into economic/commercial and uneconomic/non-commercial segments are raising new concerns over equity in the provision of energy services and over the impact on the poor. However, these different market segments can be implemented through different models (figure 4-3). At the national level, a mix of all these types of projects (commercial, hybrid or non-commercial) and models would be applicable based on the merits of individual projects.

Figure 4-3. Segmentation of rural electrification market



4.1 Stimulating the market for renewable energy services

The Asian and Pacific region is endowed with abundant renewable energy resources. Among these resources are wind, biomass, geothermal, hydropower and solar power. Despite their huge potential, their current utilization is marginal and the contribution of renewable energy to the region's energy mix remains insignificant compared with that of fossil and mineral energy resources.

Providing of renewable energy services and technologies required understanding of the demand for energy services, basic socio-economic indicators, end-user's willingness to pay, competence of local entities in developing markets for energy services, experience in handling site and resource-specific technologies. It is especially important to identify and evaluate all risks and barriers to developing the market for renewable energy services. Such market studies will assist in identifying specific areas with greater market potential and defining strategies to address potential financial risks and barriers. It will also help to assess the potential for tapping new market participants and resources to further propel the growth of demand and supply of energy services.

In many countries, government policies continue to favour the supply of conventional fuel, such as kerosene and diesel, at subsidized

rates to rural areas. Moreover, renewable energy technologies are perceived to be risky, projects are small and involve high transaction costs. Under prevailing conditions, private investors are not willing to fund projects unless the Government is committed to address these issues and create a level playing-field with conventional options. In the present environment of energy sector liberalization, much of the ongoing efforts of the Government and the private sector seem concentrated on providing enhanced energy services to urban consumers. To ensure participation in the delivery of energy services to the rural poor, Government may motivate the private sector to provide capital, entrepreneurship and links to modern technology providers while the Government provides infrastructural support and a fee in the form of payment per poor household served. This payment could be calculated on the basis of the magnitude of benefits allocated to urban households in the form of depreciation, tax credits and subsidies on conventional grid-connected energy supply options.

Financial incentives also can help to stimulate the market, mainly in the direction of improving performance, increasing production and reducing costs.

4.2 Encouraging competition among energy service providers

Competition among energy service providers is encouraged through the decentralization of energy supply systems, especially power sector reform. However, it is not well established in rural areas in the region where the customers still do not have many energy service options. In general, when faced with a natural monopoly such as electricity distribution, the policy response may be to regulate prices and terms of service directly rather than to leave the issues to an inadequately competitive market. When faced with rural energy markets, the most relevant issues are reliability of the technology and cost. Efforts to give end users the ability to choose their energy service providers will create a competitive environment. With the competition, energy service providers will have the incentive to find opportunities for cost savings, good quality products and new market ideas. Those capable of providing reliable energy services at the lowest cost could be given concessions to operate in one or more zones. The benefits of these concessions will be passed on to end users in the form of lower prices and better service.

The Government of China has been implementing the Globe Environment Facility and the World Bank Assisted China Renewable Energy Development Project since 2001. The project aims to use state-

of-the-art and cost-effective wind and photovoltaic technologies to supply electricity in an environmentally sustainable way and to provide modern energy to dispersed rural households and institutions. To encourage competition, a direct grant is provided to photovoltaic system companies to assist them in marketing, selling, and maintaining 10 MWp of photovoltaic systems, i.e., an estimated 300,000-400,000 systems, in remote rural villages in isolated rural areas without access to electricity in Qinghai, Gansu, Inner Mongolia, Xinjiang, Tibet, western Sichuan provinces and adjacent areas. The solar home system companies would receive a grant of US$ 1.50 per Wp per system with a capacity of 10 Wp or greater. This financial support would assist companies to: (a) improve photovoltaic product quality; (b) improve warranties and after-sales services; (c) strengthen business capabilities; and (d) increase marketing efforts. However, the process to become a qualified company is very competitive. The most important factors are product quality and after-sales services; the cost of the system is always a major consideration for customers.

Two more programmes from South America provide more examples. A scheme implemented by Chile in 1994 was aimed at increasing access to electricity in rural areas by promoting the decentralization of decision-making to the regional and community level; encouraging competition between technologies and suppliers; and ensuring the financial commitment of all stakeholders, including private companies and beneficiaries. Concessionary subsidies were extended to those companies that could meet certain investment criteria and social objectives. As a result, while the scheme managed to exceed the coverage targets for 2000 (75 per cent electrification in rural areas), the Government's share of the investment had actually decreased because of the private sector's contribution to financing the expansion projects. Similarly, the Government of Argentina awards concessions through competition to formal distribution companies that ask for the least subsidy to expand services to low-income customers, thus creating incentives for cost-effective technological and commercial solutions aimed at benefiting the poor.[50]

[50] Penelope J. Brooks, "Better energy services for the poor: issues, challenges and opportunities for the private sector", *Infrastructure for Development: Private Solutions and the Poor,* 31 May – 2 June 2000, London.

Box 4-5. The township brightness programme to promote renewable energy in China

China's renewable energy industry has grown steadily over the last decade, and a principal target of technological advancement has been rural village and household power systems. Nationally, almost 97 per cent of Chinese households have access to electricity; yet, there are still 30 million people not connected to the power grid. To address this need, village systems based on photovoltaic and wind power provides a cost-effective alternative to grid extension to these areas, and have been the focus of Chinese rural electrification initiatives in recent years.

In late 2001, China launched an ambitious renewable energy-based rural electrification programme known as Song Dian Dao Xiang, literally "sending electricity to townships". In just 20 months, the programme electrified more than 1,000 townships in nine western provinces, bringing power to nearly one million people and providing the basis for rural economic development. Installation was completed in June 2003 and consisted of 20 MW from PV sources, 840 kW from wind, and 200 MW from small hydropower sources (in Hunan and Yunnan provinces). The Government provided US$ 240 million or yuan 2 billion, to subsidize the capital costs of equipment, and is now drafting guidelines for tariffs and system ownership.

The next phase of this initiative will be the Village Electrification Programme, which is targeted for 2005-2010 and will electrify another 20,000 villages in China's off-grid western region. Capacity-building will be an important component of this phase, and the authorities will work with international and local agencies to develop and implement a training programme for national and local-level engineers and technicians. Other inputs that will be critical to overall programme sustainability include system design, productive use components, load management, system monitoring, reliable batteries and appropriate tariffs.

The Township Electrification Programme is one of the largest renewable energy-based rural electrification programs in the world and it has enough critical mass to create a truly robust and sustainable renewable energy infrastructure and stimulates the market in China, especially for PV power. The programme represents an important launch point, as the lessons learned will have an immediate impact not only on future objectives of rural electrification, but also ostensibly on renewable energy programmes worldwide.

4.3 Strengthening rural energy delivery networks

Rural energy delivery networks can be established through delivering both products and services. Typical rural delivery networks include the supply of firewood to households along with kerosene, petrol and diesel for lamps, vehicles and pumps. The services, especially after-sales services including training, maintenance and repair are very

important parts of the rural energy delivery network. Many lessons have been learned from projects that failed owing to a lack of services. Some rural areas already benefit from the network of high-value products and services, mostly through hire-purchase outlets. There is good scope for developing and strengthening such existing chains to enhance energy service delivery mechanisms. Multinational soft drink companies such as Coca Cola or Pepsi[51] have provided examples of how to develop appropriate and dynamic marketing approaches.

4.4 Rural credit

Extension of electricity grids to a remote rural villages can be very expensive, in particular if there are only a few households to be connected in a village. The problem is not that rural households are unwilling to pay, it is because of high initial costs that they cannot pay. It is one obstacle for providing energy supplies to rural areas. Moreover, there is often no proper channel for rural households to get credit for paying the high initial costs of acquiring or improving their energy services.

Traditional financing institutions are not geared to address the specific risks and returns of rural energy development that generally involves large-scale provision of small-scale energy supplies. There is a need to subject the public sector to higher levels of commercial discipline and to convince the private sector to accept longer lead times to realize returns on the capital investments; in turn, poor people should be assisted and encouraged to substitute the traditional forms of inefficient technologies with expensive energy-efficient ones, thus improving their livelihood and quality of life. It is an effective way to convert capital costs into affordable operating costs through the investments of financial institutions and the private sector. One way to overcome this constraint is for villagers to form groups that are responsible for ensuring that each member of the group repays the loan. Another option is to lend to intermediary non-governmental organizations that are more likely to recover loan repayments than commercial organizations. A third option may be to promote, for example, solar home system companies to lease basic equipment to rural households and communities.

The need for appropriate institutional solutions should be emphasized. In the past few years, there have been a number of success

[51] In order to increase their sales volume, the soft drinks firms have established well-organized distribution networks as well as cold chains in rural areas.

stories in the region regarding credit to support energy services, such as Grameen Shakti in Bangladesh and Savordaya in Sri Lanka, which set up rural energy micro-credit schemes with the assistance of international donors.

4.5 Reducing the cost of modern technologies

The cost of modern technology, mainly renewable energy technologies, is relatively high compared with conventional energy technologies. In the early 1990s, only the richest households in rural India could afford two- and four-light solar home systems. The cheapest one-light solar home system is beyond the means of the poorest 25 per cent of the rural population. However, some poor people are still able to buy such technologies owing to the declining cost of the systems.

Poor people spend a significant proportion of household income on meeting their basic energy service needs. Therefore any change in the cost of energy can make a big difference to them. The rapid pace of technological changes is creating opportunities for broader ranges of small-scale households, low-cost energy supply options that are affordable to the poorest. This is especially true for technologies using locally available renewable energy resources, both for off-grid and utility-connected applications. By achieving economies of scale, this can translate into cheaper and more reliable energy for low-income households and communities, provided actions are taken to reduce taxes and abolish import restrictions on technologies that are not available indigenously.

4.6 Supporting the creation of local energy service companies

A new generation of local entrepreneurs is required to deliver rural energy services. To bring down the cost of after-sales services, these entrepreneurs should be based near the beneficiaries so that they can attend to operation and maintenance needs within hours or days. Working in close cooperation with NGOs and local authorities, Governments could identify unemployed youth and support them with appropriate practical training so that they are capable of installing, operating and maintaining off-grid renewable energy-based systems. A few entrepreneurs could be grouped together to create energy service companies that would be involved in the rural energy service business. Government may provide capital subsidies or other forms of financial assistance such as concessional equity or debt financing to overcome the drawback of initial capital costs. On the other hand, energy service companies could introduce fee-for-service schemes for their beneficiaries

so that funds would be readily available to cover operating and maintenance costs.

"RESCOs" is an example of a toolkit that has been created to serve as a guide for creating a rural energy service company as a sustainable energy enterprise. The toolkit covers structural, financial, marketing and product issues in several ways. First, as a checklist, second as an integral part of a financial due diligence and finally as a risk assessment.[52]

Women are well suited to become energy entrepreneurs because, as users of energy devices, they have a better grasp of households' actual needs and they can market more effectively to other women. Moreover, they normally have a good credit record. Therefore women should be encouraged and supported to become energy entrepreneurs rather than just beneficiaries of rural energy services.

Such women empowerment initiatives can offer multiple benefits beyond the energy sector, including diversification of productive options, creation of new economic activities to better support a family's investment in education and health.[53]

Box 4-6. India: Barefoot College – empowerment of local people

The Social Work and Research Centre (SWRC), widely known as the "Barefoot College", started operations in 1972 in a quiet village in the Ajmer district of Rajasthan, India, with the objective of catering to the basic needs of the rural population. The Centre supports the local people in using their own skills to meet their own needs and manage their own resources. From the beginning, SWRC has practised the idea of sustainable development through self-sufficiency. It has trained many semi-literate and literate women to become "barefoot solar engineers" who are capable of fabricating solar lanterns, installing, maintaining and repairing solar systems in their villages for home lighting, electrification of adult education centres, schools, etc. They are trained without any assistance from urban professionals.

Further details on the solar power initiatives of the Centre can be obtained at the website: <http://www.barefootcollege.org/html/energy.htm>.

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[52] *The Development of an Energy Appraisal Tool for Poor Communities: The EnPower Toolkit,* is available online at <www.etsu.com/energy_voices>.

[53] ESCAP, *Guidelines on the Integration of Energy and Rural Development Policies and Programmes* (New York, United Nations, 2003) (ST/ESCAP/2296).

5. Reforming the market

In today's dynamic world, the market is playing an important role in energy development. The tendency to liberalize and reform energy markets, in particular electricity markets, is attributable in part to the success of market-oriented economic development. It also has impact on the poor in rural areas.

5.1 Reforms in the electricity sector and rural electrification

Electricity is one of the key inputs for economic and social development. The provision of electricity is crucial for improving living standards, supporting development and fostering social activities.

To enhance access to electricity in rural areas, many developing countries have undertaken a number of institutional initiatives. Most of these efforts were implemented through the Government or State-owned utilities. Institutional and tariff reforms of the power sector in developing countries include unbundling of generation, transmission and distribution; and encouraging private sector participation in the generation and restructuring of electricity tariffs to remove subsidies. While undertaking reforms in the electricity sector, Governments can create rural electrification agencies that are autonomous and have the ambitious target to reach out to the poor. Before embarking on large-scale privatization, provision should be made to expand rural electrification with government investment. Electricity sector reform will affect access to the electricity services by the rural population.

In Thailand, only 7 per cent of poor rural households had access to electricity in the early 1970s; by 2000, this figure had increased to 97 per cent, mainly as a result of the implementation of an Accelerated Rural Electrification Programme launched by the State-owned Provincial Electricity Authority, which is responsible for electricity distribution in the provinces outside Bangkok. While the master plan emphasized the expansion of rural electrification through grid extension, the dedicated Office of Rural Electrification was set up specifically for that purpose. In Viet Nam, owing to the consolidation of all electricity sector activities under a State-owned management holding company in 1995, the creation of a special office for rural electrification, and adoption of a variety of innovative management approaches, the electrification level for the poor rose from 50 per cent in 1993 to 77 per cent in 2000. In Bangladesh, only 0.2 per cent of poor households had access to electricity in 1982. Following the reform efforts of the Government, the Rural Electrification Board was created with the specific responsibility

of developing the distribution network in rural areas to ensure expansion of electrification through rural electric cooperatives. By 2000, poor households with access to electricity had gone up to 19 per cent.[54]

Other aspects to be considered are the separation of energy distribution functions from generation and transmission of electricity in order to encourage competition and participation of local distributors. Similarly the separation of retailing from distribution should encourage price and service competition in low-income communities. Multiple players should be allowed to distribute generation projects to ensure expansion of services to rural areas. Rather than covering the operating costs, the government policy should be focused on administering subsidies and concessions through mechanisms that guarantee wider access to electricity services; these could include transparent and competitive bidding, concessions to local bodies and low household connection fees.

5.2 The impacts of market reforms

Attempts of developing countries to widen access to energy services by reforming and restructuring the energy sector have not produced the expected results. In fact, market-led reforms have focused mainly on improving efficiency and the performance of utilities, lowering costs, reducing the role of Governments and creating an environment for greater private sector participation. As reforms have been introduced in countries where a large share of the potential market for electricity consists of very poor people, there has been an apparent deterioration in services in some areas and the poorest people remain excluded from modern energy services.

Reforms are expected to increase tariffs. It is generally believed that the higher tariffs adversely affect electricity consumption of the poor. However, a focus on rural electrification backed by political commitment has helped some countries to achieve a certain degree of success in increasing access to electricity for poor populations in Bangladesh and Thailand.

The quality of energy services proposed for rural areas often falls far short of those provided to urban areas. This is manifested in the form of blackouts, power interruptions and fluctuating power quality, the last factor leading to situations where a rural household may spend as

[54] Global Network on Energy for Sustainable Development, *Summary for Policy Makers* (Risoe National Laboratory, Denmark, 2004).

much on light bulb replacement as on electricity.[55] Energy-efficient, decentralized and reliable small-scale energy sources that are capable of delivering energy services equivalent to those enjoyed by the urban population need to be developed. Markets reform provides an opportunity to enable the delivery mechanisms that enhance the accessibility of basic energy services of the rural population.

5.3 Leveraging the private sector to target the poor

The private sector has several essential roles to play in expanding rural energy services. Especially important roles for the private sector relate to technology, including manufacturing, marketing, installation, operation and maintenance. The private sector's inclination towards entrepreneurial risk-taking and its capability for partnering can facilitate financing, development and the spread of improved technologies.

At the local level, fostering private participation in small-scale infrastructure is a relatively new approach to meet the needs of the poor in a commercially viable way. In relation to electricity provision, there is a strong case for involving local, small entrepreneurs in energy service provision:

- Small-scale private suppliers are already active. For example, electricity customers provide reseller service to neighbours, merchants in bazaars, mini-grids and so on
- Small-scale infrastructure provision has both forward and backward linkages to local capital markets and suppliers, and hence carries local development benefits
- Private suppliers are more customer-driven than public ones, and are better at tailoring the level of supply to customer demand, for instance, basic services for poor customers, higher-level services for higher-income customers.

International institutions have a key role in furthering the agenda of the rural communities with respect to energy provision. They can draw on existing international knowledge and experience to build consensus around best practices and knowledge of energy utilization at international, national and local levels. Furthermore, they can raise the

[55] Laszlo Lovei and Alastair McKechnie, "The costs of corruption and the poor", in *The World Bank Energy Development Report 2000: Energy Services for the World's Poor* (Washington, D.C., World Bank, 2000).

profile and understanding of energy for poverty reduction and encourage dialogue between energy and non-energy specialists. They can also mobilize investments and financing for rural energy and support national policies for rural energy provision.

5.4 Impact of power sector reform on the poor[56]

International comparisons of poverty data entail both conceptual and practical problems. Different countries have different definitions of poverty and consistent comparisons between countries can be difficult. Local poverty groups tend to have higher purchasing power in rich countries, where more generous standards are used than in poor countries. For instance, according to the Government of India, people who earn less than Rs 10 (around 21 cents) per day are considered below the poverty line. By contract, international agencies such as the World Bank define the poor as the population surviving on less than US$ 2 per day. If this definition in used, almost 86 per cent of the population in India is poor (table 4-2).

There is a large disparity in the per capita consumption of electricity in South and South-East Asia, with Singapore leading the list with per capita consumption at 6,641 kWh per year, and Nepal having the least per capita consumption at 47 kWh per year. Similar disparities are prevalent in electrification levels, with Thailand having the highest electrification level of 97 per cent and Bhutan only 11 per cent. Electrification levels in India and the Philippines are 46 per cent and 87 per cent, respectively. The Philippines is at the high end of the regional electrification spectrum and India is in the middle.

It is projected that electricity demand in South and South-East Asia will grow at the rate of 7 per cent per annum during the period 2003-2010. Not only will increases in income level bring about higher consumption of electricity, but also electrification of areas not having access to electrical power should cause a substantial increase in consumption. To meet the challenges of increasing electricity demand and overcome the lack of government ability to finance electricity projects, it is felt that private investment should be encouraged. Therefore, market reform started from the 1980s; many countries have restructured their electricity industry by adopting different models for restructuring, privatization and competition.

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[56] Global Network on Energy for Sustainable Development, "A case study of South and South East Asia" (2003).

Table 4-2. Electricity services in South and South-East Asia: 2002

South and South-East Asian countries	Electricity consumption (billion kWh)	Population (millions)	Percentage of population below poverty line	Percentage of population below US$ 1	Percentage of population below US$ 2	Electrification levels (%)	Per capita consumption (kWh)
Bangladesh	11.87	133.4	35.6 (1996)	29.10	77.80	30	89
Bhutan	na	0.828	na	na	na	11	na
India	391.65	1 033.39	26.10 (2000)	44.20	86.20	46	379
Indonesia	73.70	213.638	27.1 (1999)	7.70	55.30	67	345
Malaysia	58.87	23.796	15.5 (1989)	na	na	90	2 474
Maldives	na	0.283	na	na	na	62	na
Nepal	1.11	23.585	42.0 (1996)	37.70	82.50	15	47
Pakistan	45.41	141.450	34.0 (1991)	31.00	84.70	55	321
Philippines	34.97	77.015	40.00 (2001)	na	na	87	454
Singapore	27.25	4.103	25.0 (1996)	na	na	na	6 641
Sri Lanka	5.01	19.649	na	6.60	45.40	50	255
Thailand	82.79	61.238	13.1 (1992)	2.00	28.20	97	1 352
Viet Nam	20.04	79.526	50.9 (1993)	na	na	58	252

Source: Compiled from the World Bank web site www.worldbank.org.

Note: na = not available

Countries such as Indonesia, Malaysia, the Philippines and Singapore have already introduced competition in the power market, whereas, in countries such as Bangladesh, Bhutan, Nepal, Pakistan and Sri Lanka, sector restructuring is still on paper. However, in India, sector restructuring and the establishment of independent regulators started in the late 1990s with reforms remaining in a nascent stage. The experience of other countries could prove useful for India's reform process.

Experiences of India and the Philippines

With the early 1990s crisis and the advent of IMF and World Bank sponsored reform processes, the Indian economy underwent a structural change, adopting a liberalized policy for many sectors. This also opened up energy generation to private sector participation. Later, however, it was realized that the private power policy for generation projects would not succeed unless they were preceded by extensive reforms in distribution.

Thereafter, new legislation was formed, which paved the way for setting up of independent regulatory bodies in the sector and also many states restructured and unbundled their sector through appropriate legislation. This new legislation, however, did not spell out provisions for the extension of electricity services to the poor or a mechanism for subsidizing marginalized consumers. Unfortunately, electricity sector reforms in India have invariably neglected the poor as has happened in many other countries. The focus of reform legislation has been more on improving the financial viability of the ailing power sector than on improving access to electricity. The Indian Reform Act does not even contemplate rural electrification and systems upgraded. This forms a major lacuna in the Indian reform model and there is a need to make appropriate policy and legislative changes to address the electricity needs of the country's large population of poor people.

In contrast to the Indian reform legislation, legislation in the Philippines clearly defines marginalized consumers; it provides lifeline rates for the poor and policies for cross-subsidies, subsidies and the expansion of networks. The legislation act stipulates a definite the time frame for the elimination of cross-subsidies and at the same time ensures subsidized rates for those identified as poor.

Further, it mandates expansion of electricity services to rural areas and compulsory levying of universal charges for meeting the subsidy requirement for electrification of poor areas.

In India, impoverished agricultural and residential consumers (falling to the lowest band of consumption) are not metered and very often, the consumption by these groups is inflated to show lower commercial losses. This means the actual availability and consumption of electricity by these groups is lower than the statistics would imply. The reform mandate requires reduction in transmission and distribution (T&D) losses but does not prescribe the means for achieving this reduction. For example, the legislation does not mandate 100 per cent metering and curbing of theft and pilferage. Once all consumers are metered it would be possible to separate T&D losses and actual consumption by unmetered consumers.

The experience of the Philippines is very enlightening for enhancing electricity access in the country. There is a need to have proactive legislation that addresses issues associated with access to reliable and affordable sources of electricity. Innovative mechanisms such as the provision of lifeline rates and special functions such as missionary electrification to meet the electricity needs of the poor need to be developed.

6. Enabling the change

The dynamic process of energy sector reform through liberalization and decentralization, creates new challenges and opportunities for change. The dormant market for rural renewable energy services can be stimulated by undertaking several measures that would help to reduce consumer barriers, particularly to off-grid renewable energy services.

To start with, information about the various renewable energy options should be disseminated through a range of communication tools and media. Specialized independent centres should be established to provide technical assistance to interest groups representing potential customers for off-grid energy services to enhance their brokering and supporting capabilities.

Populations without access to electricity are often scattered in very remote regions where information on renewable energy systems is practically non-existent. Also, installation of grid-independent renewable energy-based systems has led to poor performance owing to inadequate information and training. People need good advice on the most suitable options before making an intelligent investment in energy products. Initiatives may be taken to provide such information to educate and inform the end-users while convincing them to purchase suitable products and services. Information may also be packaged in catalogues containing details of products that are aimed at serving basic rural

needs, such as water, energy, communication and health care. Along with information, adequate training is crucial in order to realize any lasting benefits. Human and institutional capacity-building and development is also needed to bring about sustainability.

6.1 Building human and institutional capabilities

An essential requirement for designing and implementing a sustainable energy strategy is sufficient human and institutional capacity. Professionals and policymakers need to be informed of and trained to deal with the technical, legal, regulatory and institutional issues associated with the challenge of sustainable energy development. Most energy planners working with utilities, government ministries and agencies have focused on supply-side planning. Reorienting energy services towards sustainable development requires that the approach be widered and that energy be considered not so much in terms of increasing supplies, but in terms of providing energy services for specific needs.

There is often a lack of sufficiently skilled personnel to develop and implement decentralized rural energy plans and programmes. While schools can help in gathering data, it is necessary to introduce higher-level training for rural energy planners, involving rural communities, relevant non-governmental organizations and private sector representatives. National universities and training institutions can be involved to sustain national energy planning. For example, university-level courses in rural energy planning have been initiated in China and India.

The management systems employed by electrification schemes are often based on village cooperatives. The system operators lack training and there is no technical back-up; further, the financing and revenue streams are not sufficient, and there is no incentive for management to improve performance. Planners should be able to identify potential maintenance issues and disseminate information to users and managers about such systems. Different institutions need different capacity development such as:

National and provincial planning bodies

- Informing and training all sectors of government (finance, planning, line ministries etc.) to make sound decisions on energy strategy
- Orienting and training sectoral agencies in charge of various aspects of rural infrastructure development (for example education, health, agriculture, animal husbandry, forestry, poverty reduction, social welfare) in energy issues

- Basic national assessments of local resources for renewable energy in order to plan for renewable energy development
- Technology management and adaptation issues including assessment, selection and modification of technologies

Energy project and programme implementers

- Providing basic information and technical knowledge on energy issues
- Training NGOs and community-based organizations in assisting with energy project identification and implementation, including the facilitation of micro loan programmes
- Orienting research and training institutions dealing with rural development, poverty reduction, gender and energy issues
- Business and technical training for service providers in energy service provision and equipment supply
- Training and education to create local manufacturing capabilities, sales and service industries related to sustainable energy

Rural communities

- Provide information on available options, costs and benefits of modern energy sources and technologies
- Skill development to operate and maintain decentralized energy systems
- Awareness regarding the environmental and health impacts of traditional energy use patterns
- Build the capacities of and set in place mechanisms for rural communities, especially women, to participate in energy programmes at the needs identification, design, implementation and evaluation stages

6.2 Improved data collection and processing

Predictions about energy have limited value without accurate data. Rural energy or non-commercial energy data are not listed in conventional energy statistics. A more comprehensive and reliable rural energy information system includes assessments of rural energy needs on an area basis, patterns and trends of conventional and alternative energy use, and the economic, social and environmental indicators for rural development.

Governments should commit substantial human and financial resources to carry out surveys and establish information systems that could be effectively utilized by various agencies involved in rural development. One cost-effective solution would be to involve rural populations in collecting and updating data for their own localities. This would enable the rural energy database and local awareness of energy issues to be created through incorporating energy surveys in high school curricula. This would encourage school children to become rural energy practitioners.

6.3 Supporting research and development

Government-funded R&D often has a short-term focus because the aim is to develop projects, the results of which can be commercialized in a short period of time. This is intended to convey the message that R&D interests are indeed in the public interest. Development of energy technologies that respond to the needs of the rural population requires Governments to have a long-term strategy and commitment to basic research. It is important that public authorities support generic research activities instead of large-scale commercialization projects.

Some developing countries depend heavily on importing advanced technologies from industrialized countries. Active participation in the energy innovation process is essential to assure that the technologies are well adapted to the available resources, specific needs and capabilities of the country concerned. Technology adaptation includes making the products more reliable, resistant to the local climate, affordable, amenable to fabrication with local skills and adapted to the specific requirements and habits of the users.[57] The overall strategy should be needs-based, focusing on applying science and technology to meet the needs of the rural population.

Where feasible, direct government funding may also be committed to encourage the private sector to perform more long-term R&D research. Emphasis should be given to enhance collaboration among Government, industry and other organizations to ensure efficiency and productivity.

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[57] United Nations Development Programme, *World Energy Assessment: Energy and the Challenge of Sustainability* (New York, United Nations Development Programme, 2000).

6.4 Advocacy

Advocacy can contribute to creating awareness of the role of energy in national and rural sustainable development, to sharing information and to drawing public attention. This leads to an enhancement in participatory decision-making related to energy services. Different stakeholders play different roles. For instance, organizational intermediation involves not only the initiation and implementation of programmes, but also lobbying for the policy changes required to construct an "environment" of regulation and support in which energy technology and the various players can thrive. This involves putting in place the necessary infrastructure and getting the incentives correct in order to encourage owners, contractors and financiers. Organizational intermediation must include the development of regulatory support and incentive structures, which can specifically address the energy needs of the poor in rural areas.

Organizational intermediation is distinguished from social intermediation. Organizational intermediation involves the identification of owners and beneficiaries of projects and the "community development" necessary to enable a group of people to acquire the capabilities to take on and run individual investment projects obtaining for them a voice in project identification, design and management of programmes. The following examples elaborate how such organizations contribute the process of advocacy.

Development agencies

The mandate of these agencies is to enhance international and regional cooperation to improve access to reliable, affordable, economically viable, socially acceptable and environmentally sound energy services. This is done as an integral part of poverty reduction programmes, by facilitating the creation of an enabling environment and addressing capacity-building needs, with special attention paid to rural and isolated areas when appropriate.

A number of development agencies are helping to achieve the Millennium Development Goals. Their role is not so much through direct involvement but by financing market studies and the development of business plans to assist private sector interests in establishing and operating energy services for rural people. These efforts are aimed at addressing uncertainty and providing the necessary interface between poor communities, energy services and private capital.

United Nations – realize the objectives of the MDGs

The United Nations has taken the energy-MDG nexus forward under its Millennium Project, which over a period of three years will develop a plan of implementation that will enable all developing countries to meet the MDGs and thereby substantially improve the human condition by 2015. Ten thematically-orientated task forces perform the bulk of the research, within which energy is represented.[58] A workshop in October 2004 in the United States defined the energy services and corresponding targets required to meet the MDGs in the poorest countries with a special emphasis on sub-Saharan Africa. The output of the workshop provided direct input into the findings of the Millennium Project, which seeks to integrate the scaling up of access to improved energy services into its recommendations for how the MDGs can be met.

There is strong support for pro-poor policies among United Nations entities. Advocating such policies is considered a priority role for the United Nations. Public-private partnerships are supported for the sake of efficiency and resource mobilization, provided attention is given to equity. Moreover, it is in line with the spirit of the Global Compact and the Millennium Declaration that highlight principles shared by multinational corporations. Decentralization is perceived as a trend that will release energies and initiatives but which will have to be closely monitored and framed by national Governments. United Nations organizations are more and more inclined to recognize the importance of local authorities in reaching out to the poor and seek their advice in the negotiation of international norms and conventions for which they will have direct responsibility to implement.

Sector reforms and access to the poor.

The Global Network on Energy for Sustainable Development has focused its activities around the basic theme of "energy access to the poor". Its approach so far has been to engage identified centres of excellence (both in developing and developed countries), which formulate working groups within the Network, in conducting initial assessment of relevant themes. The work on the first theme, namely, Impact of power sector reform on poor, has been completed and policy guidelines are being formulated. The second theme focused on renewable energy and energy access to the poor.

[58] Available online at www.unmillenniumproject.org.

Barriers to adoption of renewable energy in the region

Although renewable energy technologies (RETs) have already proven themselves and have made a niche in several applications relevant to enhancing the energy access of the poor, they continue to suffer from issues related to (a) their techno-commercial viability; (b) management and community involvement in planning and implementation; (c) institutional requirements, including the regulatory and policy framework to bring RET-based distributed generation and supply of electricity into the mainstream of rural electrification planning; and (d) funding and financial mechanisms to bring RET-based services within the affordable and acceptable limits of the poor in rural areas. The Renewable Energy and Energy Efficiency Partnership regional initiatives conducted regional meetings in 2003 to probe deeper into region-specific barriers to the deployment of renewables.

Communications and knowledge management strategy for advancing partnerships[59]

The Global Village Energy Partnership (GVEP) is a voluntary programme that brings together Governments, public and private organizations, multilateral institutions, consumers and others from developing and industrialized countries in an effort to ensure access to modern energy services for poor and marginalized members of society. The programme is undertaken as a means of accelerating economic growth and reducing poverty.

The Partnership's stated objectives are to:

- Catalyse country commitments to village energy programmes and guide policies and investment in this area
- Bridge the gap between investors, entrepreneurs and energy users in the design, installation and operation of replicable energy-poverty projects
- Facilitate policy and market regulatory frameworks to scale up the availability of energy services
- Serve as a marketplace for information and best practices on the effective development and implementation of energy-poverty projects/programmes
- Create and maintain an effective coordination mechanism for addressing energy-poverty needs

[59] Available online at www.gvep.org.

GVEP is currently developing its communications and knowledge management strategies. The focus of the communications strategy is on information about the partnership which needs to be communicated both to internal and external audiences. The focus of the knowledge management strategy is to provide knowledge about energy services that is needed by consumers, suppliers and other energy sector stakeholders in developing countries and transition economies to develop and implement projects.

7. Conclusion

Energy services for sustainable development in rural areas require much greater attention to institutional set up and market reform. The establishment and promotion of institutional mechanisms to improve access to reliable and affordable energy services for sustainable development is an important measure for achieving the MDGs. In this regard, institutional mechanisms should focus on two aspects. The first is energy services and options for rural development and the second is wider rural advancement opportunities to make use of energy options.

The institutional mechanisms are essential not merely to establish energy carriers in accessible limits, but also to ensure that affordable, reliable and adequate services are secured by rural people to alleviate poverty, overcome seclusion and oppression, and lead a healthy life. The existing institutional framework offers opportunities for decentralized interventions, but suffers from a lack of capacity and space to involve stakeholders and to follow a participatory process. The other limitations of administrative mechanisms include: the sector-oriented top-down development tracts, lack of sound mechanisms to integrate the sectors and local concerns; inability to make linkages through inputs and outputs; and the lack of local plans to make use of spatially varying renewable energy resources and options.

These circumstances show that institutional mechanisms need to focus on decentralized regional frameworks. This will reduce the bias in national interventions and spatial imbalances in accessibility to energy services and affordability.

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CHAPTER 5

HOW TO MAKE IT HAPPEN: DELIVERY MECHANISMS FOR INCREASED ACCESS TO ENERGY SERVICES IN RURAL AREAS

1. Introduction

In chapter 3, it was argued that energy provision is about understanding the role that energy services play in people's lives, and responding to constraints in improving livelihoods. Energy must therefore be situated within the overall development framework and considered as one of many facets affecting the livelihoods of the poor. It must also be understood in terms of how the poor value and use it.

In chapter 4, it was argued that it is necessary to develop institutional mechanisms to enhance services. It was further argued that reforms should focus on decentralized regional frameworks. This would enable planners to give more attention to the specific needs of the region as well as to the people using energy by reducing the bias in national interventions that often result in spatial imbalances in accessibility to energy services and affordability.

With an appropriate policy framework supported by adequate institutional support, access to energy services could be accelerated. As providing energy services to rural areas is often considered a social cause, these services are often provided to rural communities in the form of major government-supported programmes or through the support of international development institutions. However, a number of projects have also been implemented in developing countries to enhance energy services with market-based incentives. An important element in these various models of delivering energy services would be to generate feedback from these programmes and projects in order to improve policies and institutional mechanisms to support wider access to energy services in rural areas. Without this linkage, the experience and knowledge generated through the implementation of these programmes and projects, in particular, by the local people or the beneficiaries cannot be fully utilized.

In this chapter, attempts to analyse and identify factors contributing to advances in the rate of access to energy services in rural areas will

be made through existing programmes and projects, which were presented at the aforementioned ad hoc expert group meeting. In addition, analysis of the bottom-up approach, will be made to identify appropriate incentives written into policies to promote such an approach. Particular attention will be paid to the economics of providing energy services to encourage more market-based programmes.

2. The central challenge: affordability

2.1 Alternative service delivery and financing mechanisms

Relatively poor people often make significant cash payments towards energy, which suggests that in principle it may be possible to meet their needs with market-based solutions. Innovative service delivery models are being tested in many parts of the world.

Even with financing options, these delivery mechanisms are likely to reach only the middle and higher income groups in rural areas. In Bangladesh, the estimated baseline demand for SHS is 12,000 to 15,000 households gaining access in the next five years. However, surveys reveal that such households are more likely to be in the relatively higher-income bracket, earning incomes around US$ 1,000 per annum.[60] This is corroborated by Grameen Shakti's experience which indicates that even with financing options, rural households having a monthly income exceeding Taka 4,000 or US$ 71 are the prime customers of their SHS. Grameen Shakti offers a range of payment systems to its customers. Option 1: Customer pays 15 per cent of the total price of the system as down payment and the rest (85 per cent) is paid with 12 per cent service charge (interest) within 3 years in 36 monthly installments, Option 2: Customer pays 25 per cent of the total price of the system as down payment and the balance (75 per cent) is paid with 8 per cent service charge (interest) within 2 years in 24 monthly installments, Option 3: Customer pays 15 per cent of the total price as down payment and the balance (85 per cent) including 10 per cent service charges are to be repaid by 36 account payee checks in advance and cash purchases, for which Grameen Shakti provides 4 per cent discount on the total price of the system. The lower income groups are likely to benefit only from targeted policies, including subsidy policies.

[60] World Bank, "Feasibility study for a solar home systems project within the context of alternative options for rural electrification", (Washington, D.C., World Bank, 2000).

Box 5-1. Case study: Deepam Scheme in Andhra Pradesh, India

The government of Andhra Pradesh state in India launched an innovative targeted subsidy programme in July 1999 called the Deepam Scheme to encourage the uptake of liquefied petroleum gas (LPG) among low-income households. In this Scheme, the government pays the LPG connection fee for women who belong to self-help groups and whose households are classified as living below the poverty line.

There are more than 373,000 self-help groups in Andhra Pradesh with over 5 million members. About 150,000 of these self-help groups are in rural areas. As of March 2002 over 1.5 million LPG connections had been released through the Deepam Scheme, including 1.2 million in rural areas. The majority of the recipients are members of self-help groups under the Development of Women and Children in Rural (or Urban) Areas.

The state government of Andhra Pradesh has authorized 1.7 million connections to be released to date. Overall, the Scheme will cover 3 million households; the state government covers the total cost of Rs. 3 billion (over US$ 60 million).

The Deepam scheme differs from traditional fuel subsidies in two respects: first, it is targeted; and second, it is a one-time capital subsidy in that it subsidies LPG connection rather than LPG refills. Deepam beneficiaries have to cover the other costs paid in advance such as the purchases of stove and connecting accessories amounting to about Rs. 1,000. At the state level, the government of Andhra Pradesh surrenders 5 litres per month of kerosene for every new Deepam beneficiary enrolled in exchange for increased allocation of subsidized LPG by the Central Government.

The World Bank, with support from the Government of Andhra Pradesh, commissioned an evaluation study to examine the performance, effectiveness, sustainability and replicability of the Deepam Scheme. This evaluation study, conducted by the National Institute of Rural Development, in 2001 was based on focus group discussions with 66 self-help groups and interviews with 134 Deepam beneficiaries in the above-mentioned districts in addition to the discussions with other LPG users, non-users, oil company representatives, dealers and government officials involved in the Scheme. In each district, three mandals (groups of villages) were selected. Since the logistics concerning LPG cylinders were expected to be an issue, villages and self-help groups within mandals were grouped on the basis of the distance to the closest LPG dealer. Further, only those self-help groups that had been participating in the scheme for more than a year were selected in order to make a meaningful assessment of LPG consumption. The important findings of the evaluation study are as follows: (a) lack of an adequate LPG distribution network is a problem for the Deepam Scheme, (b) a few beneficiaries have refill cylinders delivered to their homes, and (c) average LPG consumption is 3 kg per month per household. The most common reason given for low consumption of LPG was the higher refill cost ranging from Rs. 250-300 depending on the distance to the dealer.

Box 5-1. *(Continued)*

Deepam Scheme – the way forward

The Deepam Scheme is a rare example of a government initiative of targeted capital subsidy aimed at empowerment of women to promote better energy services and a clean domestic environment.

Achieving the social objectives of the scheme – saving women's time and health for other activities, improving the household environment, and reducing pressures on forests – in a tangible manner is of great importance. This study found that for the majority of rural households, the incremental cost of substituting biomass with LPG was sufficiently high to deter a significant switch to LPG. Instead, the financial considerations have confined LPG to incidental use (such as making tea or preparing meals for unexpected guests), or to periods when the opportunity cost of fuelwood use is high, such as the monsoon season. Reliance on biomass as the primary fuel continues among the majority of Deepam beneficiaries.

Capital subsidies to alleviate the high cost of energy services paid in advance is generally acknowledged to be far better than operating cost subsidies (such as fuel price or power tariff subsidies). However, capital subsidies facilitate access to good quality service only if consumers can pay for the operating costs themselves so that a viable energy market can develop. This study shows that urban households are more willing to pay for LPG cylinder refills than rural households, because biomass is limited in availability (and consequently more expensive in urban areas) and cash income is probably higher and more consistent among urban dwellers. That is why the capital subsidies provided in the Deepam Scheme have been better utilized in urban areas. However, the question remains as to how to help the rural poor, the principal target group of the Deepam Scheme, to enjoy similar benefits from LPG connection.

The beneficiaries universally referred to time savings in cooking as the chief benefit of LPG use. While there is less awareness about the health benefits of LPG use women have noticed the absence of smoke and the impact on their eyes, throat and lungs. Exposure monitoring in Andhra Pradesh and elsewhere indicates that unless LPG becomes the primary energy source, indoor air pollution levels will remain high. At the level of LPG consumption found in this study, the health benefits of LPG connection remain low in rural areas.

The state government has decided to add an additional 1.3 million new connections under the Deepam Scheme at a cost of Rs. 1.3 billion. In this context, the principal questions are whether and how a commercially viable market can be developed and sustained in rural areas.

Box 5-1. *(Continued)*

The experience with the Deepam Scheme has confirmed the worldwide experience with the household use of LPG. LPG is strongly income elastic at low income levels, so that the poor will use LPG sparingly. As long as free or cheap biomass is available, households will continue to use traditional fuels rather than LPG unless they are well off. Cylinder management makes the distribution of LPG in rural areas especially difficult and commercially unattractive unless LPG is universally used as the primary cooking fuel. Merely urging distributors to set up more depots just to cater to Deepam beneficiaries who do not consume much more than 3 kg per month is unlikely to resolve delivery problems.

An important consideration is the deregulation of the downstream petroleum sector. One of the objectives is to create an open and competitive market with a level playing field, designed to increase efficiency in the sector and ultimately reduce the cost of service to consumers. Differential treatment given to State-owned oil companies and private sector LPG distributors (in the form of subsidies reserved exclusively for the former) goes against the spirit of sector deregulation and its objectives. By continuing to give not only a price subsidy but also a cylinder connection fee subsidy only to the dealers for State-owned oil companies, the Deepam Scheme in its current form slows down the move towards a market-based petroleum sector.

Source: World Bank, *"The Indoor Air Pollution Newsletter: Energy and Health for the poor"*, Issue No. 6, March 2002 (Washington, D.C., 2002).

2.2. Addressing first costs

In rural electrification, a real barrier to affordability is the initial connection charge demanded by the utility. In Nepal, for instance, the cost of connection in National Energy Administration projects is US$ 35 on average and the cost of internal wiring US$ 25 as a minimum. The combined costs paid in advance (including internal wiring) are often more than 10 per cent of the average annual rural household income. This barrier of high advance costs is higher in the case of renewables. The purchase price of an SHS can represent up to 50 per cent of the annual income of rural households.[61] Some of the successful strategies adopted in addressing the first cost barrier in obtaining improved energy services include the following strategies:

[61] Douglas Barnes and K. Jechoutek, *Financing Decentralised Renewable Energy: New Approaches* (Washington, D.C., World Bank, 1998).

Box 5-2. Case study: China Rural Energy Enterprise Development

The China Rural Energy Enterprise Development (CREED) initiative seeks to create a sustainable energy development path for rural people in the north-western part of Yunnan Province and neighbouring areas in western China. CREED also aims to help to alleviate environmental problems such as deforestation and biodiversity loss caused by the unsustainable collection of wood for fuel in an area known for its rich biological diversity.

CREED builds on the approach being used successfully in the United Nations Foundation-funded Africa Rural Energy Enterprise Development project in Africa and Brazil Rural Energy Enterprise Development project in Northeast Brazil. It adapts that approach to the different political, geographic, economic and cultural characteristics of western China. CREED aims to influence broader energy and development initiatives that are under way in China and to redirect existing sources of financing so as to achieve sustainable energy goals.

CREED will invest in new small entrepreneurs offering energy services to rural customers based on energy technologies and practices that are environmentally more sustainable than current approaches. Adopting a method developed by project partner E + Co of coupling enterprise development services with closely targeted financing, the CREED initiative will help to start and support new businesses that supply improved energy to the rural poor. CREED will also work with local partners to develop rural energy services by providing support for consumer credit and income-generation activities so that poor families will have the means – and incentives – to purchase and use better alternatives. These two main project goals will be carried out in a way that helps a variety of Chinese partners to continue the approach and that anchors it in Chinese Government policies and programmes that are themselves strengthened through the project.

Source: Available online at www.c-reed.org

(a) **Support connection charges of grid electrification:** A strategy that worked well in widening access to electrification is reducing initial connection charges by spreading them over several years by rolling them into the tariff.[62] In Nepal, micro-hydropower schemes such as Ghandruk were able to achieve 100 per cent connection rates by charging modest connection charges. Decentralized systems have tried to solve the problem of advance costs through credit, leasing and subsidies.

[62] Ibid.

(b) **Offering consumer choice:** Customers desire a range of component options and service levels and can benefit from even small systems. Based on affordability analyses, some donor programmes for solar home systems began by offering large 100-watt solar PV systems. However, it was found that these systems were too expensive for rural households and the sizes were decreased to 50 watts and even to 20 watts.[63] Options that enable households to purchase small systems initially and "up-grade" or expand these systems are another way to increase affordability. The World Bank-funded Energy Service Delivery project experience in Sri Lanka indicated that most sales of solar home systems were of 32 Wp systems (selling for about US$ 450) and that customers desire a range of component options, including small systems (such as 20 to 30 Wp). Accordingly, the system specifications under the second phase, the RERED project, were modified to allow more affordable systems of capacity 30 Wp or less to be eligible for grants under the project.

(c) **Credit for energy services:** Affordability for improved energy services stands to be increased dramatically with credit facilities made available to the population. Credit may be provided by dealers themselves, by development banks or by microfinance institutions.[64] Microcredit is the provision of small amounts of credit to clients who are underserved by traditional, formal banking institutions, because of their lack of assets. Such institutional are closer to rural customers than commercial banks, enjoy lower transaction costs and are more capable of dealing with the financing aspects than technology suppliers or dealers. The Grameen Shakti of Bangladesh is the most written about example of a microcredit organization providing finance for energy services. With more than 1,000 branches and 2 million members, Grameen Shakti provides credit for terms up to three years with 15 to 25 per

[63] Eric Martinot, Akanksha Chaurey, Debra Lew, Jose Moreira, Njeri Wamukonya, "Renewable energy markets in developing countries". *Annual Review of Energy and the Environment* 27.

[64] Providing consumer credit through dealers has been tried in some countries, but it achieved only limited success. Dealers are reluctant to extend credit to rural customers with little credit history, and credit administration and collections may be costly. The ESD Programme in Sri Lanka was originally designed for dealers/developers of SHS to provide marketing, technical support as well as consumer credit. Dealers however soon realized that microcredit evaluation, delivery and recovery were specialized functions beyond their capabilities and that the success of such rural microcredit largely depends on a rural presence, local connections and an understanding of the people themselves.

cent down payment for solar PV home systems. In Sri Lanka, Sarvodaya, a national microfinance organization, offers two to five years of credit with a 20 to 25 per cent down payment for the purchase of solar home systems.

Box 5-3. SELCO model

SELCO brings together life-changing technologies with the service and financing needed to make them accessible to developing country markets. Wireless technologies such as solar PV demand little physical infrastructure, but a human infrastructure is required. Skilled rural men and women are needed to introduce, supply, service and finance solar electricity systems. SELCO has created that crucial human infrastructure, connecting reliable, affordable and convenient solar PV solutions to those people who most need it. SELCO does this by combining three essential elements:

- **Products:** SELCO uses small-scale modular wireless technologies such as solar photovoltaics. The systems offer advanced, inexpensive lighting, electricity, water pumping, water heating, communications, computing and entertainment. These products can be purchased for individual homes and businesses. They do not require connection to a larger network.

- **Service:** SELCO meets its customers where they live. With its extensive network of service agents, it is able to provide at-home design consultation, installation and after-sales service on all products sold. Proximity to customers enables SELCO to better understand, efficiently service and develop long-term relationships with them.

- **Finance:** SELCO helps its customers finance their purchases. It partners with rural banks, leasing companies and microfinance organizations to provide the necessary credit to its customers.

Combining these three elements creates a virtuous cycle: using high quality products reduces the cost of ongoing service and maintenance. With high quality products and ongoing service, customers are able to receive financing for their purchases. By providing its combination of product, service and finance, SELCO is able to offer superior lighting and electricity at a monthly price comparable to using traditional, less effective sources.

The prospects for consumer credit are, however, very specific to cultural, legal and financial factors in each country. The Sri Lankan microcredit model appears sustainable but perhaps only because Sri Lanka has a strong and long-standing microfinance culture and set of institutions in rural areas, along with a well-developed commercial banking system.[65] SELCO in India adopted a variety of credit services including tying up with a rural development bank to direct financing and tying up with NGOs suited to the specific customer profile.

(d) **Making rural energy services affordable:** Microcredit programmes have been active in renewable energy lately, some focusing exclusively on supporting women, such as the stand-alone solar photovoltaic systems promoted by Grameen Shakti in Bangladesh or the Viet Nam Women's Union.

In some communities where transactions of most goods and services are done through bartering, it is difficult for poor households to contribute cash for energy services. In such circumstances, communities can work out schemes in which a part or all of the operating and maintenance costs of the renewable energy systems can be covered by contributions in kind. In Vellimalai, a village within a forest reserve in South India, forestry officials have worked out a scheme with the community so that villagers are required to contribute fuel-wood by turn for the operation of a small gasifier-based power generator that provides enough electricity for home and street lighting and community television.

Local communities and NGOs can also play an effective role in assisting the potential beneficiaries to initiate income-generating activities by training, providing microcredit and helping them to market their products so that the latter would be in a better position to pay for the energy services. The United States Agency for International Development (USAID) has provided funding assistance for revolving fund projects by extending seed money that can be used to offer credit plans for families wishing to own solar home lighting systems. With the assistance of USAID, an Indian NGO has set up a revolving fund to provide solar photovoltaic powered home lighting systems to tribal women who pay back the installation costs on a monthly basis from the proceeds of the sales of additional baskets they can produce during the extended lighting hours.[66]

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[65] Eric Martinot, Akanksha Chaurey, Debra Lew, Jose Moreira, Njeri Wamukonya, "Renewable energy markets in developing countries". *Annual Review of Energy and the Environment* 27.

[66] United States Agency for International Development, *Energy for Life: A Case Study Compendium*, Prepared for the Ninth session of the Commission on Sustainable Development.

3. What's involved in making it happen?

There are clearly many ways in which the overall energy supply and use system might be conceptualized. The most effective to increase energy service in rural areas is the policy instrument. The approach extends the idea of financial intermediation, technical intermediation, social intermediation and organizational intermediation.

3.1 Financial intermediation

Financial intermediation involves putting in place all the elements of a financial package to build and operate decentralized rural energy supply companies (RESCOs) in place. The process is sometimes referred to as "financial engineering" and covers:

- The transaction costs of assembling equity and securing loans
- Obtaining subsidies
- The assessment and assurance of the financial viability of schemes
- Assessment and assurance of the financial credibility of the borrower
- The management of guarantees
- The establishment of collateral ("financial conditioning")
- The management of loan repayment and dividends to equity holders

Financial intermediation can also be used to cover whole schemes rather than just investment in an individual plant. In this way projects can be "bundled" together in a way which:

- Makes them attractive to finance agencies
- Establishes the supply of finance on a "wholesale" basis from aid agencies, Governments and development banks
- Creates the mechanisms to convert these flows into a supply of retail finance (equity and loan finance at the project level)

3.2 Technical intermediation

Technical intermediation involves both improving the technical options by undertaking research and development activities and importing the technology and know-how "down" through the development of capacities to supply the necessary goods and services. These goods and services include:

- Site selection
- System design
- Technology selection and acquisition
- Construction and installation of civil, mechanical and electrical components
- Operation and maintenance
- Troubleshooting, overhaul and refurbishment

3.3 Social intermediation

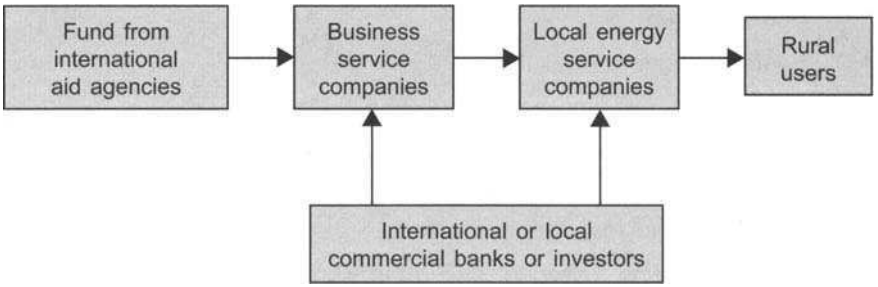
Social intermediation involves the identification (by socio-economic status and gender) of owners and beneficiaries of projects and the "community development" necessary to enable a group of people to acquire the capabilities to take on and run each individual investment project. It includes measures for enabling poor people and specifically women to obtain a voice in project identification, design and management of programmes.

3.4 Organizational intermediation

Organizational intermediation involves not only the initiation and implementation of programmes, but also lobbying for the policy change required to construct an "environment" of regulation and support in which the energy technology and the various players can thrive. This involves putting in place the necessary infrastructure and getting the incentives right to encourage owners, contractors and financiers. Organizational intermediation must include the development of regulatory support and incentive structures, which can specifically address the energy needs of the poor and women, particularly in rural areas. Organizational intermediation may be usefully distinguished from a related activity, social intermediation.

4. The market delivers: market-based models

There are very limited "success stories" for increasing energy services sustainably in rural areas using a market-based model, owing to the distributed service and limited profit of investment in this area. However, international aid agencies have developed several market-based business models to increase energy access in rural areas. Most of the market-based models' implementational flow is as follows:



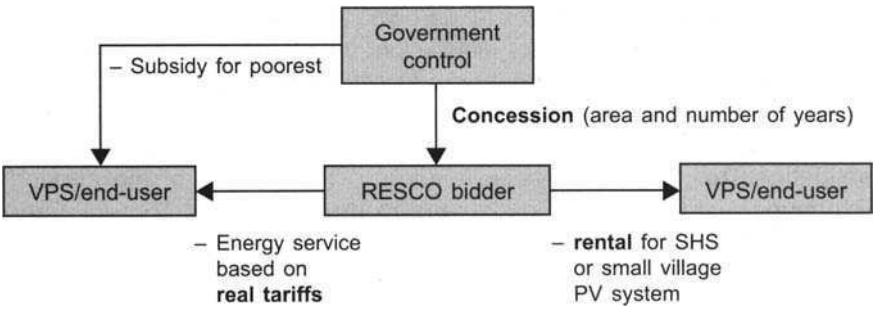
Box 5-4. E + Co model

E + Co's mission is to promote a transition to a new energy paradigm that is based on the implementation of clean, economically sound energy projects that reach rural as well as urban populations in developing countries. Energy is a key factor in economic development. Modern, clean energy services enable quality-of-life improvements, environmental protection and income-generation. Modern energy services have direct benefits (lighting, cooling, motor power) but more important is the fact that modern energy services provide indirect benefits (educational, community and income-producing activities) and induced benefits (such as the creation of enterprises to install and service energy systems and the training of local technicians). E + Co's strategy is to support viable clean energy enterprises that ensure the delivery of affordable and reliable energy services to such communities. E + Co works to demonstrate that this delivery can be market-driven and commercial. Its efforts in Africa are structured so as to apply the lessons learned through experience in providing enterprise development services and investment worth US$ 6 million to more than 50 enterprises in 25 developing countries to the markets of Africa.

Note: E + Co: Energy through enterprise, available online at www.energyhouse.com.

In the successful market-based model, the role of the business service companies that need to develop market-based ideas and get seed money from aid agencies and then attract money from commercial banks is crucial. Then a local RESCO should be set up, with the support of business service companies. In the market-based policy option, international aid funds still play an important role. E + Co (United States) is typical of a business service company in rural electrification and other rural energy services in developing countries.

Other market-based models could be the "concession approach" and "rental approach" as shown below:



A concession approach has been demonstrated in Argentina,[67] where an award will be given to the most qualified RESCO bidder to provide the energy services as a regulated monopoly in a certain area and over a certain number of years, thereby operating in a "controlled" free-market environment. The tariffs should be real, reflecting the actual costs of service, but subsidies for the electricity used could be extended to the poorest (based on household spending for lighting in the absence of electricity or on a household's willingness to pay) and then reduced over time during the concession period.

In a rental approach, as Soluz have shown in Honduras and Dominican Republic,[68] the RESCO shoulders the costs of the equipment, meaning the customer never owns the system, but they have to show their repayment capacity while paying rent on it. If the energy service agreement needs to be cancelled it can be by giving advance notice; when payment is discontinued a technician can transfer the system to another customer. The disadvantage is that this approach can generally only be used for equipment that can be easily relocated, for example for SHS and small village PV systems.

[67] The programmes are PAEPRA (1995-2000) and PERMER (2000-2005).

[68] Available online at www.soluz.net.

Some of the key emerging models are as follows:

Fee-for-service or the rental model: In the fee-for-service model, a service provider (possibly a RESCO) makes available a system to an end-user. The end-user never takes ownership of the system but signs a contract with the RESCO for installation, maintenance and repairs, and agrees to make periodic payments in return for the energy services obtained. Consumers are expected to provide some form of security, possibly a down payment, with failure to meet monthly payment obligations for energy services leading to termination of the service. Examples include Soluz Dominicana in the Dominican Republic and Shell in South Africa.

Box 5-5. Soluz model

Soluz Honduras and Soluz Dominicana, subsidiaries of Soluz, Inc., began operations in July 1998 that combined have supplied over 5,000 PV systems. Soluz Honduras's revenues are from the sale of PV equipment and services to rural customers in local currency. The company is capitalized with equity and debt financing. The company sells SHS for cash or on credit and provides electricity services on a fee-for-service base, which is becoming more and more popular.

In the Dominican Republic, Soluz is cooperating with an NGO on a rural credit programme that finances some customers in their geographical area. They also use their own capital to extend credit. However, the fee-for-service offer is now the most common choice of customers. By maintaining ownership of the PV system's assets, Soluz is able to provide them at affordable monthly rents, ranging from US$ 10 to US$ 20 per month, prices equivalent to that currently paid for kerosene, dry cell batteries and the re-charging of car batteries for television usage.

Leasing model: The leasing model involves bulk procurement of equipment by a leasing company (lessor) and marketing either through a direct lease or a lease-to-own agreement with the end-users (lessee). The lessor retains ownership of the system or gradually transfers units to the end-user. When the lease agreement expires, most programmes give the lessee the option to purchase the system. Leasing is a convenient arrangement for the end-user as the demand on liquidity is low. In addition, there is usually minimal or no down payment, except for a security deposit. This approach, however, needs higher initial capital costs since the lessor must be able to procure initial systems in bulk.

Cooperatives model: Rural electricity cooperatives are usually modelled after the rural electrification programme that existed in the

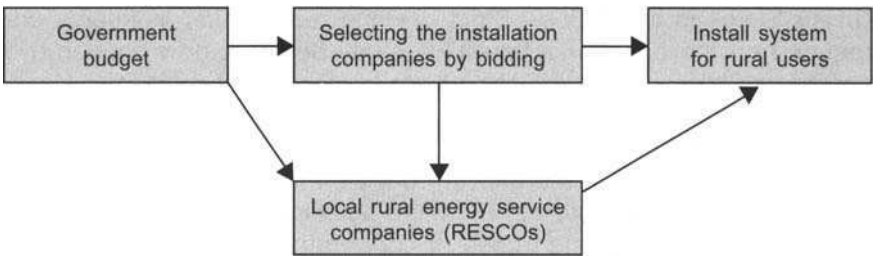
United States in the 1930s. Strict revenue requirement standards are required on the basis of a feasibility study before a new cooperative service can be approved. Subsidies are in the form of subsidized loans, used mainly for expansion of the network, and a cross-subsidy in the form of lower purchase costs from the public utility. The more that local communities are integrated into the decision-making process and the more ownership they develop, the more sustainable the project will be. The most well-documented case of cooperatives in the region is the Rural Electrification Board of Bangladesh.

5. The Government delivers: government-managed or operated models

The government-led model can take several forms. For example, for the Mexico Pronosol Programme, the Government maintains control of the programme and the private sector only participates as a vendor of goods and services and never as the owner-operator. A "bottom-up" approach was taken allowing awareness-building on renewable energy and the participation of communities, and this effort has increased the rural electrification level with over 40,000 SHS having been disseminated.

For the Chile Programa de Electrificación Rural or Rural Electrification Programme, the Government employed a subsidy approach, which was only for the initial investment and did not include operation and maintenance (O&M) costs for which tariffs were set high enough to cover these costs. The actual financing for the energy systems (decided by the lowest cost to provide electricity) was 10 per cent from users, 20 per cent to 30 per cent from a distribution company (responsible for O&M) and 60 per cent to 70 per cent subsidy from the State. Although new electricity supply was provided to more than 90,000 households, exceeding targets, most projects were on-grid extension and diesel systems for off-grid rather than renewables.

A control and command model is also found in China for financing energy services in rural areas. Even if it is the Government that controls the financial model, market elements are included in the policy options. In 2001, the Chinese Government launched a village power programme to install about 700 village power systems with central and local government financial inputs. The financial flow in the control and command model is as below:



In this model, the Government is the financial agency and the installation company and the local service company play a crucial role in supplying energy service to rural areas. However, the sustainability of this model depends very much on continued government support.

Box 5-6. Village power model in China

In 2001, in order to meet the power needs of public utilities and residents of unelectrified townships in remote, border regions of western China, the National Development and Reform Commission initiated its Township Electrification Programme (Song Dian Dao Xiang). Of the 1,065 townships included in the Programme, 688 were targeted for the construction of PV power stations, with a total installed capacity of 20 MW. Small-scale hydropower stations were planned for 377 townships, with a total installed capacity of 264 MW. Currently, nearly all the PV stations have been constructed and are now generating power; the majority of planned hydropower stations are under construction. The townships encompassed in the Programme are spread across 12 provinces (or provincial-level municipalities). The total investment for the programme is yuan 4.7 billion or approximately US$ 568 million (of which yuan 2.96 billion is provided by government bonds). The programme is divided into two phases: the first phase includes 699 projects and the second phase has 366 projects. The Programme represents the first time that the Government of China has used stand-alone renewable energy power-generation systems on a large scale to resolve the electricity needs of unelectrified areas, realizing a transition from pilots and experiments in the use of such RE systems. At the same time, the programme has, to a large extent, stimulated the rapid development of China's PV industry. The Programme's success is evidenced by the fact that China's capacity for production of PV modules has increased by 10 times in just the past 3 years.

A number of countries, mainly developed countries, have now enacted renewable energy portfolio standards (RPS) which require a minimum percentage of power sold in a given region or service territory is met by renewable energy sources. Usually proposed along with RPS

are powers trading schemes whereby retail providers may trade their "renewable energy" generation obligations among one another as long as all meet their respective standards, using "green certificates". Recently, many developing countries have been promoting or adopting RPS to enhance the utilization of renewable energy. Box 5-7 describes Thailand's plan.

Box 5-7. Renewable energy portfolio standards: Thailand

In August 2003, the Government of Thailand formulated a new renewable energy strategic plan and set an ambitious target of increasing the share of new and renewable energy from 0.5 per cent in 2002 to 8 per cent of the primary energy supply in 2011. This target accounts for 6,540 ktoe of renewable energy supply (electricity, heat and biofuel) in 2011, of which 1,060 ktoe is expected to be from power producers using renewable energy. Of this, the energy production of 764 ktoe or generation capacity of 1,840 MW is anticipated to be from new renewable power generators. According to this target, biomass is expected to play a major role in new renewable electricity generation owing to the great potential of resources and relatively lower cost of electricity generation. Electricity generation by solar energy will also play an important role owing to its large resource potential as well as to the potential domestic manufacturing capability for PV components. RPS will be a major mechanism to stimulate the production and development of the PV market in Thailand and thereby lower the cost of electricity generation by solar energy. It is expected that a total of 250 MW of new PV systems will be installed by 2011. Of this, a total of 36 MW of new solar home systems will be installed in 3,000,000 households in remote areas by 2005. Each household will receive support for the installation of a 120 W PV system.

In order to achieve the ambitious target of renewable energy development, the Ministry of Energy plans to apply such mechanisms as imposing renewable portfolio standards on new power plants as well as providing financial and tax incentives to promote the utilization of renewable energy. Currently, the Ministry of Energy is developing an action plan for renewable energy development in Thailand. To support the implementation of the renewable energy plans, the Ministry is also developing a road map for research and development of renewable energy technologies including PV technologies in Thailand. Particular support will be given to advanced research and development on technologies or the application of a combination of local wisdom and technology.

6. Mixed models: Private sector participation in government-managed initiatives

Increasingly in developing countries the task of ensuring adequate energy supplies is being left to the private sector. This is primarily the result of structural adjustment programmes, central to which are the privatization of publicly owned utilities and the elimination of costly subsidies. In the absence of carefully defined contractual relationships between the new private utilities and the State, reliance on the private sector to provide energy services to the rural poor may result in their continued neglect, since potential returns on investment in rural areas may be lower than in other areas, or non-existent. Despite this there are examples of successful commercial rural electrification: SELCO (Solar Energy Light Company), active in India, Sri Lanka and Viet Nam,[69] and Soluz are good models, using a fee-for-service approach and customer financing and leasing approaches.

Concession model: This is a variation of the rental approach with the Government identifying priority areas, followed by bidding for area concessions, and the Government awarding concessions for a specified period to a selected company, similar to a franchise. The selected company exclusively serves a specific geographic region, with an obligation to serve all who request serviced. The Government also provides subsidies and regulates the fees and operations of the concession. Users pay a connection tariff and a monthly fee (set by the Government) and a declining subsidy is provided to the concessionaires based on the provisions of their contract.

Another successful story of private participation for increasing energy service for rural areas is the Small Hydropower Programme (SHP) in China. Its development initially required a large investment in construction, but it is a cost-effective option in the long term. Some of the strategies adopted in promoting private financing for China's development of such programmes, especially in the smaller sized ones, include the following:

- **"Multi-channel, multi-level and Multi-structure" fund raising:** The Government of China has determined that local people should seek funds from individuals, cooperatives, companies and other external sources for the development of such hydropower programmes. Foreign investors are also encouraged to invest in such stations. The principle of "who invests, who owns, who

[69] Available online at www.selco-intl.com.

benefits" is aimed at allowing investors from multiple levels and areas to gain by investing in the Programme.

- **Shareholding and cooperative systems:** Since the beginning of the 1990s, most programme stations in China were developed under a shareholding system, which has become very effective in attracting funds.
- **Government grants:** All levels of government in China release several million yuan each year as grants for small hydropower development programmes. Other preferential policies, such as soft loans and rural electrification schemes further support small hydropower programme development. However, government support is decreasing in significance for funding such activities.
- **Fund-raising by local communities:** Local people are usually willing to contribute to the development of nearby small hydropower resources with the potential to provide local benefits. The Government of China has prioritized assisting and organizing the local people to establish small hydropower stations and local grids below 10 kV. Locals without funds also offer free labour for the construction of stations and grids.
- **Bank loans:** In the past 10 years, financial companies and banks have gradually become the major source of funds for small hydropower development. With the development of the market economy, the banks and other financial institutions have become more committed to the funding of such programmes. In 2001, loans from banks reached 51.9 per cent of funds.

7. Conclusion

Formulating energy policies to enhance access to energy services in rural areas needs strong institutional support to ensure efficient implementation of various programmes/projects in rural communities. In order to accelerate widening the access to energy services in rural areas, it is imperative for Governments to analyse various options that could be developed and applied to developing programmes. Depending on the needs of the rural communities, their economic activities as well as geographical conditions, elements of market-based models could be built into the programmes, which will enhance sustainability of those programmes in a cost-effective manner. Additionally, it is important that an agency, in a position to make policy recommendations, is involved in monitoring the implementation aspects of these programmes in order to further refine policies to enhance access to energy services in rural areas.

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CHAPTER 6

THE WAY FORWARD

Widening energy access for the poor is limited by the location-specific availability of primary resources from which modern energy services are derived. The forms of feasible energy supply in a given country or rural area are determined largely by the presence of corresponding primary resources. Energy by itself is capable only of beginning to transform rural poverty. In addition, several complementary inputs such as transport infrastructure, communication facilities, water supply and health and education services, are necessary to bring about more profound changes, especially the elimination of poverty. While energy is a crucial input in the development process, a word of caution should be added concerning what and how much energy can do to change the lives of rural people.

In terms of the overall approach, energy provision is less about technology and more about understanding the role that energy services play within people's lives and responding to constraints in improving livelihoods. Energy must therefore be situated within the overall development framework and considered one of the many facets affecting the livelihood opportunities of the poor, and understood in terms of how the poor value and use it. A case can be made therefore to move away from, or expand the boundaries of, the traditional paradigm of technology-driven market penetration approaches to energy towards a more development-focused approach that consciously seeks a role for energy within the overall development framework.

Even well-conceived investments in rural energy may falter when economic conditions work against them. For example, in rapidly developing regions, the provision of electricity helps to raise the productivity of agriculture and increase earnings from agriculture. However, when development efforts fail, say, because of poor crop pricing or marketing policies, then electricity supply would do little to remedy the situation; indeed, electricity or other modern fuels would not be in great demand.

At the aforementioned expert group meeting in September 2004, the experts agreed that the global development agenda, as reflected in the MDGs, would not be met unless rapid progress is made in extending efficient and affordable energy services to the 2.4 billion people who are not served.

The experts identified the following main issues pertaining to the provision of energy services for sustainable development in rural areas:

- Constraints in materializing the linkages between access to energy services and the MDGs
- Lack of coordination and cooperation within and among various ministries, agencies, institutes and other stakeholders
- Lack of specific pro-poor programmes and strategies to provide modern energy services and address gender and environment issues
- Inadequate access to finance for small-scale rural energy projects focusing on gender and sustainable livelihoods

Based on the presentations and discussions on energy services for sustainable development in rural areas, the following main options were identified and recommended with the goal of improving access to reliable energy services that are pro-poor, gender-sensitive, environment-friendly and sustainable:

Policy framework

- Situate energy within the overall development and MDG framework, integrating social, economic and environmental aspects of energy use
- Advocate energy-MDG linkages through quantitative data
- Explore a full menu of options for providing energy services to the poor, not necessarily top-of-the-line technologies
- Carry out energy planning processes in a decentralized manner, with the active participation of local stakeholders
- Develop pro-poor strategies with respect to sector reforms
- Use renewables as a means to expand affordable and sustainable energy choices for the rural poor
- Emphasize technologies addressing women-specific energy needs
- Focus on the use of energy for sustainable livelihoods, including productive uses and enterprise development
- Promote policies for sustainable fuel-wood production, conversion and utilization

Implementation mechanisms

Institutional aspects

- Promote coordinating and regulatory bodies at appropriate levels for motivating and involving relevant stakeholders, mobilizing finance and facilitating strategic partnerships
- Establish institutional mechanisms and strengthen capacity at national/subnational levels for improving the quality of the rural energy data collected
- Ensure institutional arrangements and support local stakeholders for decentralized energy planning

Stakeholder involvement

- Form strategic partnerships among the private sector, financing institutions, NGOs and other civil society organizations that represent rural communities, rural energy service companies and rural entrepreneurs, and academic and research institutions
- Encourage interaction among local stakeholders to ensure their effective participation in the energy planning process
- Ensure that local communities play a central role in developing energy plans and projects
- Factor the social preparation component into rural energy projects and programmes

Regulations, enforcement and monitoring

- Encourage off-grid electricity provision through effective regulatory measures
- Adopt/adapt, as appropriate, regulatory measures to improve the efficiency and sustainability of traditional fuel-wood production, conversion and utilization
- Enforce quality/performance standards for rural energy products and services
- Develop and incorporate poverty, environment and gender-sensitive monitoring mechanisms, linked to MDGs, for energy projects

Enabling activities

- Create an enabling environment for women to access energy services
- Ensure access to information and provide training on energy technologies and systems, including project development, financing and implementation
- Make energy services affordable for the poor (using "smart" subsidies/incentives/credit/linked with income-generating as well as expenditure-saving activities)
- Adapt and simplify technical standards for rural consumers
- Promote local R&D initiatives for developing and adapting appropriate technologies and practices, based on local knowledge and resources
- Support and encourage local entrepreneurs, particularly women

The experts suggested that ESCAP and other international organizations focus their future efforts on the following:

- Advocate the linkages access to energy and the MDGs
- Facilitate the sharing of knowledge and experiences on rural energy projects, programmes and policies
- Promote technical cooperation for capacity enhancement on policy and technology development
- Facilitate the establishment of a regional funding mechanism for small-scale rural energy projects, focusing on gender and sustainable livelihoods.

ANNEX I

The following case study, presented at the ad hoc expert group meeting, is reproduced in full as an example demonstrating the process in assessing the feasibility of various technologies in rural communities and linking it with the assessment of government policies.

CASE STUDY: FINANCING FOR RURAL ENERGY DEVELOPMENT IN NEPAL

By
Bikash Pandey
Country Representative, Winrock International Nepal

1. Background

The Government of Nepal has given high priority to alternative modalities for enhancing access to energy services in rural areas. The difficult topography of the country, lack of road access and the general poverty of rural people have led to a search for least-cost methods for incrementally improving energy access. Renewable energy technologies (RETs) such as micro-hydropower, improved water mills, solar home systems and household biogas have provided reliable and cost-effective energy services to hundreds of thousands of rural households and millions of people, with the majority of households having been supplied in the last decade or so.

RETs were first promoted by the Government in the late 1970s through the Agricultural Development Bank of Nepal (ADB/N). ADB/N provided both loans and channeled government subsidies to farmers to purchase RETs. A number of international and local NGOs supported technology development for a range of renewable energy technologies. This early support has led to the development of a vibrant RET sector comprising equipment fabricators, construction companies and suppliers of equipment. The Government of Nepal established the Alternative Energy Promotion Centre (AEPC) under the Ministry of Science and Technology in 1996 to promote a range of RETs, including biogas, micro-hydropower, solar home systems and improved cooking stoves. AEPC provides subsidy support and quality control and undertakes promotional activities. AEPC can also delegate responsibility for the

promotion and management of particular technology sectors in other independent organizations. The Rural Energy Development Programme (REDP) promotes micro-hydropower projects in 25 districts of the country. AEPC remains the apex organization for all these programmes, with day-to-day management carried out by designated independent organizations.

To date it is known that about 40 per cent of the population has access to electricity. Of this about 3 per cent is provided by solar home systems and micro-hydropower[70] and the rest from the electricity grid. Distributed RETs have also provided a number of non-electricity energy services such as cooking fuel and mechanical milling in rural areas. Table 1 demonstrates the substantial role RETs play in energy provision in rural Nepal. Up to 11 per cent of the country's population or about 13 per cent of the country's rural population has access to modern energy services. The percentage cannot be strictly added since households can in principle have more than one RET in their homes, for example the same household can be using biogas for cooking and micro-hydropower or solar home systems for lighting. In practice, it is known that around two thirds of biogas plants have been installed in areas served by the national grid. This compares quite favourably with about 30 per cent of the rural population having access to grid electricity. Distributed RETs cost substantially less than grid connections. In addition, users themselves generally invest two thirds or more of the cost of these technologies. Investment from the Government for increasing access is around one seventh the cost of grid access per household.[71] In addition, operation and maintenance costs are additional in the case of grid supply, whereas users cover these costs themselves in the case of distributed RETs. Although it can be argued that the comparison may be unfair as the quality of energy is much higher on the national grid than with RETs, it must be kept in mind that many areas of the country will not be connected to the grid in the immediate future. Further, the fact that seven times as many households can receive services with the same level of government investment is a major consideration for national Governments which have many competing demands for their scarce resources. Finally, services such

[70] Community Awareness Development Center, *Renewable Energy Data of Nepal 2003* (Kathmandu, CADEC, 2004).

[71] B. Pandey, "Renewable energy technologies – alternative energy or mainstream option for rural Nepal?" pp. 183-185. Conference Proceedings: Renewable Energy Technology for Rural Development (RETRUD-03), Institute of Engineering, Tribhuvan University.

as domestic cooking would not be affordable using grid electricity for most users, whereas these services are available through the RET, i.e., biogas.

Table 1. Coverage of RETs in rural Nepal

RET	Numbers installed	Capacity installed	Households served	Percentage of population
Micro-hydro • Electrification • Milling	1,371	7,472 kW	 77,500 30,000	 1.8 0.7
Solar PV	42,550	1,700 kW	42,550	1.0
Biogas	111,395	66,147 m^3	111,395	2.6
Micro-hydro mills	804	7,107 kW	178,000	4.1
Improved water mills	872	1,308 kW	32,700	0.8
Total				11.0

Source: Community Awareness Development Center, *Renewable Energy Data of Nepal 2003* (Kathmandu, CADEC, 2004).

Assumptions:

(a) The additional number of households that receive milling services but are not connected to the micro-hydro mini-grid is 30,000;

(b) Each rural household uses 40 W for micro-hydro milling. These mills are often powered by cross-flow turbines and directly drive milling equipment;

(c) Insignificant numbers of households are provided with electric lighting by micro-hydro mills and improved water mills.

2. Implementation mechanisms

Two major implementation mechanisms have been successful in the promotion of energy services in Nepal: market-based scaling up of RETs and social-mobilization.

This paper focuses only on the first of these mechanisms and specifically concentrates on the financing aspects.

2.1 Market-based scaling up of RETs

Market-based scaling up was first effectively demonstrated in Nepal in the Biogas Support Program (BSP). In 1992, BSP took a technology which had been promoted by a single government-supported company for over 10 years, developed strict quality control procedures and introduced competition among a number of private construction companies. Subsidies for users were provided through those construction companies that agreed to abide by quality standards. These programmatic innovations resulted in a substantial scaling up of the sector. The results have been over 130,000[72] high-quality biogas plants built to date at competitive prices, 97 per cent of which are working well and an additional 25,000 new plants are being built each year.

AEPC has taken this same formula and adapted it to two other sectors: micro-hydropower and solar home systems since 2000. The NGO Center for Rural Technology (CRT) has similarly begun to scale up the improved water mill sector using a similar approach. The question of financing is key in scaling up. Scaling up is not possible without a substantial increase in resources to the sector both as a subsidy and credit.

2.1.1 Subsidy

The justification for the Government to provide subsidies to users to purchase RETs is that they are needed to cover the difference between higher benefits to society compared with more modest private benefits accruing to users. The benefits to society that can justify subsidies are reduced deforestation and land degradation, lower levels of air pollution, reduced imports of petroleum fuel, social equity in providing modern energy services to rural people, particularly those that benefit women and children and marginalized communities. The expected benefit to global society is reduced greenhouse gas emissions. There are a number of other benefits of modern energy services for which poor people cannot immediately pay the full costs.

Governments often find it worthwhile to subsidize RETs in order to provide these benefits as well as additional benefits associated with social equity and justice. These benefits are improved indoor environment, improved quality of life, reduced illness and better educational opportunities for children. For those sectors where the social benefits to the poor and societal benefits in general are much larger than private benefits, the Government will look for ways to provide

[72] Up to July 2004.

long-term subsidies. In the case of Nepal this may include biogas (see annex I) and micro-hydropower and improved water mills (annexes II and IV). In the case of solar home systems, where the benefits are limited largely to the user household, the justification of government subsidies is to create market supply chains and networks, or to "prime the pump" as it is sometimes known. These subsidies would be phased out, after having provided the initial support, once the supply network, market mechanisms and certification processes are in place.

The provision of subsidies brings up issues related to the sustainability of initiatives and possible market distortions. An often well-founded concern is that the demand for systems will collapse when subsidies are removed. A second concern is that subsidies will be appropriated by equipment suppliers, who artificially raise the cost of systems. This has brought up the concept of so-called "smart subsidies", which are, in principle, supposed to mitigate these concerns. Although the definition of smart subsidies varies, the main characteristics of intelligently designed subsidies are as follows:

- Long-term and consistent support with a phase-out plan, where appropriate
- Transparency, manifested in clear rules
- Leveraging high-quality standards
- Effective competition and minimum market distortion

The BSP-designed long-term subsidy programme fulfils these requirements to a great extent. It is committed through 2009 with a strong probably of continuing for a longer period; has simple and clear rules; 97 per cent of working plants attest to the high quality of plants; and a reduction in 30 per cent in real prices since 1992 demonstrate that there is effective competition. The other RET sectors in Nepal are striving to implement similarly successful subsidy programmes.

Well-managed subsidy programmes have one major benefit which is not adequately acknowledged by critics of subsidies for RETs. Subsidies have proven to be an effective way to bring technology suppliers to the table and agree to abide by quality standards enforced by the central organization dispensing subsidies. This becomes particularly important in sectors such as biogas and micro-hydropower, which are constructed mainly by small local companies and for which there are no international suppliers. If biogas plants were to be available to farmers strictly via the market mechanism, without a subsidy programme or quality control, a risk would be that insufficient information would get to the farmer about the quality of products offered by different

companies. This would result in competition on the basis of price alone and suppliers cutting corners on quality. Eventually poor quality would result in a high percentage of breakdowns, lowering the attractiveness of the product, further reducing price and quality control, and eventually resulting in a collapse of demand for the systems. In contrast, solar panels and some of the other components of solar home systems are supplied by international companies with a fair degree of brand name recognition and thus are much less prone to this kind of vicious circle (lower price – lower quality – reduced demand – lower price). In addition, solar home systems have international standards such as the global approval programme for photovoltaics (PV GAP); suppliers can show that they adhere to such quality standards and demonstrate this to their clients.

The enforcement of high quality in system sales through a subsidy programme, on the other hand, generates confidence among farmers and a consequent increase in demand. It also means that the Government and donors are prepared to continue providing subsidies in the long run. This can create a positive virtuous cycle of high quality, producing greater confidence among users and credit organizations; more demand, good margins, high quality and continued donor and government support. The RET sector in Nepal has been fortunate in that it has had consistent support from the Government and a number of donors who have provided long-term support for subsides. This has resulted in relatively few market distortions. The subsidies are also decreasing over time, even in nominal terms, resulting in a decrease in the subsidy burden to donors and the Government.

2.1.2 Quality control

Subsidies in Nepal have been successful when they have been effectively used to leverage high-quality systems. Attempts have been made to replicate this BSP model among other RET sectors. Each of the technology areas is managed separately through a central quality-control organization. In most cases this is the Alternative Energy Promotion Centre of the Government of Nepal. However, it can also be a number of other organizations delegated by AEPC as listed in table 2. The national implementation organization works directly with companies which supply systems. These companies receive subsidies on behalf of the purchasers of systems. The price for the system which the customer sees is the market price minus the subsidy amount. The national implementation organization evaluates the quality of systems installed through a variety of procedures. Guidelines have been published concerning the quality of components. In the case of solar home systems, components have to be certified by the Solar Energy

Testing Station. Because of the large numbers of systems installed in remote locations, not all systems can be monitored in the field. In the case of biogas, 5 per cent of all plants installed in the last three years are physically inspected each year. In the case of solar home systems, about 10 per cent of the systems are inspected per year. Individual companies that are found to have supplied low-quality products or installed them poorly are penalized for all the systems they installed in that year in proportion to their total installations. Each company is evaluated annually in terms of its performance.

Table 2. Managers of subsidy programmes and donors, by RET sector

RET	Implementation of subsidy programme	Donors
Biogas	Biogas Support Programme	GoN, KfW, DGIS
Solar home systems	AEPC/ESAP	GoN, DANIDA
Micro-hydropower	AEPC/ESAP	GoN, DANIDA
Improved cooking stoves	Centre for Rural Technology	DANIDA
Improved water mills	Centre for Rural Technology	SNV/DGIS

Notes: GoN – Government of Nepal
KfW – Germany Kreditanstalt für Wiederaufbau Bank
DGIS – The Netherlands' Directorate General for International Cooperation
DANIDA – Danish International
SNV – Netherlands Development Organization

2.1.3 Credit

Nepal's renewable energy sector was fortunate in that it has an enlightened credit organization, the Agricultural Development Bank of Nepal (ADB/N) which was the country's first national-level promoter of RETs. In the 1970s, since no other national government body promoted RETs, ADB/N also dispensed subsidies for systems on behalf of the Government. As a result, 100 per cent of the systems which were constructed received both government subsidy and credit. With the scaling up of installations in the early 1990s, starting with the Biogas Support Programme, users could access government subsidies for RETs directly from equipment suppliers and did not need to take out a loan. While this liberated users from having to deal with the bureaucracy involved in obtaining a loan, it also resulted in a steady decline in credit-

financed systems. Today, less than 25 per cent of biogas or solar home systems are financed. The rest are bought in cash paid by the user and government subsidy. Limited access to credit means that the subsidy and tax breaks which the Government provides for RETs are not available to the poor who cannot find the cash needed to pay for the remaining cost of the system. The poor do not readily have US$ 150 to US$ 300 cash which they could pay for RET systems. However, a much larger number of them could pay this amount over a couple of years. This begs the question: if the larger banks such as ADB/N are too bureaucratic to handle small loans or too far away from rural consumers to provide credit financing for RETs, how will these consumers be able to access credit to purchase systems?

Microfinance has had substantial success in increasing access to credit for the very poor as proved by the Grameen Bank of Bangladesh. These are small loans provided to the very poor, mostly women, on the basis of group or social collateral for immediately productive activities. Loan terms are also short, ranging from a few weeks to a few months. There have also been a few good examples of microfinance organizations lending for RET systems. In the region, the two best know organizations are Grameen Shakti of Bangladesh and SEEDS in Sri Lanka.

AEPC has begun to provide funds to microfinance institutions (MFIs) including cooperatives, savings and credit groups and NGOs involved in providing credit to rural consumers to on-lend to users for the purchase of biogas plants. MFIs receive funds from AEPC at 6 per cent and can lend them to farmers at up to 16 per cent interest annually. If this scheme is successful, other RETs such as solar home systems and pico-hydropower could also be included in the programme in the future.

Winrock International, in collaboration with AEPC and BSP, trains MFIs to increase their capability to finance biogas and other RETs. Most MFIs have little knowledge of RETs. One major challenge is that MFIs believe in lending for products which are immediately productive and would generate income within a short time. Apart from some exceptions, RETs have much longer time frames to increase income. MFIs need to be trained to identify opportunities for increasing income through the use of RETs. They can also provide concurrent loans, one for income-generation and the other for an RET if the income generated can cover the repayment of both loans. Other borrowers find ways to repay loans from income from other sectors, such as agriculture and family members employed in urban areas or overseas. The experience to date is that MFIs can be convinced that RETs can present them with an attractive loan product.

As of September 2004, 79 MFIs have taken loans from AEPC to finance biogas systems. In fiscal year 2003/04, 533 biogas plants were reported to have been completed using AEPC loans. As of September 2004, AEPC had outstanding loans of NRs. 9.2 million, which were sufficient to finance an additional 736 plants. In addition to this, a number of MFIs trained by Winrock have also been financing biogas plants from their own resources.

A team representing Winrock, AEPC and BSP was formed to review the existing procedure of AEPC and make recommendations for necessary amendments. After consultation with a number of MFIs which borrow from AEPC and MFIs financing biogas from their own resources, the team made a series of recommendations. AEPC has recently amended its procedures based on these recommendations. The following are the amendments made:

Table 3. Modifications in AEPC procedures for financing MFIs

Item	Previous provision	Modification
Loan per plant	NRs. 12,500	NRs. 15,000
Loan limit under guarantee from Board of Directors	NRs. 500,000	NRs. 600,000 (as first loan) NRs. 750,000 (as second loan) NRs. 900,000 (as third loan)
Initial advance	20 per cent of the sanctioned amount	25 per cent of the sanctioned amount
Reimbursement	MFI should reimburse 50 per cent of the advance amount within a period of 3 months and 100 per cent within 6 months from date of agreement.	MFI can obtain reimbursement of the agreed amount within a period of one year from the date of agreement.

Currently, AEPC provides loans through rural-based primary MFIs to on-lend credit for farmers to install biogas plants. This provision requires AEPC to travel to the field to assess MFIs individually every time they receive a loan application from a new MFI, some of which are located in remote areas far from the AEPC office in Kathmandu. This lengthens the processing time for applications. AEPC has recently amended its procedure to allow microfinance apex bodies to receive AEPC loans to provide wholesale loans to primary MFIs. Once

implemented, this new rule would allow AEPC to provide funds to a smaller number of larger wholesale MFIs. However, this means that wholesale organizations would need to be provided funds at a rate lower than 6 per cent so that they could cover the cost of doing business. This is awaiting the required approval from the Ministry of Finance for the revision of AEPC interest rates for lending to microfinance wholesale institutions.

Allowing microfinance apex bodies to receive AEPC funds to finance biogas could significantly increase the number of MFIs providing loans for biogas plants, and therefore significantly increase the number of installed systems. Through the years, apex bodies have built up an intimate knowledge of their MFI members. Respected apex organizations, which provide wholesale financing to their members, have established strict eligibility requirements and procedures to ensure that members keep accurate records, have reputable staff and use sound savings and lending practices, and are thus more likely to repay their loans to the apex body.

Because apex bodies have already conducted thorough assessments of each of their members, they can process loan applications from members much more quickly. Once AEPC is able to provide wholesale financing through microfinance apex bodies, which they would in turn on-lend to their member MFIs, much of the MFI assessment and loan risk burden could be shifted away from AEPC, enabling it to distribute more financing for biogas plants.

2.1.4 Carbon finance

Donors in general are not able to provide support indefinitely for renewable energy programmes. Eventually if the Government is convinced that the programme needs to be supported for a longer period, it must find the funds to continue the programme itself. RETs will then have to compete for scarce government funds. Since RETs contribute to a reduction in greenhouse gases, they contribute positively to the global environment. Through the aforementioned Clean Development Mechanism, or CDM, RET promotion programmes can receive payment for the emission reduction credits (Carbon Credits) which they generate. These revenues could provide sustainable financing to continue support of RET programmes. A recently developed project design document for a CDM project of EcoSecurities and Winrock shows that, particularly in the case of household biogas plants, the emission reduction credits generated can be substantial as the table below demonstrates.

Table 4. Net greenhouse gas savings per digester (tCO_2eq/biogas plant/yr)

Size of plant	Terai (plains)	Middle Hills	Average (Terai and Hills)
4 m^3	3.17	5.75	4.46
6 m^3	7.27	8.00	7.63
8 m^3	9.33	9.94	9.63
10 m^3	7.44	7.87	7.65
Average for all sizes			7.35

Substantial revenue (about US$ 40 million) is expected to be generated by the Biogas Support Programme in the next 10 years. These funds, which would go to AEPC, would be used to fund support of BSP and, if there is surplus, other RET sectors as well. While biogas is the most attractive sector from the perspective of carbon finance, all the other sectors, namely, solar home systems, micro-hydropower and improved water mills, could also make attractive CDM projects which could substitute for donor financing for RETs in the long run.

3. Conclusions

Financing mechanisms are key to scaling up access to renewable energy technologies. Nepal's experience shows that subsidies are essential for scaling up renewable energy technologies, at least in the beginning. Subsidies have to be designed intelligently if they are to avoid distorting the market for RETs. They must leave behind a mechanism for strong quality standards.

Credit is another equally important mechanism for increasing access to RETs among the poor. As RETs require small amounts of loans for rural inhabitants, MFIs can be suitable for providing credit for RETs. However, the capacity of MFIs has to be enhanced before they can provide loans for a large number of RETs. MFIs must also be convinced that RETs are a viable loan product for their borrowers. Carbon finance shows promise for generating substantial revenue for RET promotion programmes in the future. Increasingly, a combination of credit and carbon finance is going to be the way towards sustainable financing for supplying energy services to rural populations.

Appendix A

Biogas Support Programme

In 1992, the Governments of Germany, Nepal and the Netherlands established the Nepal Biogas Support Programme (BSP) to promote the installation of high-quality biogas plants in Nepal. So far more than 130,000 plants have been installed through this programme. Today, there are 40 companies that construct, market, install and provide guarantees for the biodigesters. BSP provides extensive quality-control services for the biogas programme. Each year BSP's quality control officers randomly visit 5 per cent of the plants constructed that year and each of the previous two years to monitor plant quality and durability and the quality of operation and maintenance training provided to users.

According to BSP practice, biogas construction companies are responsible for free maintenance and after-sales services for three years. Biogas companies also provide a three-year guarantee on plants. BSP provides operation and maintenance training to all users to enable them to carry out day-to-day maintenance and minor repair jobs by themselves. After a one-day training course, users are able to operate the plant. BSP's policy of regular quality control and supervision of newly constructed plants as well as after-sales service of plants ensures the quality of plants and services. In addition, BSP assigns staff to make routine visits to biogas plants for maintenance once a year whether there is a problem or not.

Summary of the technical aspect of biogas

Some important technical aspects of biogas for MFI consideration have been summarized below.

Table A-1. Important technical aspects of biogas

Technical reliability	First introduced in 1976, it has since become a very promising technology. BSP has set specific standards for the plant. The GGC 2047 standard model has been prescribed. 130,000 plants have been installed; 97.5 per cent of the plants installed so far are functional Expected life of the system is over 20 years
Availability of system components	All necessary components are manufactured in Nepal. The system is installed under the supervision of trained technical staff
Warranty	Suppliers provide three-year warranty from the date of construction for the complete system
Availability of reliable service	BSP and manufacturing companies will provide repair services upon request
Managerial considerations	
Operational simplicity	Any person who has undergone short orientation training can operate the system
Maintenance requirement	The system does not require much maintenance, but the rubber hosepipes and O-ring must be replaced every few years, and the stove burner and water drain must be cleaned regularly. Also it is recommended that a check for gas leaks be made on a regular basis
Availability of training to system user	System supplier provides training to the user on proper care of the system
Availability of spare parts in the country	All parts available through manufacturers

Figure A1. Biogas chamber

Applications

Biogas can be used for household as well as industrial purposes. To date in Nepal, biogas is used mainly for cooking (80 per cent) and lighting (20 per cent) purposes. Other possible uses of biogas include refrigeration, engine operation and electricity generation.

The by-product of biogas plants is called *slurry* and has high fertilizer value. The fertilizer can be utilized for crop and vegetable production as well as for feeding fish.

Feedstock

Cattle dung is the primary feedstock for biogas production. Although it is also possible to connect toilets with biogas plants, human excreta produces only minimal amounts of gas. The required amount of dung and water per of plant is presented in the table below:

Table A-2. Required feedstock according to size of plant

Plant size (m^3)	Dung (kg/day)	Water (litres/day)	Approx. number of cattle required
4	24	24	2-3
6	36	36	3-4
8	48	48	4-6
10	60	60	6-9

Life expectancy/repair and maintenance

Nepali biogas plants are of a high quality and generally last more than 20 years without major problems apart from minor repair and maintenance. As with other technologies, the life expectancy of biogas plants also depends on regular maintenance and the feedstock used.

Economics

The cost of a biogas plant can range from NRs 19,000 to 30,000, depending on system size and location. The following table illustrates the average cost of a biogas plant, government subsidy and the amount of loan needed.

Table A-3. Total cost of an average biogas plant

Size (m^3)	Location	Average cost (NRs)	Minimum government subsidy (NRs)	Borrower's contribution (NRs)	Loan amount required (with subsidy) (NRs)
4	Terai	18,824	5,500	3,765	9,559
4	Hills	19,592	8,500	3,918	7,174
6	Terai	21,319	5,500	4,264	11,555
6	Hills	22,093	8,500	4,419	9,174
8	Terai	25,093	5,000	5,019	15,074
8	Hills	26,224	8,000	5,245	12,979
10	Terai	28,209	5,000	5,642	17,567
10	Hills	29,479	8,000	5,896	15,583

The actual cost of a plant may vary depending on the construction site and availability of local construction materials. The loan needed for a biogas plant ranges from NRs 7,174 to 17,567 with subsidy.

The Government provides a subsidy for the purchase of biogas plants.[73] Biogas subsidy rates (applicable for the year 2003/04) were as follows:

Table A-4. Biogas subsidy rates for 2003/04

Capacity (m^3)	Remote hills (NRs)	Hills (NRs)	Terai (NRs)
4	11,500	8,500	5,500
6	11,500	8,500	5,500
8	11,000	8,000	5,000
10	11,000	8,000	5,000

[73] The Government does not provide subsidies to institutional plants where there is no permanent family residence and no ownership for operation and maintenance. Similarly, only households that use biogas for cooking purposes are eligible for the subsidy.

The Government plans to decrease the amount of subsidy yearly, eventually removing the subsidy altogether once the market for biogas is sufficiently robust.

Although a biogas system itself does not generate direct income, its benefits can be valued in economic terms. Annual benefits gained from a typical household biogas plant are presented in the following table:

Table A-5. Annual economic benefits from a typical household biogas plant

Benefits indicators	Benefits in quantitative terms (per year per plant)
Time savings (firewood collection, cooking, etc.)	1,000 hours
Fuel-wood savings	4 tons/yr
Agricultural residues savings	0.76 tons
Reduction of carbon dioxide emissions	7.35 tons
Fertilizer	5 tons

Benefits

Some benefits of biogas technology can be summarized as follows:

Gender benefits: Biogas provides a direct benefit, especially, to rural women, as a result of the reduction of their workload with the shift from cooking with fuel-wood to doing so with biogas. It can save up to three hours a day per family, mainly due to the reduction in time spent in collecting fuel-wood, cooking and cleaning utensils.

Environmental benefits: Biogas reduces the pressure on forests, alleviating deforestation. One biogas plant saves about 2.3 tons of fuel-wood per year, which amounts to roughly 0.03 hectares of forest land per year. Thus, the more than 130,000 biogas plants in Nepal are estimated to have saved approximately 3,300 hectares of forest annually. Similarly, studies indicate that one plant produces approximately 10 tons of biocompost per year. About 90 per cent of the current owners of biogas plants use biofertilizer for crop and vegetable production. Biofertilizer, if treated and applied properly, can have a high fertilizer value, improve soil structure and contribute to maintaining the level of organic matter in the soil. Another environmental benefit of biogas is the reduction of almost 7.34 tons of CO_2 per year per plant. Thus, the

130,000 plants constructed in Nepal mitigate more than 500,000 tons of CO_2 annually. If these carbon credits are traded on the international market, they could generate a value of approximately US$ 2 million annually.

Health benefits: A big problem for rural people, especially women and children, is indoor air pollution and smoke exposure inside the kitchen while cooking. Poor indoor air quality is one of the major causes of acute respiratory infections among rural women and children. Biogas reduces exposure to smoke and significantly lessens air pollution inside the kitchen, ultimately improving health, including reduced eye infections, respiratory diseases, coughs and headaches. In addition, more than 70 per cent of the purchasers of biodigesters chose to construct sanitary latrines simultaneously, leading to significantly improved sanitary conditions in these homes.

Economic benefits: Biogas reduces fuel expenses for cooking and, to some extent for lighting purposes. The high-quality biofertilizer contributes to higher crop and vegetables yields, which eventually helps to generate additional income. It is found that if the slurry is properly composted, the quality as well as quantity of organic fertilizer will be increased. The yield rate from proper slurry utilization was found to be 30 per cent more than from farmyard manure. The slurry is also very useful as fish food. Research carried out by BSP in Chitwan indicated that the use of slurry for feeding fish produced fish at almost double the average national growth rate.

Limitations

Biogas plants in Nepal are operated primarily with cattle dung as feedstock. The system requires daily charging with dung; hence, the borrower needs to maintain an adequate number of livestock. To provide sufficient cattle dung, at least two heads of cattle are required per house. Households that do not possess any cattle will not be able to benefit from this technology. Similarly, biodigester installation requires adequate space on the user's land near the house. If a user does not have adequate land on which to install the plant, he or she will not be able to take advantage of the technology. Furthermore, the capacity and location of the plant cannot be changed once installed.

Biogas plants need an adequate water supply to add to the cow dung. Households that do not have a water source nearby may find it difficult to mix the correct ratio of cow dung to water.

The biogas process requires a certain temperature for fermentation. Because of this, biogas technology is not feasible in areas where there are very low temperatures or at a high altitude.

Appendix B

Micro-hydropower

Introduction

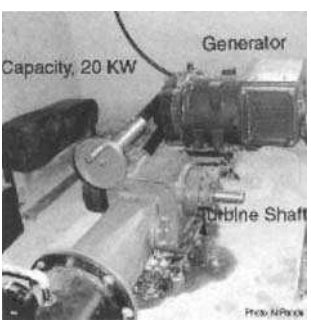
Nepal has a long history of tapping its hydro potential, as illustrated by water wheels (*ghattas*) used traditionally to convert kinetic energy from flowing water into mechanical power for grinding, husking and other uses. An estimated 25,000 such units are currently in operation in Nepal, meeting the agro-processing energy needs of villages in hilly and mountainous regions around the country.

In spite of widespread streams and rivers with fairly high power potential, the majority of citizens in rural Nepal still live without power for light, communication and industries. The establishment of small civil construction near streams can enable production of small amounts of locally manageable power at relatively low cost.

Technology

Hydropower involves the generation of energy from water. When water at a height is allowed to fall down through suitable conveyances (for example, a penstock), the potential energy associated with water at height is converted into kinetic energy (velocity) of running water. The velocity and associated mass of the water possess momentum (mass times velocity). When the momentum is allowed to strike an object, for examples the blades of a rotating body such as a turbine, it will impart energy to that rotating system. This imparted energy has the capacity to do work and is utilized mechanically (typically in water mills) to generate electricity.

Figure B-1. Hydropower unit



Pico hydro or peltric sets: A peltric set is a small vertical-shaft Pelton turbine with a generator that is coaxially coupled, and is capable of generating electricity from a small quantity of water in the range of a few watts to 3 kW. This range of power generation is also called *pico* hydropower. Because Nepal has many small rivers and perennial waters falls, this is an appropriate technology for rural electrification in many

hilly and mountainous areas. The hill and mountain population is highly scattered and their per capita demand for electrification is relatively low; thus, this technology, in its simplicity and flexible power output, is ideal for rural electrification. Currently, a large number of such units are in operation and there is a huge demand for more units. There are numerous manufacturers catering to this need and the future of this technology is very promising.

Micro-hydro: According to UNIDO standards, a hydroelectric plant with a capacity of up to 100 kW is categorized as *micro* hydropower. In Nepal larger systems are categorized as mini (100 kW to 1 MW), small (1 to 10 MW) and large (above 10 MW).

To date, there are 371 micro-hydropower plants installed in Nepal, representing 5.07 MW of installed power; 875 peltric sets contribute an additional 1.47 MW of installed power.

Some important technical aspects of pica/micro-hydropower (P/MHP) systems for the consideration are presented below.

Table B-1. Some important technical aspects of P/MHP for the consideration

Technical reliability	875 peltric and 371 P/MHP have been installed in 61 districts; expected life of the system is over 15 years
Availability of system components	All major components of P/MHP systems are manufactured in Nepal except the generator
Warranty	Generally, 1 year from the date of system implementation
Availability of reliable service	Good service resources available in Nepal
Managerial considerations	
Operational simplicity	A literate person with simple training in operation and maintenance can operate the system.
Maintenance requirements	The system needs regular care and maintenance, for example, lubricating and cleaning
Availability of training and the plant owner	During the installation period, the system installer provides on-the-job training in system operation and maintenance to the operators/technicians of the power plant
Availability of spare parts in the country	System suppliers maintain spare parts
Availability of repair and maintenance service	System suppliers/service centres provide such services upon request

Life expectancy/repair and maintenance

The functional life of a micro-hydropower plant is considered to be 15 years. However, a lot depends on how the plant is maintained. Civil structures usually last for a long time, if they are not subject to natural calamities such as floods and earthquakes. The life of electro-mechanical components depend on the quality of the products installed and on how they are maintained. Regular preventive maintenance generally increases the life of the equipment.

Applications

The electricity generated from P/MHP can be used for lighting, cooking, heating, agro-processing, entertainment, communication, lift irrigation, or any other electrical application. In some areas of Nepal, especially in the Annapurna area, it is also used for low-wattage cooking. Hydropower also has the potential for domestic water heating and space heating applications, but no such applications have been reported in Nepal yet.

Figure B-2. End uses of P/MHP

Economics

The size and location of a hydropower system largely determines its cost. The following table presents the average cost of a P/MHP hydro plant, the government subsidy provided and the loan amount required.

Table B-2. Total cost of a P/MHP hydro plant

Type	Average cost (NRs per kW) (NRs)	Minimum government subsidy (NRs)	Borrower's contribution (NRs)	Loan amount Needed without subsidy (NRs)	Loan amount needed with subsidy (NRs)
Micro-hydro	150,000	70,000	30,000	120,000	50,000
Peltric set	100,000	55,000	20,000	80,000	25,000

Table B-3. Micro-hydro subsidy rates for 2003-2004

Capacity/type	Subsidy per kW (NRs)
Up to 3 kW peltric system	55,000 per kW
3 to 100 kW micro system	700,000 per kW

The Government also provides a separate subsidy for the transport of hydropower construction materials. The subsidy for transportation of equipment for P/MHP systems (applicable for fiscal year 2003-2004) was as follows:

Table B-4. Government subsidy for transportation of hydro construction materials

Distance (days of walking)	Subsidy (NRs)
Less than 2 days	No subsidy
2 to 5 days	8,750 per kW
More than 5 days	21,000 per kW

Annual economic benefits from a typical community micro-hydro plant are presented in the following table. These are typical figures for a plant in Humla, one of Nepal's remote, hilly districts. However, keeping in mind that micro-hydropower plants are very site-specific, these figures should be taken only as indicative of the benefits that are realized.

Table B-5. Savings from P/MHP

Most of the energy used for:	Lighting
No. of houses considered	100
No. of lanterns/bulb required per household	4
Wattage equivalent @ 25 W per lantern/bulb	4 x 25 = 100 W
District considered	Humla
Monthly kerosene requirement per family	4 litres
Price of kerosene (at the depot)	NRs 24 per litre
Transportation cost of kerosene	NRs 30 per litre
Other expenses (handling and storage)	NRs 9 per litre
Total cost	NRs 63 per litre
Total village demand	400 litres per month
Total village appliance (e.g., lantern) cost	4 x NRs 80 x 100 = 32,000
Appliance life	5 years
Total village accessories required/yr	NRs 60 x 100 = 6,000
Total system cost at today's value for 15 yrs	NRs (400 x 12 x 15 x 63) + (32,000 x 15/5) + (6,000 x 15) = 4,722,000
Micro-hydro (According to current practice)	
Village demand	10 kW
Rates per kW	Max. NRs 150,000
Transportation of construction materials (per kW)	Max. NRs 27,000
Total revenue at NRs 1/w/month (will meet all running and repair maintenance cost)	NRs (100 x 100 x 12 x 15) = 1,800,000
Total system cost at today's value for 15 yrs	NRs (177,000 x 10) + 1,800,000 = 3,570,000
Net savings when P/MHP is preferred over kerosene	NRs 1,296,000

Cost and savings of MHP system

Box B-1. Costs

Capacity of the system	2 kW
Total cost of the system	NRs 300,000
Subsidy	NRs 110,000
Borrowers' contribution	NRs 60,000 (20 per cent of the total cost)
Loan	NRs 130,000
Loan without subsidy	NRs 240,000
Number of households to benefit	20
Number of electric lamps in each household	4

Box B-2. Savings

Cost of kerosene for 3 kerosene-fed lamps burning for 3 to 4 hours each day	NRs 12
Monthly cost of kerosene = NRs 360. Savings in kerosene each year	NRs 4,320
Monthly cost of dry cell battery for use in listening radio	NRs 20
Savings from dry cell battery each year	NRs 240
Annual savings from kerosene and battery	NRs 4,560
Annual savings from 20 households	NRs 91,200
Unlike in other cases, households have to pay a monthly tariff for electricity used. Generally one has to pay about NRs 2 per Watt per month. Hence the total annual tariff to be paid by 20 households is approx. (2,000 W x NRs 2/W/month x 12 months)	NRs 48, 000
Effective savings (91,200-48,000)	**NRs 43,200**

It is assumed that regular revenue generated by the system will cover the operation and maintenance cost of the system.

Benefits

One of the main benefits of P/MHP is that it can provide relatively reliable and affordable bulk power that can be used for any application requiring electricity. Other benefits include the following.

Environmental benefits: Pico and micro-hydropower projects do not require massive construction and hence do not disturb the local

ecology. Minimal tree cutting occurs during grid extension. P/MHP conserves trees by reducing the pressure on wood for lighting and heating and partially for cooking.

Social benefits: Relative to large hydro projects, P/MHP systems are much less invasive on the local surroundings, and do not require the relocation of large populations living near the source of the water.

Cultural benefits: Pico and micro-hydropower is generated at the local level where it is needed. Hence, local people have a better chance of accessing the energy.

Benefits of decentralized power: Appropriate utilization of P/MHP supports the Government's decentralization policy. It can generate local employment, business activities and end-use facilities as well as support the local economy. This is expected also to reduce people's tendency to migrate because of a lack of facilities and income-generating activities.

Limitations

High initial cost: The main barrier to the establishment of P/MHP systems is the high initial costs. Even though the cost of energy produced over time is low per unit, its initial cost is NRs 100,000-150,000 per kW, a huge investment for the rural poor. However, this can be addressed through innovative financing mechanisms. Further, owing to Nepal's hilly and mountainous topography and lack of regional infrastructure, transportation of the equipment needed to construct P/MHP systems is costly in remote areas.

Potential of frequent interrupted supply and high down time: Frequently interrupted supply due to technical problems is common. There are many elements in the system; some are stationary and some rotating, some simple to understand and some more complex. This gives rise to problems for the operator to regulate the system smoothly if he or she is not trained properly. This may cause frequent interruptions in power generation and a lot of down time in the system. Lack of technical and managerial skills for operation and maintenance among the rural population is another problem.

Site specific/seasonal: Hydropower generation depends on water head and discharge available at that place, which limits its generation to some specific sites.

Bureaucratic: Communities must have written approval from the District Development Committee/Village Development Committee prior to installation of P/MHP systems.

Appendix C

Solar home systems

Introduction

Energy from the sun can be categorized as direct or indirect based on utilization. The direct forms of energy that can be harnessed are thermal and photovoltaic. Solar photovoltaic, or simply solar PV, is a form of renewable energy technology in which radiation (light) from the sun is directly converted into usable electrical energy by means of a device called a solar PV module.

Solar electricity has become a prominent market product. By the end of 2002, the total installed capacity of solar PV worldwide exceeded the 2,000 MW benchmark, with a total business volume of about US$ 2 billion. As of July 2003, 42,550 solar home systems with a total capacity of 1,585 kWp had been installed in Nepal.

Life expectancy/repair and maintenance

The life expectancy of a typical solar PV panel is over 20 years, with relatively little maintenance required. Most suppliers provide a 10-year warranty for PV panels, and a 2-year warranty for batteries. Depending on the type of battery used, the battery must be replaced every 3 to 5 years.

Applications

The electricity generated from a solar PV system can be used to meet most electrical needs, depending on the size of the system and size of the electrical load. The following are some examples of common uses of solar PV in Nepal.

Solar home system

A solar home system is a relatively small solar PV system used for household lighting purposes. A typical SHS in Nepal generally consists of a 20 to 50 W PV module, a suitable storage battery (12 V, 40-75 Ah), a charge regulator, three to five 7-11 W light bulbs, and the necessary wiring accessories. A typical 40-W PV system will easily operate two 10-watt light bulbs and a 14-inch black and white television for 6 hours a day, given the right insulation. More than 25,000 house-holds are already using SHSs in Nepal and the demand is growing rapidly.

Table C-1. Some important technical aspects of solar PV

Technical reliability	First introduced in Nepal in 1993, since then it has become a very promising technology in rural electrification. Over 25,000 households have been electrified. Expected life of the PV system is over 20 years.
Availability of system components	Except for the solar module and storage battery, all other major components of SHS are manufactured in Nepal. Spare parts are available in Nepal
Warranty	Suppliers provide a 10-year warranty for PV modules, and a 2-year warranty for other components
Availability of reliable suppliers	Many service /system suppliers are available in Nepal
Managerial considerations	
Operational simplicity	Any person who has completed a short orientation training course can operate the system
Maintenance requirements	The system requires relatively little maintenance. Maintenance includes regularly adding distilled water to the battery, cleaning the module surface, and replacing the battery every 3 to 5 years, depending on the type of battery used. The prevailing market price for a deep cycle battery is approximately NRs 4,500.
Availability of training for system users	System supplier provides training to the user on proper care of the system
Availability of spare parts in the country	System suppliers maintain spare parts
Availability of repair and maintenance service	System suppliers provide such service upon request

Economics

The cost of a complete solar PV system depends upon the size of the system (the capacity of the solar module and other components used in the system). One of the major factors limiting massive deployment of solar PV systems is the high initial investment cost. Between 1995 and 2004, the cost of PV power plunged from US$ 1,785/Watt to around US$ 5/Watt (uninstalled), but this is still a relatively high amount for low-income populations.

The cost of a complete 30 to 40 W SHS currently is about NRs 25,000 to 30,000. The majority of the cost (about 60 per cent) is for the

module and battery. In April 2004, the prevailing market price for a deep-cycle battery was approximately NRs 4,500. The remaining 40 per cent covers the charge regulator, lamps, wiring accessories and installation. The cost of larger systems is dictated by the array capacity required.

In systems with heavy loads, an additional cost is incurred from the load itself. For example, in the case of water-pumping systems, the cost of the array, pumps and pipe systems must be added. Therefore, rigorous economic analysis has to be done for larger systems in order to compare the cost of solar PV with other options such as diesel or kerosene generators.

The following table illustrates the average cost of a PV-powered solar home system, government subsidy and the loan amount needed.

Table C-2. Total cost of a PV SHS

Size	Cost range (NRs)	Average cost (NRs)	Minimum government subsidy (NRs)	Borrower's contribution (20 per cent of total cost) (NRs)	Loan amount needed (without subsidy) (NRs)	Loan amount needed (with subsidy) (NRs)
10 W	11,000-13,000	12,000	6,000	2,400	9,600	3,600
20 W	19,000-25,000	22,000	8,000	4,400	17,600	9,600
30 W	19,000-26,000	22,500	6,400	4,500	18,000	11,600
35-40 W	24,000-34,000	29,000	6,400	5,800	23,200	16,800
50 W	28,000 -45,000	36,500	6,400	7,300	29,200	22,800
75 W	49,000-60,000	54,500	6,400	10,900	43,600	37,200
100 W	68,000	68,000	6,400	13,600	54,400	48,000

The loan amount needed for a SHS ranges from NRs 3,600 to NRs 22,800 with government subsidy, and NRs 9,600 to NRs 29,200 without. These required loan amounts fall within MFIs' upper ceiling (NRs 30,000) for allowable loan amounts. However, solar PV systems of 75 W and higher require loan amounts exceeding NRs 30,000. Some MFIs in the country have financed larger PV systems, either by

increasing the borrower's contribution or by other innovative means to address the loan limit.

As the initial investment cost of a sizeable solar PV system is often prohibitively high, the Government of Nepal has been subsidizing SHSs since 1995. This subsidy was originally channeled through the Agricultural Development Bank of Nepal (ADB/N) and set at 50 per cent of the total system cost. Realizing the need for a separate entity to be responsible for policy formulation and promotion of renewable energy technologies in Nepal, the Government established the Alternative Energy Promotion Center (AEPC) in 1996. AEPC started managing the PV subsidy (and other RE subsidies) in 1999.

In October 2000, the Government announced a new renewable energy subsidy policy, making separate provisions for SHSs, institutional solar PV systems and PV-powered water pumps. Those wishing to obtain subsidies must submit an application to the Interim Renewable Energy Fund (IREF) jointly managed by AEPC and the Energy Sector Assistance Programme (ESAP), a Danish-supported programme, through the solar electric system manufacturer/supplier.

Subject to the approval of the subsidy request, the supplier installs the SHS and gets the subsidy amount refunded once the application is cleared by IREF. The subsidy is available for the installation of solar PV systems for home systems as well as water-pumping applications. For home lighting systems, the amount of the government subsidy is currently NRs 12,000, 10,000 and 6,400 (or up to 50 per cent of the system cost) for very remote, remote and non-remote areas, respectively, for a system of 10 Watts or higher. Drinking water systems can be subsidized up to 75 per cent of the total system cost. PV subsidies for fiscal year 2003-2004 were as follows:

Table C-3. SHS subsidy for 2003-2004

Capacity	Very remote hill districts	Remote hill districts	Accessible hill districts
Less than 10 watts	No subsidy	No subsidy	No subsidy
30 watts or more	NRs 12,000	NRs 10,000	NRs 6,400

Notes: Subsidy for PV (SHS) less than 30 watts is 50 per cent of the cost or NRs 8,000, whichever is less; a subsidy of 75 per cent of system cost is available on PV systems installed by social service institutions; and subsidies for solar PV are not available in areas covered by grid supply.

Benefits

One of the main benefits of solar PV is that it can provide relatively reliable and affordable power that can be used for any application requiring electricity. Other benefits include the following:

Wide availability of solar resources: Sunshine is available, and free, almost anywhere in the world. Solar PV-powered electricity can be produced anywhere this resource exists, opening access to electricity for remote locations without access to other resources.

High quality: If installed properly, solar PV provides extremely high quality, reliable electricity, often of much higher quality than that provided by many national grids.

Modularity: PV panels are modular and can be transported and installed easily. System size can be rapidly upgraded or down-sized by removing or adding cells, and PV-powered energy can be brought on- or off-line in a matter of minutes.

Environmentally sound and relatively safe: Solar PV provides a clean, quiet, environmentally friendly source of electricity that emits no harmful emissions. PV-powered lighting can replace kerosene lanterns, reducing indoor air pollution and risk of fire.

Relatively low maintenance and easy to operate: Solar PV requires relatively little maintenance and is very easy to operate.

Limitations

High initial investment cost: Though the price for solar PV panels continues to decrease, it remains prohibitively high for much of the rural poor population.

Batteries require regular replacement: Lead-acid batteries must be replaced every 2 to 3 years, and deep-cycle batteries every 4 to 5 years. This increases the cost of PV systems, and also necessitates that environmentally sound disposal systems be put in place.

Limited capacity: While significant advances have been made in PV technology, the efficiency of solar PV technologies is still limited (currently PV systems are not more than 10 to 15 per cent efficient). Thus, in order to attain high electrical output, several panels must be used, covering a large surface area and raising the price of the system.

Subject to resource availability: PV output is dependent on the availability of the solar resource. Output is limited or non-existent on cloudy and rainy days, and at nighttime.

Appendix D

Improved water mills

An estimated 25,000 traditional water mills are currently in operation in Nepal, meeting the agro processing energy needs of villages in hilly and mountains regions around the country. Improved water mills not only help to increase income levels but help local customers with efficient and diversified end-use services such as rice-hulling and oil-expelling.

The Centre for Rural Technology (CRT) is a non-governmental organization engaged in upgrading traditional technologies as well as developing new appropriate technologies to meet diversified needs of the rural poor. CRT has been assisting traditional water mill (ghatta) owners in the hilly regions of Nepal for a decade so that they could improve their mills. CRT provides quality-control services for improved water mills. The Government, with SNV support, has been implementing the national Improved Water Mill Support Programme with CRT as the leading implementing agency.

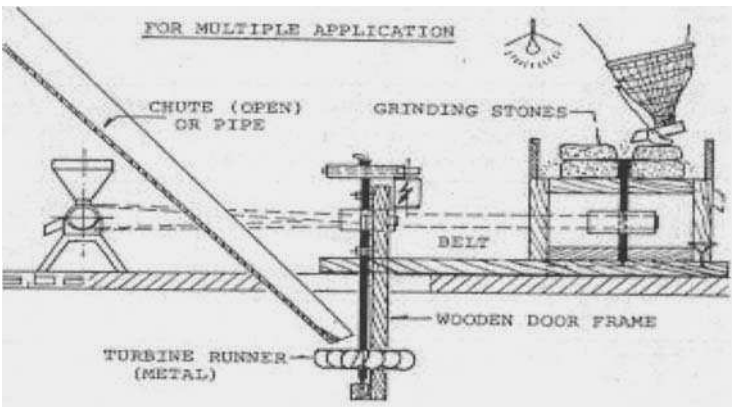
Figure D-1. Ghatta house (water mill)

Source: CRT website.

Technology

The improved water mill is a modified version of a traditional water mill. By replacing the wooden runner with a better designed metal runner, the operational efficiency of an improved water mill can be increased. Apart from this, the addition of a metal shaft and pulley allows for a range of other applications, such as rice-hulling, oil-expelling, and electricity generation, in addition to the traditional grinding. IWM is attractive for MFIs to provide loans since it produces income and is not used for domestic purposes alone.

Figure D-2. Structural diagram of an improved water mill



Source: CRT website.

Life expectancy/repair and maintenance

The functional life of an improved water mill is considered to be 10 years. Maintenance requirements are minimal and can easily be managed by the local miller. The CRT provides a three-day operational training course for the operators/system owners to enable them to operate the system easily. (A list of CRT recognized IWM appliances manufacturers is available from CRT).

Some important technical aspects of improved water mills for MFI consideration are summarized below.

Table D-1. Some important technical aspects of water mills for MFI consideration

Technical reliability	832 IWMs have already been installed. Expected life of the system is over 10 years
Availability of system components	All major components of IWMs are manufactured in Nepal
Warranty	Generally 1 year from the date of installation
Availability of reliable service	CRT-recognized service centres provide reliable repair and maintenance services
Managerial considerations	
Operational simplicity	A literate person with simple training can operate the system
Maintenance requirements	Maintenance requirement is minimal
Availability of training for the plant owner	During the installation period, CRT provides a 3-day training course in system operation and maintenance to the operators/owners of the IWM
Availability of spare parts in the country	System suppliers keep stocks of spare parts
Availability of repair and maintenance services	System suppliers/ service centres provide such service upon request

Applications

The mechanical power generated by the improved water mill can be used directly for grinding grain, hulling rice, generating electricity and even for pumping water.

Figure D-3. Improved grain grinder

Source: CRT website.

Economics

The Government provides a subsidy for IWM systems. The subsidy available for IWM projects (applicable for fiscal year 2003-2004) is as follows:

Table D-2. Government subsidy for IWM

Type	Government subsidy (NRs)
Grinding	10,000
Grinding and other end-use service	20,000

The cost of IWM depends upon the location and capacity. The following table presents the average cost of an IWM, the government subsidy provided and the loan amount required.

Table D-3. Total cost of an IWM

Type	Average cost (NRs)	Government subsidy (NRs)	Borrower's contribution (NRs)	Loan amount needed (without subsidy) (NRs)	Loan amount needed (with subsidy (NRs)
Grinding	18,149	10,000	3,630	14,519	4,519
Grinding and hulling	44,934	20,000	8,987	35,947	15,947

The loan needed for an IWM plant ranges from NRs 4,519 to 15,947 with government subsidy and NRs 14,519 to 35,947 without. The loan needed with subsidy falls within the microfinance limit. The maximum loan needed for an IWM without subsidy exceeds the Nepali microcredit limit. In such cases, it might be better to encourage a higher contribution from the owner.

Grinding

Cost/benefit analysis of a grinding system

Table D-4. Annual operational cost

Particulars	NRs
Miller's salary (12 months at NRs 1,500/month)	18,000
Repair and maintenance (10 per cent of the total cost)	1,849
Depreciation (20 per cent of the mechanical components)	3,629
Total	23,478

Table D-5. Annual income

Type of grain	Processing duration		Total processing (hours)	Processing capacity (kg/hr)	Total processing (kg)	Processing charge (NRs/kg)	Income (NRs)
	Hours/day	Days/yr					
Maize	7	270	1,890	30	56,700	0.5	28,350
Wheat	2	120	240	35	84,00	0.5	4,200
Millet	1	90	90	50	4,500	0.5	2,250
Total							34,800

Net Income NRs 34,800-23,478	NRs 11,322
Net income from a traditional mill	NRs 1,725
Increase in income	NRs 9,597
50 per cent of increase in income	NRs 4,798.50

Grinding and hulling

Cost and savings of a grinding and hulling system

Table D-6. Annual operational cost

Particulars	NRs
Miller's salary (12 months at NRs 2,500/month)	30,000
Repair and maintenance (10 per cent of the total cost)	4,493
Depreciation (20 per cent of the mechanical components)	5,897
Total	40,390

Table D-7. Annual income

Type of grain	Processing duration		Total processing (hours)	Processing capacity (kg/hr)	Total processing (kg)	Processing charge (NRs/kg)	Income (NRs)
	Hours/day	Days/yr					
Maize	6	270	1,620	35	56,700	0.5	28,350
Wheat	1	120	120	40	4,800	0.5	2,400
Millet	1	90	90	50	4,500	0.5	2,250
Paddy	2	270	540	80	43,200	0.75	32,400
Total							65,400

Net Income NRs 65,400-40,390	NRs 25,010
Net income from traditional mill	NRs 1,725
Increase in income	NRs 23,285
50 per cent of increase in income	NRs 11,642.50

The cost of the grinding system is NRs 44,934. MFIs typically ask owners to contribute 20 per cent of the total cost. Hence, the owners must produce NRs 8,987 as their contribution to procure a system. The total loan amount needed will be NRs 15,947 (with government subsidy). With an annual interest rate of 16 per cent, the borrower would be able to pay back a loan of NRs 15,947 out of additional income alone in slightly over one year.

Table D-8. IWM (grinding + hulling) loan repayment

Payback period (years)	Monthly installment (NRs)	Monthly savings (NRs)	Balance required from other sources (NRs)
2	781	970	0
1	1,447	970	477

The table above clearly illustrates that the loan amount for the system can be recovered from the additional income in slightly over one year.

The subsidy provided by the Government has a significant effect on the cost, and therefore the payback period of a NRs 35,947 IWM (grinding + hulling system) loan without subsidy will be slightly over four years.

Benefits

Increased income of the system owner: Processing capacity of an improved water mill has been found to be nearly double that of a traditional one. Increased efficiency of the system results in increased income for the owner.

Reduced waiting time for the customers: Owing to the increased processing capacity of the improved mill, the waiting time for the costumers is reduced significantly.

Multiple uses: In addition to the grinding services offered as in the case of a traditional water mill, improved water mills can provide a range of services such as paddy-hulling and rural electrification.

Limitations

Susceptible to water levels: The flow of water has a significant effect on the technology. While low water levels lead to inadequate processing, excess water can damage system parts.

Site-specific: Once constructed, the mills cannot be relocated elsewhere.

ANNEX II

China's Renewable Energy Law

Contents

Chapter 1. General

Article 1 In order to promote the development and utilization of renewable energy, improve the energy structure, diversify energy supplies, safeguard energy security, protect the environment and realize sustainable development of the economy and society, this Law is hereby prepared.

Article 2 Renewable energy in this law refers to non-fossil energy of wind energy, solar energy, water energy, biomass energy, geothermal energy and ocean energy among others.

Application of this Law in hydropower shall be regulated by the energy authorities of the State Council and approved by the State Council.

This Law does not apply to the direct burning of straw, firewood and dejecta, etc., on low-efficiency stoves.

Article 3 This Law applies to territory and other sea area of China.

Article 4 The Government lists the development of utilization of renewable energy as the preferential area for energy development and promotes the construction and development of the renewable energy market by establishing total volume for the development of renewable energy and taking corresponding measures.

The Government encourages economic entities of all ownership forms to participate in the development and utilization of renewable energy and protects the legal rights and interests of the developers and users of renewable energy on the basis of law.

Article 5 Energy authorities of the State Council implement management measures for the development and utilization of renewable energy at the national level. Relevant departments of the State Council are responsible for the management of relevant development and utilization of renewable energy within their authority.

Energy authorities of local people's governments above the county level are responsible for the management of the development and utilization of renewable energy within their own jurisdiction. Relevant departments of local people's governments above the county level are responsible for the management of relevant development and utilization of renewable energy within their authorities.

Chapter 2. Resource survey and development plan

Article 6 Energy authorities of the State Council are responsible for organizing and coordinating national surveys and the management of renewable energy resources and work with related departments to establish technical regulations for resource surveys.

Relevant departments of the State Council, within their respective authority, are responsible for related renewable energy resource surveys. The survey results will be summarized by the energy authorities in the State Council.

The result of the survey of renewable energy shall be released to the public, with the exception of confidential contents as stipulated by the Government.

Article 7 Energy authorities of the State Council sets middle and long-term targets of the total volume for the development and utilization of renewable energy at the national level, which shall be implemented and released to the pubic after being approved by the State Council.

Energy authorities of the State Council shall, on the basis of the target of total volume in the previous paragraph, as well as the economic development and actual situation of renewable energy resources of all provinces, autonomous regions and municipalities, cooperate with people's governments of provinces, autonomous regions and municipalities in establishing middle and long-term targets and release them to the public.

Article 8 Energy authorities of the State Council shall, on the basis of the middle and long-term total volume targets of renewable energy throughout the country, prepare national renewable energy development and utilization plans, which are to be implemented after being approved by the State Council.

Energy authorities of the people's governments at the level of province, autonomous region and municipality shall, on the basis of the middle and long-term targets for the development and utilization of renewable energy, cooperate with relevant authorities of the people's governments at their own level in preparing national renewable energy development and utilization plans for their own administrative regions, which shall be implemented after being approved by people's governments at their own level.

The approved plans shall be released to the public, with the exception of any confidential content as stipulated by the government.

If an approved plan needs to be modified, approval of the original approving authorities shall be obtained.

Article 9 In preparing the plan for the development and utilization of renewable energy, opinions of relevant units, experts and the public shall be solicited and the scientific reasoning shall be done.

Chapter 3. Industry guidance and technology support

Article 10 Energy authorities in the State Council shall, in accordance with the national renewable energy development plan, prepare and promulgate development guidance catalogs for renewable energy industries.

Article 11 Standardization authorities of the State Council shall set and publicize technical standards for renewable energy electric power and the technical standards for relevant renewable technology and products for which technical requirements need to be standardized at the national level.

For those technical requirements not dealt with in the national standard in the previous paragraph, relevant authorities of the State Council may establish a relevant industrial standard, which shall be reported to the standardization authorities of the State Council for filing.

Article 12 The Government lists scientific and technical research in the development and utilization of, and the industrialized development of, renewable energy, as the preferential area for "hi-tech" development and "hi-tech" industrial development in the national programme, and allocates funding for the scientific and technical research, application demonstration and industrialized development of the development and utilization of renewable energy so as to promote technical advancement in the development and utilization of renewable energy, reduce the production cost of renewable energy products and improve the quality of products.

Education authorities of the State Council shall incorporate the knowledge and technology on renewable energy into general and occupational education curricula.

Chapter 4. Promotion and application

Article 13 The Government encourages and supports various types of grid-connected renewable power generation.

For the construction of renewable energy power generation projects, administrative permits shall be obtained or filing shall be made in accordance with the law and regulations of the State Council.

In the construction of renewable power-generation projects, if there is more than one applicant for project licence, the licencee shall be determined through a tender.

Article 14 Grid enterprises shall enter into a grid connection agreement with renewable power-generation enterprises that have legally obtained administrative licence or for which filing has been made, and buy the grid-connected power produced with renewable energy within the coverage of their power grid, and provide grid-connection service for the generation of power with renewable energy.

Article 15 The Government supports the construction of independent renewable power systems in areas not covered by the power grid to provide power service for local production and living.

Article 16 The Government encourages clean and efficient development and utilization of biological fuel and encourages the development of energy crops.

If the gas and heat produced with biological resources conform to urban fuel gas pipeline networks and heat pipeline networks, enterprises operating gas pipeline networks and heat pipeline networks shall accept them into the networks.

The Government encourages the production and utilization of biological liquid fuel. Gas-selling enterprises shall, on the basis of the regulations of energy authorities of the State Council or people's government at the provincial level, include biological liquid fuel conforming to the national standard into its fuel-selling system.

Article 17 The Government encourages workplaces and individuals in the installation and use of solar energy utilization systems of solar energy water-heating system, solar energy heating and cooling system and solar photovoltaic system etc.

Construction authorities of the State Council shall cooperate with relevant authorities of the State Council in establishing technical economic policies and technical standards with regard to the combination of solar energy utilization system and construction.

Real estate development enterprises shall, on the basis of the technical standards in the previous paragraph, provide necessary conditions for the utilization of solar energy in the design and construction of buildings.

For buildings already built, residents may, on the condition that its quality and safety is not affected, install a solar energy utilization system that conforms to technical standards and product standards, if agreement has been otherwise reached between relevant parties.

Article 18 The Government encourages and supports the development and utilization of renewable energy in rural areas.

Energy authorities of local people's governments above the county level shall, on the basis of local economic and social development, ecological protection and health need etc., prepare a renewable energy development plan for the rural area and promote biomass energy, such as marsh gas, conversion, household solar energy, small-scale wind energy and small-scale hydraulic energy.

The people's government above the county level shall provide financial support for the renewable energy utilization projects in the rural areas.

Chapter 5. Price management and fee sharing

Article 19 Grid power price of renewable energy power-generation projects shall be determined by the price authorities of the State Council based on the principle of being beneficial to the development and utilization of renewable energy and being economical and reasonable, where timely adjustment shall be made on the basis of the development of technology for the development and utilization of renewable energy. The price for grid-connected power shall be publicized.

For the price of grid-connected power of renewable power-generation projects determined through tender as stipulated in paragraph 3 of Article 13 hereof, the bid-winning price shall be implemented; however, such a price shall not exceed the level of grid-connected power of similar renewable power generation projects.

Article 20 The excess between the expenses that power grid enterprises purchase renewable power on the basis of the price determined in Article 19 hereof and the expenses incurred in the purchase of average power price generated with conventional energy shall be shared in the selling price. Price authorities of the State Council shall prepare specific methods.

Article 21 Grid connection expenses paid by grid enterprises for the purchase of renewable power and other reasonable expenses may be included within the grid enterprise power transmission cost and retrieved from the selling price.

Article 22 For the selling price of power generated from independent renewable energy power system invested or subsidized by the Government, a classified selling price of the same area shall be adopted, and the excess between its reasonable operation, management expenses and the selling price shall be shared on the basis of the method as specified in Article 20 hereof.

Article 23 The price of renewable heat and natural gas that enters the urban pipeline shall be determined on the basis of price management authorities based on the principle of being beneficial to the development and utilization of renewable energy and being economical and reasonable.

Chapter 6. Economic incentives and supervisory measures

Article 24 The government budget establishes a renewable energy development fund to support the following:

1. Scientific and technological research, standard establishment and pilot project for the development and utilization of renewable energy;
2. Construction of renewable energy projects for domestic use in rural and pasture areas;
3. Construction of independent renewable power systems in remote areas and islands;
4. Surveys, assessments of renewable energy resources, and the construction of relevant information systems;
5. Localized production of the equipment for the development and utilization of renewable energy.

Article 25 Financial institutions may offer preferential loans with financial interest subsidy to renewable energy development and utilization projects that are listed in the national renewable energy industrial development guidance catalogue and conform to the conditions for granting loans.

Article 26 The Government grants tax benefits to projects listed in the renewable energy industrial development guidance catalogue, and specific methods are to be prepared by the State Council.

Article 27 Power enterprises shall authentically and completely record and store relevant materials on renewable energy power-generation, and shall accept the inspection and supervision of power supervisory institutions. Power supervisory institutions shall do the inspection in accordance with stipulated procedures, and shall keep commercial secrets and other secrets for inspected units.

Chapter 7. Legal responsibilities

Article 28 If the energy authorities of the State Council and the people's governments above the county level as well as other relevant authorities breach this Law and have one of the following, the people's government of their own level or relevant authorities of the superior people's governments may order them to make correction, and impose administrative penalties for competent personnel that are liable and other personnel directly liable; in case that such breaches constitute a crime, criminal liabilities shall be legally pursued.

1. Failure to make administrative licensing decisions in accordance with the law;
2. Failure to make an investigation when illegal activities are dicovered;
3. Other acts of not legally performing supervision and management responsibilities.

Article 29 If the power grid enterprises breach Article 14 hereof and fail to purchase renewable power in full, which results in economic loss to the renewable power-generation enterprises, such power grid enterprises shall be liable for compensation, and the national power supervisory institutions shall order them to make a correction within a stipulated period of time; in cases of refusal to make a correction, a fine of less than one times the economic loss of the renewable power-generation enterprises shall be imposed.

Article 30 In cases when enterprises related to natural gas pipeline networks and heat pipeline networks breach paragraph 2 of Article 16 hereof and do not permit the connection of natural gas and heat that conform to the grid connection technical standard in the network, which results in economic loss to gas and heat production enterprises, relevant enterprises shall be liable for compensation, and the energy authorities of the people's government at the provincial level shall order them to make correction within a stipulated period of time; in case of a refusal to make a correction, a fine of less than one times the said economic loss shall be imposed against them.

Article 31 If gas-selling enterprises breach paragraph 3 of Article 16 hereof and fail to include biological liquid fuel that conforms to the national standard into its fuel-selling system, which results in economic loss to the biological liquid fuel production enterprises, relevant enterprises shall be liable for compensation, and energy authorities of the State Council or people's government at the provincial level shall order them to make a correction within a stipulated period of time; in cases of a refusal to make a correction, a fine of less than one times the said economic loss shall be imposed against them.

Chapter 8. Miscellaneous

Article 32 Terms used herein shall have the following meanings:

Biomass energy: means energy converted from natural plants, rejecta as well as urban and rural organic waste.

Renewable energy independent power system: means independent renewable power system not connected to the power grid.

Energy crop: means herbage and wood plants specially planted and used as raw materials for producing energy.

Biological liquid fuels: means methanol, ethanol, biodiesel and other liquid fuels derived from biomass resources.

Article 33 This Law shall become effective on 1 January 2006.