TOWARDS AN 'ENERGY PLUS' APPROACH FOR THE POOR

A review of good practices and lessons learned from Asia and the Pacific

Empowered lives. Resilient nations.

United Nations Development Programme

ENVIRONMENT AND ENERGY

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"UNDP partners with people at all levels of society to help build nations that can withstand crisis, and drive and sustain the kind of growth that improves the quality of life for everyone. On the ground in 177 countries and territories, we offer global perspective and local insight to help empower lives and build resilient nations."

Cover photos courtesy of UNDP/Energy Access for Poverty Reduction

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Abbreviations and acronyms

ACCESS	Accelerating Community Electricity Services using Solar (Project)
AEPC	Alternative Energy Promotion Centre
AGECC	Advisory Group on Energy and Climate Change
APRC	Asia-Pacific Regional Centre
BSP	Biogas Support Programme
CBO	community-based organization
CDM	Clean Development Mechanism
CRE	Commercialization of Renewable Energy (Project)
CREIA	Chinese Renewable Energy Industries Association
DGIS	Directorate General For International Cooperation of The Netherlands
DoE	Department of Energy (the Philippines)
DPBURC	Development and Promotion of Biogas Utilization in Rural China (Project)
ECS	Electricity Consumer Society
ERPA	Emission Reduction Purchase Agreement
ESD	Energy Services Delivery (Project)
EUR	Euro (currency)
FJD	Fijian dollar (currency)
FREP	Fiji Rural Electrification Programme
GEF	Global Environment Facility
GHG	greenhouse gas
GIZ	German Agency for International Cooperation
GOA	Ghatta Owners Association
GTZ	German Agency for Technical Cooperation
IDA	International Development Association
IEA	International Energy Agency
INR	Indian rupee (currency)
IWM	Improved Water Mill Programme
kgoe	kilograms of oil equivalent
kW	kilowatt
kWh	kilowatt hour
LAK	Lao kip (currency)
LED	light emitting diode
LKR	Sri Lankan rupee (currency)

LPG	liquefied petroleum gas
MW	megawatt
MoA	Ministry of Agriculture
MFI	microfinance institution
MDG	Millennium Development Goal
NGO	non-governmental organization
NPR	Nepalese rupee (currency)
PHP	Philippine peso (currency)
PREDP	Participatory Rural Energy Development Programme
REDP	Rural Energy Development Programme
RE	renewable energy
RERED	Renewable Energy for Rural Economic Development (Project)
RET	renewable energy technology
RGGVY	Rajiv Gandhi Grameen Vidyutikaran Yojana
SEEDS	Sarvodaya Economic Enterprise Development Services
SHS	solar home system
SLRS	solar lantern rental system
SNV	Netherlands Development Organisation
SPV	solar photovoltaic
SSMP	Sustainable Solar Market Package
SWH	solar water heater
TIDE	Technology Informatics Design Endeavour
TRC	Technical Review Committee
TTF	Thematic Trust Fund
UNFCCC	United Nations Framework Convention on Climate Change
UNDP	United Nations Development Programme
USD	United States dollar (currency)
VANREPA	Vanuatu Renewable Energy and Power Association
VHP	Village Hydro Project
WSCG	Women's Savings and Credit Group

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Preface

> Energy plays a central role in addressing two of the world's great challenges: fighting poverty and addressing climate change. Smart energy policies have the potential to fight poverty and address climate change simultaneously (Helen Clark, 2010).

Energy poverty inhibits economic and human development. Lack of access to reliable, affordable and sustainable energy services contributes to a self-perpetuating cycle of poverty and problems of health, hygiene, gender inequity and environmental degradation.

Currently, almost 800 million people in Asia-Pacific have no access to electricity and almost 2 billion rely on the traditional use of biomass for cooking. Lack of access to modern energy means using polluting kerosene lamps for illumination, cooking with inferior fuels and suffering lengthy exposure to harmful smoke and fumes and, in most cases, ending the productive day at sundown. Lack of affordable and efficient energy services presents a barrier to the most basic development.

Asia-Pacific countries have applied many cutting-edge practices in providing energy access to the poor, including innovative financing mechanisms. Apart from satisfying basic needs, energy services can act as an instrument to empower women and disadvantaged communities; as an entry point to mobilize communities to take charge of their own development; and, most importantly, as a means to livelihood enhancement and poverty reduction. However, the scale of expansion of energy access projects has been far from sufficient.

Between 2009 and 2011, the UNDP Asia-Pacific Regional Centre led a collaborative review of 17 energy access programmes and projects implemented by governments, development agencies and the private sector in Asia-Pacific. By examining complex issues surrounding energy access, the review contributes to the on-going discussion on universal access to energy, and suggests pathways towards achieving it. The review collates knowledge of policies and practices in dissemination of low-emissions technologies, financing, market development, entrepreneurship, institutional strengthening and policy development that can be converged to make energy services affordable for the poor. This report provides practical guidance for policymakers and development practitioners on energy access. Together with a Policy Guidance Note and 17 case studies (published concurrently), it comprises a package of good practices and lessons learned in expanding energy access.

The review shows that projects and programmes which combine the delivery of energy services with income-generating measures – for example, business development and information support, access to capital and market linkages – have the greatest potential for poverty reduction and economic and human development. The review hence seeks to pave the way for a transition to this 'Energy Plus' approach.

Nicholas Rosellini
Deputy Assistant Administrator and
Deputy Regional Director
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Executive summary

This report documents good practices and lessons learned in addressing energy poverty and expanding energy services for the poor.[1] It draws from the experiences of 17 energy access programmes and projects in the Asia-Pacific region.

The 'Energy Plus' approach

The 17 reviewed energy access programmes and projects have brought improvements to the quality of lives of communities in terms of energy cost savings, health, education, communication, access to information and women's empowerment, thus contributing to the achievement of the Millennium Development Goals. In addition, initiatives that promote low-emission technologies contribute to the global climate change agenda.

The impact of energy access projects on livelihoods and incomes is less visible. This is because most energy access projects adopt a 'minimalist' approach, focusing on the basic energy needs of the poor (lighting homes, cooking, heating). While the importance of these cannot be overemphasized, such a strategy is not sufficient for effective poverty reduction. On the other hand, projects that complement energy service provision with measures that raise incomes and improve livelihoods – e.g. improving access to information, market linkages, business development services and access to capital – show tremendous promise in poverty reduction and economic and human development. Such 'Energy Plus' initiatives, however, are few in number and are yet to be scaled up in terms of the number of people reached.

The report highlights that breaking through the energy-poverty cycle is best achieved by combining the delivery of energy services with measures that generate cash incomes. This 'Energy Plus' approach has the greatest potential for reducing poverty and achieving the Millennium Development Goals.

The report identifies good practices and lessons learned for making a transition to this approach, in areas of energy service delivery, financing and mainstreaming.[2] These are summarized below.

Good practices in energy service delivery

- Ensure that the energy solution is 'right'. The product/service should be extensively tested to ensure that it is sufficiently robust and that it effectively addresses consumer needs, preferences and affordability.
- Involve communities in project processes by:
  - aligning the project within the prevailing local governance framework;
  - ensuring that project goals and objectives emphasize women; and
  - ensuring that the reporting of project results and monitoring data are disaggregated by gender.
- Create commercially viable markets for energy products and services by:
  - clustering dispersed markets;
  - building on existing supply chains and distribution channels;
  - establishing strict quality control measures;
  - building awareness of consumers including women; and
  - strengthening the capacity of entrepreneurs and supporting their growth.
- Monitor projects and systematically track their impacts. The projects' monitoring and evaluation systems need to incorporate indicators and measureable targets to capture the benefits achieved.

1 In the context of this review, 'energy poverty' refers to a situation where 'access to clean, reliable and affordable energy services for cooking and heating, lighting, communications and productive uses' is not established (IEA, UNDP and UNIDO, 2010).

2 'Mainstreaming' is defined here as the process of incorporating the components or sub-components of a project into the national or local development priorities (UNDP, 2009c).

Good practices in project and end-user financing

- Government policies and projects on expanding energy access and promoting renewable energy must be supported by allocations in the national budget.
- A combination of appropriate financing options (for example, subsidies, end-user financing and micro-credit) should be made available to consumers.
- Microfinancing options should be made accessible since they are instrumental in scaling up energy access for the poor.
- Income-generating activities (such as development of local entrepreneurship, access to business finance and establishment of market linkages) should be built into programme/project design in order to maximize poverty reduction.

Good practices in mainstreaming energy access within national development strategies

- Develop a long-term, well-articulated national policy on energy access and renewable energy, inclusive of sectoral and sub-national strategies. Such a policy must be situated within the overall government policy framework of development and poverty reduction.
- Develop capacities of all key stakeholders, including project implementing agencies, technology suppliers, service providers, financial institutions, civil society organizations and final consumers (including women).
- Engage with stakeholders at all levels to ensure a broad base for information dissemination, to ensure support for projects and to achieve national consensus on the importance of energy access (thus encouraging its integration into government development programmes).
- Establish and strengthen lead energy institutions. A strong national energy institution can ensure that good practices and lessons learned in individual projects get translated into sector-wide strategies and policies.

The way forward: an institutional partnership framework for expansion

An appropriate institutional partnership framework for expansion ensures that the respective stakeholders pursue the good practices identified above:

- Governments should provide an enabling policy environment and regulatory framework, including a commitment to effective public-private partnerships, and facilitate private sector participation in the manufacture, sale and service of quality energy products at scale.
- Development partners should co-finance 'common goods' such as product development; market development; capacity development; policy dialogue and advocacy; and provision of risk underwriting to innovative pilot initiatives.
- The private sector is responsible for the provision of appropriate, high-quality products and services.
- Community-based organizations and non-governmental organizations (NGOs) should lead community mobilization, consumer awareness and information dissemination.
- Financial institutions should provide low-interest loans and micro-credit to the private sector and end-users.

1 Introduction

UNDP/Energy Access for Poverty Reduction/ACCESS – the Philippines

Children gathered around a solar lantern. Project: Accelerating Community Electricity Services using Solar (ACCESS) – the Philippines.

- The number of poor who lack access to modern energy is staggering. Worldwide, 2.7 billion people (almost 2 billion in Asia-Pacific) rely on the traditional use of biomass for cooking, and 1.4 billion (almost 800 million in Asia-Pacific) do not have access to electricity.
- Reaching the poor is difficult. Rural areas, where affordability presents a major issue, remain the most deprived: globally, 85 percent of the people who lack access to electricity live in rural areas.
- Government efforts to expand energy access have focused heavily on electricity. Provision of clean cooking facilities (clean cooking fuels and stoves, advanced biomass cookstoves and biogas plants) has received relatively less attention.
- Energy poverty has distinct gender characteristics, and has a disproportionate effect on women and girls.
- Pursuing energy access in the face of climate change impacts presents an additional challenge.

1. Introduction

Access to modern energy services ('energy access') is essential to economic and human development.[3] Lack of energy access ('energy poverty') and its impact on health, education and income continue to be a significant cause of chronic poverty in developing countries. Since poverty, in turn, inhibits access to essential energy services, a vicious cycle develops. While many energy access programmes and projects have been implemented in developing countries, most have experienced limited success in expanding energy services to large numbers of poor people.

This report presents a synoptic review of 17 energy access programmes and projects in Asia-Pacific, undertaken by UNDP Asia-Pacific Regional Centre (APRC) in 2009-2011 (henceforth, 'the Review'). The Review aims to achieve a better understanding of what has helped poor communities and households gain access to modern energy services and what governments and development partners can do to further expand these efforts. This report targets energy project practitioners, national governments and development partners. The report is accompanied by a series of 17 case studies and a Policy Guidance Note.

The structure of the report is provided below.

Introduction. Chapter 1 presents an overview of energy access issues and challenges in the Asia-Pacific region and introduces the Review (including its conceptual framework, the process followed and a brief overview of the projects reviewed).

Project impacts. Chapter 2 reviews the impacts of the reviewed programmes and projects in terms of the achievement of Millennium Development Goals (MDGs) and the number of people reached.

Towards an 'Energy Plus' approach. Chapter 3 proposes a conceptual framework, based on the lessons emerging from the Review, for designing and implementing more effective energy access programmes and projects.

Good practices and lessons learned. Chapters 4-6 detail good practices and lessons learned in strengthening energy service delivery, project and end-user financing, and mainstreaming energy access into national development strategies.

Key messages. Chapter 7 summarizes the Review findings, and identifies strategies and areas for future action in expanding access to energy services.

1.1 The development context: energy services for the poor

1.1.1 Achievements in expanding energy access

In the last several decades, many developing countries have expanded electricity and clean cooking fuels to many people, both in absolute and relative terms. For example, in 2008 electrification rates in China and the Socialist Republic of Viet Nam reached 99 percent and 95 percent of households respectively.[4] In the Federative Republic of Brazil, the proportion of the population using modern cooking fuels increased from 16 percent in 1960 to virtually all of the population by 2004, while the national electricity grid was extended to more than 95 percent of the population.[5] In the Pacific, the Republic of the Fiji islands increased rural access to electricity from 30.6 percent in 1986 to 81.4 percent in 2007.

3 'Modern energy services' are defined as including (a) electricity; (b) modern fuels to meet cooking needs (electricity, liquid fuels including LPG, natural gas, kerosene, ethanol and biofuels, but excluding traditional biomass such as firewood, charcoal, dung, crop residues and coal); and (c) mechanical power for productive, non-industrial applications such as water pumping and small-scale agro-processing (UNDP, 2009b).

4 IEA, 2009; IEA, UNDP and UNIDO, 2010.

5 REN 21, 2010.

Table 1: Number of people lacking access to electricity and relying on traditional use of biomass, 2009

	No. of people lacking access to electricity (millions)	No. of people relying on the traditional use of biomass for cooking (millions)
Africa	587	657
Sub-Saharan Africa	585	653
Developing Asia	799	1,937
China	8	423
India	404	855
Other Asia	387	659
Latin America	31	85
Developing countries*	1,438	2,679
World**	1,441	2,679

Source: IEA, UNDP and UNIDO, 2010.

* Includes Middle East countries

** Includes OECD and transition economies

However, nearly half of the world's population still lacks reliable access to modern energy services. Roughly 2.7 billion people (40 percent of the world's population) depend on the traditional use of biomass[6] for cooking and 1.4 billion remain without access to electricity; 85 percent of these people live in rural areas.[7] In Asia-Pacific, almost 2 billion people are dependent on the traditional use of biomass and almost 800 million have no access to electricity (see Table 1).

Electrification, particularly grid-based electrification, continues to dominate the expansion of energy services in terms of both investment and number of people reached. About half of the developing countries have established electricity access targets at the national, rural and/or urban levels.

Cooking energy, on the other hand, has received relatively less attention, with just a few developing countries setting targets for access to modern cooking fuels or improved cookstoves, or targets for reducing the share of the population relying on traditional biomass.[8] There has been some recent interest in improved cooking stoves, but the impacts of these initiatives are yet to be seen.[9]

6 'Traditional use of biomass' refers to the use of basic technology such as a three-stone fire or other inefficient cookstove, and not to the resource itself (IEA, UNDP and UNIDO, 2010).

7 IEA, UNDP and UNIDO, 2010.

8 IEA, UNDP and UNIDO, 2010.

9 In 2009, the Government of India launched the National Biomass Cookstoves Initiative to develop cleaner, next-generation biomass cookstoves and deploy them in all Indian households that currently use traditional cookstoves (Venkataraman et al., 2010). In September 2010, a public-private partnership Global Alliance for Clean Cookstoves was launched; its '100 by 20' goal calls for 100 million homes to adopt clean and efficient stoves and fuels by 2020. For further information, see Global Alliance for Clean Cookstoves (2010).

1.1.2 Future prospects

By 2030, it is expected that 1.2 billion people globally will remain without electricity, most of them in sub-Saharan Africa and South Asia.[10] Moreover, the number of people using biomass (wood, crop residues and animal waste) as their main cooking and heating fuels is actually expected to grow and then stabilize at around 2.8 billion. In Asia-Pacific, the number of people using biomass is likely to decrease from the current 1.937 billion to 1.769 billion.[11] Global energy needs are estimated to grow by more than 50 percent, with developing countries contributing to nearly three quarters of this increase.[12] To meet the target of achieving universal access to modern energy services by 2030[13], investments of USD 756 billion (or USD 36 billion per year) is needed.[14]

1.1.3 Persistent challenges in expanding energy access

Focus on grid electrification. Most government efforts in the Asia-Pacific region have focused on the extension of electricity grids.[15] Grid extension plays an important role in energy access, particularly in peri-urban and rural areas with high population densities, where it is the least-cost option. However, this approach often leaves many people without access to power, particularly in remote rural areas far from grid lines. Even when grid lines extend close to un-electrified communities, many families cannot afford connection costs, unless they are heavily subsidized. Furthermore, the unsuitability of electricity for cooking and heating in developing countries (particularly in rural areas) means that this approach does not address the energy need which most affects people's lives, in particular those of women and girls.[16]

For rural areas with low population densities and/or in remote locations, decentralized renewable energy technologies (RETs) are the most suitable and environmentally friendly alternatives. However, most RETs are still not sufficiently competitive and hence continue to rely on various forms of incentives. In 2008, renewable energy options accounted for only 19 percent of global electricity generation, a very small fraction of which goes towards expanding energy access for the poor.[17] The AGECC contends that achieving universal access by 2030 will need the combination of both centralized and decentralized energy technologies and systems for electricity provision.[18]

Difficulty in reaching the poor. Modern energy services are not universally accessible. Electricity and fossil fuels rely on capital-intensive distribution networks (transmission and distribution grids or pipelines, and transport by road or rail) to deliver centrally produced supplies to rural areas. Suppliers of energy often find it difficult, time-consuming and expensive to develop distribution channels to reach rural markets. In the Pacific Island countries, residents live in scattered habitations over a large number of islands, making national electric grids impracticable; people in the Solomon Islands, for example, are spread across more than 300 islands, while in Kiribati 80,000 people live on 33 widely scattered, low atolls.[19]

Strategies yet to address the affordability issue. Rural poor live in subsistence economies that do not generate cash surpluses, limiting their purchasing power and the opportunity to shift to modern energy services. Most rural poor also find it difficult to obtain the credit necessary to pay high up-front costs for energy services. The cost of capital itself is high; and because income cycles are agriculture dependent and thus irregular, adherence to regular repayment schedules is challenging. Government and donor energy strategies for the poor continue to focus mostly on their basic energy needs,[20] and are yet to pay adequate attention to raising incomes and livelihoods, which could potentially increase affordability of energy services.[21]

10 IEA, UNDP and UNIDO, 2010.

11 IEA, UNDP and UNIDO, 2010.

12 IEA, 2007.

13 In 2010, the Advisory Group on Energy and Climate Change (AGECC), a committee set up by the UN Secretary General Ban Ki-moon, proposed a goal to achieve universal access to modern energy services by 2030.

14 IEA, UNDP and UNIDO, 2010.

15 Elsayed, 2009.

16 Modi et al. (2005) estimate that poor households need approximately 10 kilograms of oil equivalent (kgoe) of energy per capita for electricity annually, and four times this amount (40 kgoe) for cooking. The poorest families typically dedicate 80 percent of total household energy expenditure to fuels for cooking and heating, and only 20 percent for fuels and batteries to produce light.

17 IEA, 2010.

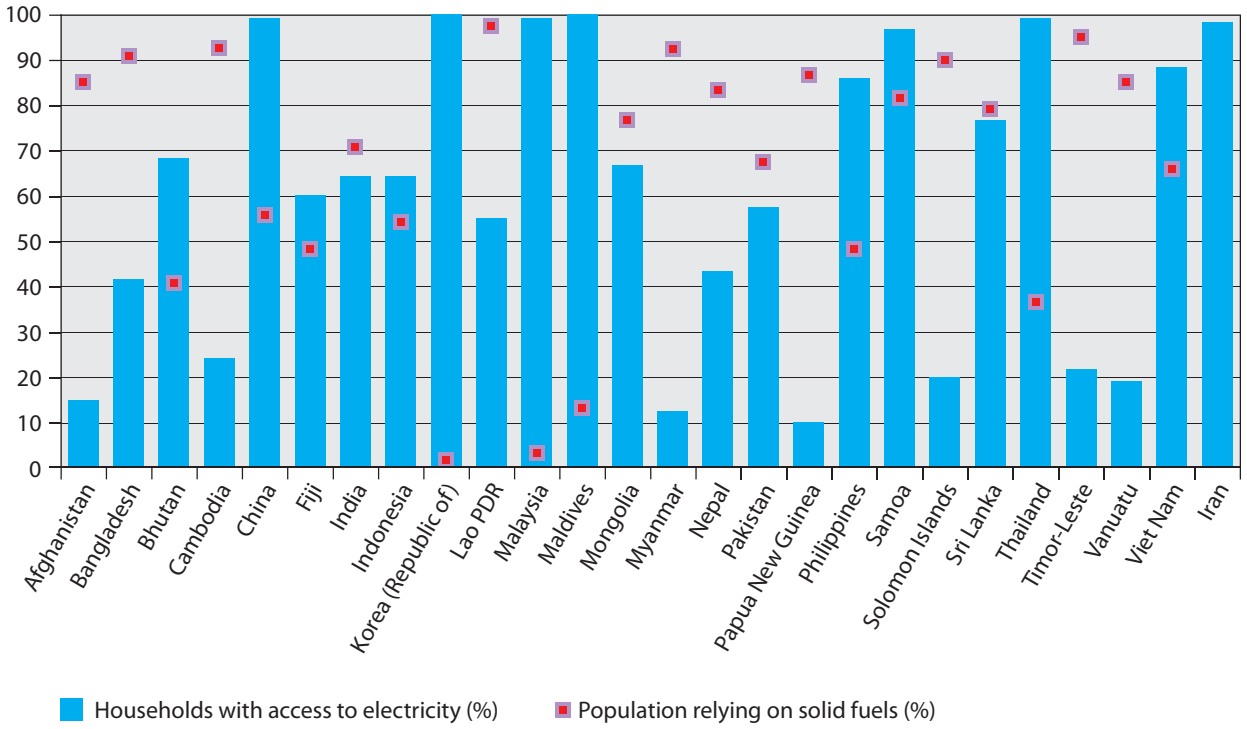
18 IEA, UNDP and UNIDO, 2010.

19 UNDP, 2007b.

20 Energy required for cooking, heating, lighting, communications, healthcare and education (IEA, UNDP and UNIDO, 2010).

21 ENERGIA, 2008.

Figure 1: Energy access situation in selected Asia-Pacific countries



Source: UNDP, 2009b

Heavy reliance on traditional biomass affects women disproportionately. Biomass accounts for more than 30 percent of the total energy consumption in many developing countries, and in some Asia-Pacific countries its share stands as high as 95 percent (see Figure 1).[22] Smoke from inefficient stoves in poorly ventilated homes kills 1.6 million people each year, the majority of whom are women and children younger than five years.[23] By 2030, household air pollution from biomass use in inefficient stoves is still likely to cause over 1.5 million premature deaths every year (over 4,000 per day).[24]

Environmental degradation. Biomass is often harvested in an unsustainable manner, contributing to environmental degradation. Deforestation, forest degradation, floods, landslides, topsoil erosion and low land productivity are the most visible manifestations of unsustainable biomass harvesting. According to the United Nations Framework Convention on Climate Change (UNFCCC), fuelwood collection accounts for 6 percent of annual global deforestation.[25]

Climate change. Increasing climate variability and climactic changes augment the social, environmental and economic vulnerability of the poor. As entire landscapes including forest systems, drylands and wastelands face greater pressures from changing climates, local communities – that often get their biomass supplies directly from the ecosystem – are increasingly vulnerable to biomass scarcities. Climate change also affects agriculture-dependent incomes, forcing many to switch to cheaper and inferior fuels.

For example, in Maharashtra (a large rural state in India) droughts that have historically occurred once every 25 years are now appearing every eight years.[26] Between 2000 and 2004, the state suffered three years of crippling drought, resulting in crop failure, livestock death and unemployment. The impacts were particularly severe among the 15 million people engaged in small and marginal farming. The annual loss from drought stood at USD 240 million in 2008, equivalent to nearly 3 percent of the state's agricultural output. Similarly, China has incurred USD 8 billion in economic losses due to drought in recent years, affecting 21 million hectares of crop fields and 40 million people.

22 IEA, UNDP and UNIDO, 2010.

23 WHO, 2005.

24 IEA, UNDP and UNIDO, 2010.

25 UNFCCC, 2007.

26 Economics of Climate Adaptation Working Group, 2009.

Table 2: Expanding energy access: key UNDP thematic areas and programming options

Areas central to expanding energy services	Programming options and activities
Energy service delivery, or developing organizational capacities to expand energy access within government, the private sector and civil society.	■ Capacity development for local governments and authorities in energy planning, budgeting, management and monitoring. ■ Capacity development for energy service providers in organizational development, management systems development, technical aspects, market assessment and expanding services to poor communities. ■ Capacity development for community-based energy service organizations to expand their technical and managerial capacities to implement energy access and related poverty reduction activities at the community and household level. ■ Development of business models, including identification of target markets and technologies; financial and economic analysis of the business; supporting business planning for local energy providers; determining marketing strategies; and provision of training and outreach on business models. ■ Entrepreneur capacity development including awareness building and training on small-scale businesses; promoting innovative financing mechanisms and financing options for energy service providers and customers; and training on maintenance of devices. ■ Dissemination of decentralized technologies.
Mainstreaming energy access considerations into national development strategies and sector policies.	■ Reform energy policy and planning to increase support and incentives for the enhanced availability and affordability of modern energy services and technologies. ■ Reform institutions and organizations to ensure that institutional structures, mandates and functions in relevant government agencies and regulatory bodies support enhanced energy access. ■ Mainstream energy access into development and sectoral strategies. ■ Align national budgeting processes with energy access objectives.
Financing or increasing access to investment financing from the public and private sectors for sustainable energy.	■ Assess public sector financing options. ■ Assess private and community financing options.

However, climate change also presents an opportunity to accelerate energy access. For example, it has become a major driver for bringing down the costs of RE technologies, thus enabling their transfer to developing countries, such as switching from the inefficient burning of unsustainably harvested biomass to more efficient appliances or new technologies. In the case of the Biogas Support Programme (BSP) in Nepal, the annual estimated greenhouse gas (GHG) emission reductions through the installation of biogas plants are about 613,000 tonnes of CO_2. This estimate also includes avoided methane emissions from anaerobic degradation of cow dung and other biomass material.

1.2 Review background

UNDP's work on energy access with its country partners focuses on meeting user needs, broadening energy supply options, and linking these efforts to meet the MDGs. In particular, UNDP emphasizes planning and implementing national capacity development initiatives that expand access to modern energy services.[27]

Three thematic areas are central to expanding access to energy services; for each of these, UNDP has established specific programming approaches for its Country Offices and their partners (see Table 2).[28] The Review builds on this work, and documents good practices and lessons learned in each of these thematic areas.

[27] For more information on UNDP approaches to enhancing energy access for the poor, see UNDP (2011).

[28] UNDP, 2009c.

Box 1: How the poor define poverty

- Lack of access to basic infrastructure, rural roads, transportation and water.
- Psychological dimensions such as powerlessness, voicelessness, dependency, shame and humiliation.
- While literacy is viewed as important, schooling receives mixed reviews. It is often reported as irrelevant to the lives of poor people.
- Poor people focus on assets rather than income, and link their lack of physical, human, social and environmental assets to their vulnerability and exposure to risk.

(Narayan et al., 2000)

1.2.1 Conceptual issues: defining energy poverty

An early challenge in defining the scope of the Review was lack of a consensus on what 'energy poverty' means, and how it relates to 'poverty' and 'energy access'. This chapter clarifies these concepts.

Poverty: a multi-dimensional phenomenon

The concept of 'energy poverty' has arisen from the definition of poverty itself. The World Bank study *Listening to the voices of the poor* concludes that poverty is a complex, multi-dimensional phenomenon – gendered, dynamic, complex, institutionally embedded, and location specific. It is routinely defined as "the lack of what is necessary for material well-being" – particularly regarding food, but also housing, land and other assets. Poverty is the lack of multiple resources leading to physical deprivation (see Box 1). This definition is consistent with the more recent notion of Multidimensional Poverty Index (MPI) as advocated in the 2010 Human Development Report, which relates poverty to overlapping deprivations suffered by households in areas of health, education and living standards. The dimensions of poverty go beyond inadequate income, encompassing poor health and nutrition, low education and skill levels, inadequate livelihoods, bad housing conditions and social exclusion.[29]

Defining 'expanding energy access'

Making modern energy available and affordable. Over the years, energy access and energy poverty have been defined in many ways.[30] These definitions converge in highlighting the role that modern energy services can play in reducing poverty and achieving the MDGs. As the perspective of poverty is becoming multidimensional, energy poverty is described as a lack of access to resources, denial of opportunities and choice in access to energy that is adequate, safe, and reliable for economic and human development. Access is then a function of availability and affordability, where energy is considered:

- 'available' if the household is within the economic connection and supply range of the energy network or supplier; and
- 'affordable' when the household is able to pay the up-front connection cost (or first cost) and energy usage costs.

Minimum energy access thresholds. There is no universally accepted minimum threshold for energy access. Poor households spend a large portion of their incomes and human resources on energy because it is essential to meeting basic needs such as cooked food and transport. Using this as the starting point, the IEA proposed 100 kilowatt hour (kWh) of electricity and 100 kgoe of modern fuels per person per year as a minimum threshold for defining energy access.[31] The high-level Advisory Group on Energy and Climate Change states that access must be reliable, affordable (the cost to end-users compatible with their income levels and no higher than the cost of traditional fuels), sustainable and, where feasible, from low GHG-emitting energy sources. At the same time, it contends that expanding energy access must go beyond meeting the basic needs: it should aim to create improved conditions for economic take-off, contribute to attaining the MDGs and enable the poorest to escape poverty.[32]

29 UNDP, 2010a.

30 Reddy, 2000; Saghir, 2004; Pachauri, S. et al., 2004; Bazilian, M. et al., 2010; Buzar, S., 2007; Kanagawa, Makoto; Nakata, Toshihiko, 2008; Pereira, M.G. et al., 2010; IEA 2009; Brew-Hammond, 2010.

31 IEA, UNDP and UNIDO, 2010.

32 AGECC, 2010.

MDGs, human development and energy access. Several studies have emphasized the importance of access to energy services for meeting the MDGs in developing countries.[33] The 2010 UNDP MDG Breakthrough Strategy recognizes the contribution of energy access towards poverty reduction. Specifically, the first proposed pillar of interventions for UNDP is to 'accelerate existing MDG achievements by supporting scaled-up implementation of proven and innovative initiatives in areas of gender, energy, water and sanitation, education, health and sustainable agriculture'.[34]

Energy access is a vehicle for economic and human development. Consequently, addressing 'energy poverty' goes beyond a conventional definition of providing basic access to encompass other, equally important, dimensions.[35] One critical component is 'time poverty', particularly among poor women, who generally must spend enormous amounts of time collecting fuelwood for food preparation. This prevents them from engaging in income-generating activities: there simply is not enough time to do both.[36] Yet another dimension comes into play when children, particularly girls, are enlisted to help their mothers in subsistence tasks such as fuelwood collection and cooking, which keeps them from going to school, ultimately hindering their employability in the future and making energy poverty an inter-generational phenomenon. Addressing energy poverty also means reducing the vulnerabilities of the poor who are influenced by environmental risks including climate change.

1.2.2 Review approach

Examining the complex issues surrounding energy access, this Review contributes to the on-going discussion on universal access to energy, considering two interrelated questions:

a) What are the common features of programmes and projects that have succeeded in providing access to clean, affordable and reliable energy services to the poor for cooking, heating, lighting, communications and productive uses?

b) What can governments and development partners do to further expand and upscale such energy access programmes and projects?

In seeking answers to these questions, the Review adopted the following approach.

Project selection

The Review process selected 17 energy access programmes and projects in Asia-Pacific.[37] Calls for expressions of interest were combined with direct solicitation of projects interested in participating in the Review. Projects were selected on the basis of information shared regarding:

- innovations in energy service delivery models;
- their contribution to mainstreaming energy access into national development strategies; and
- the extent to which they expanded, or demonstrated their potential to expand, energy services for the poor.

33 DFID, 2002; Modi 2005; Modi et al 2005. UNDP 2008a.

34 The MDG Breakthrough Strategy lays out UNDP's plan to help countries close the gap between where they are now and where they need to be to meet the MDGs and sustain the progress achieved (UNDP, 2010b).

35 One early definition of energy poverty is "the absence of sufficient choice in accessing adequate, affordable, reliable, high-quality, safe and environmentally benign energy services to support economic and human development" (Reddy, 2000). Another measure of energy poverty comprises lack of capacity to cook with modern cooking fuels and lack of the minimum electric lighting needed to read or conduct other household activities. Modi, et al. (2005) proposed that these minimum needs correspond to about 50 kgoe of energy per capita per year, and represent the basic needs for cooking and lighting; energy for agriculture, transport, grinding; and social services or industrial and commercial activities.

36 Mansvelt, 2009.

37 Countries covered are Bhutan, China, Fiji, India, Lao People's Democratic Republic, Nepal, the Philippines, Sri Lanka, Timor-Leste and Vanuatu.

Specific project selection criteria included:

- appropriateness of technology solutions;
- sustained impacts on target beneficiaries;
- level of participation of the communities;
- mainstreaming energy access into national development strategies, priorities and budgeting;
- sustainability of the energy markets developed;
- institutional capacities built at the local and national level to scale up, replicate and mainstream energy service delivery; and
- institutional partnership framework created to bring actors together within functional partnerships.

The final selection of 17 programmes and projects (out of the 34 shortlisted) cover a range of technology types, implementing agencies, distributions across the region, financing models, funding types (a balance between those funded through public finances/governments/private sector/donors) and project sizes.

Collaborative assessment

Following selection, projects were guided through a process of collaborative assessment and case study development. The project managers themselves undertook most case assessments and documentation; the rest were conducted by experts/consultants engaged by UNDP. Analysis for each project first focused on two broad questions: 1) how successful was the project in addressing energy poverty; and 2) how scalable was it? Within each of these areas of analysis, a set of relevant issues was then examined (see Figure 2). The findings from these project analyses were synthesized to draw good practices and lessons learned in energy service delivery, financing and mainstreaming, three areas identified by UNDP as central to expanding energy services for the poor.[38]

Documenting good practices and lessons learned

In the context of the Review, a 'good practice' addresses energy poverty sustainably and has the potential to expand beyond the project boundaries. Addressing energy poverty sustainably involves:

- bringing clean, affordable and reliable energy services to the poor for cooking and heating, lighting, mechanical power and communications; and
- contributing to poverty reduction through livelihood support, income generation, energy cost reduction, health improvement and education.

'Expansion of energy services to the poor beyond the project boundaries' refers to the extension of energy services to large numbers of poor people.[39] This is achieved through:

- 'scaling up', the process of broadening the project to reach more beneficiaries at the same geographic location; or
- 'replicating', a 'horizontal' project expansion to a different geographic location.[40]

All 17 reviewed programmes and projects address energy poverty sustainably. In terms of expansion, 11 of these have already either covered several sub-national provinces or achieved nationwide coverage.[41]

Good practices and lessons learned for expansion have been derived from analysis of the related project experiences. While the lessons are broadly applicable across the region, some may be more applicable than others for specific locations and types of projects.

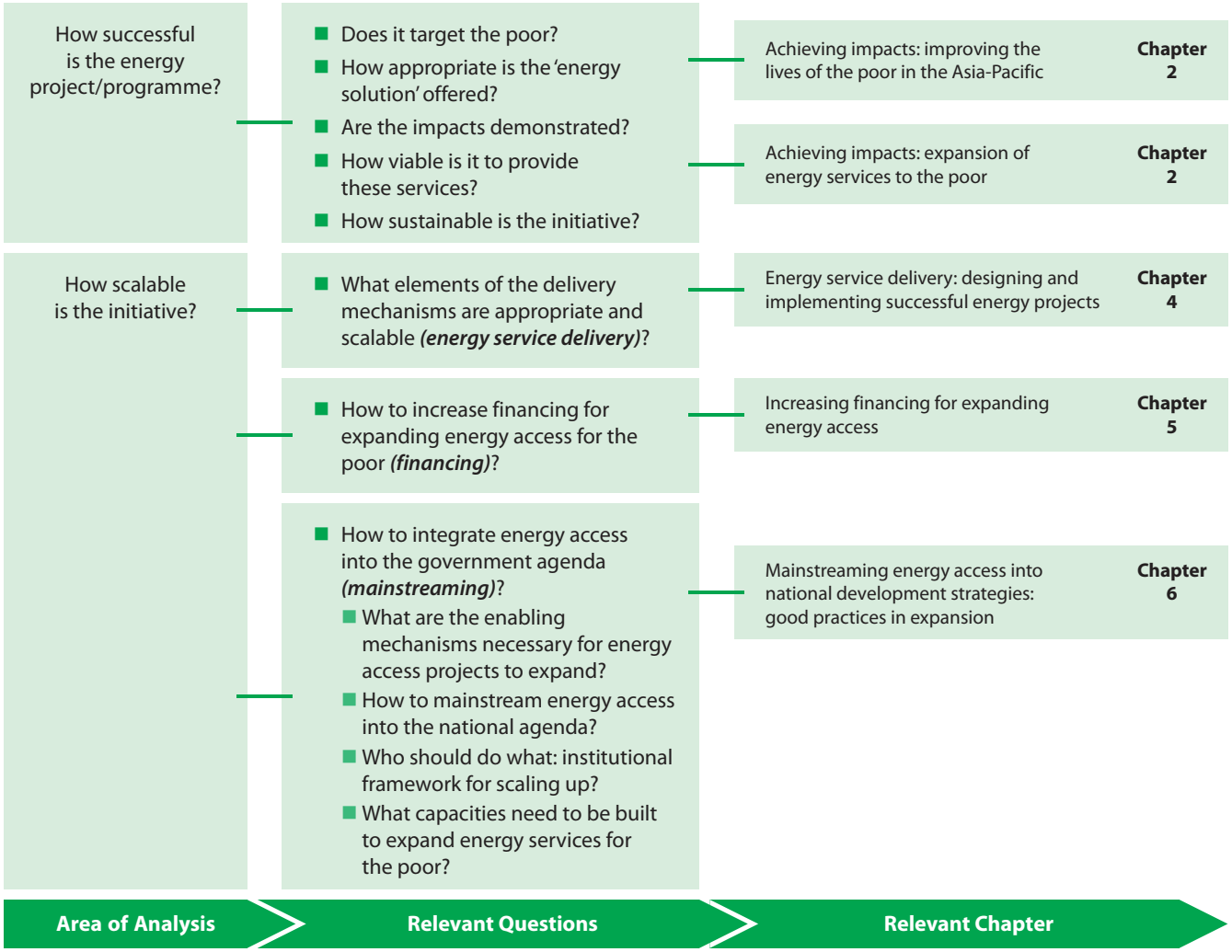
38 UNDP, 2009c.

39 Discussions with project managers (at a writeshop conducted as part of this initiative) highlighted the difficulties in defining the term 'expansion'. The extent to which energy services can be extended to the poor depends on a range of factors, including the technology being disseminated, the income levels of the poor, and the geographical location/remoteness of the area (these matters are discussed further in Section 2.2). In addition, what may represent a large number of people in an island country such as Vanuatu, may be relatively insignificant in a country such as India or China (UNDP writeshop, 2009).

40 Adapted from UNDP, 2006.

41 Many of these are ongoing programmes, and the number of people reached is expected to increase. Annex 1 presents the populations reached by each programme and project to date.

Figure 2: Conceptual framework for the Review



Source materials

The Review referred to secondary data and published literature. Available internal documentation included project reports. Project managers and staff were also consulted. Reliance on secondary data proved to be a limitation in quantifying project impacts on the MDGs. While a few projects offered some quantitative data on the impact of energy services on MDGs, most restricted monitoring to the collection of energy indicator data, with no tracking of MDG impacts. This is understandable, given that several of the projects under review did not aim to influence the MDGs in the first place, instead targeting other, equally important objectives.

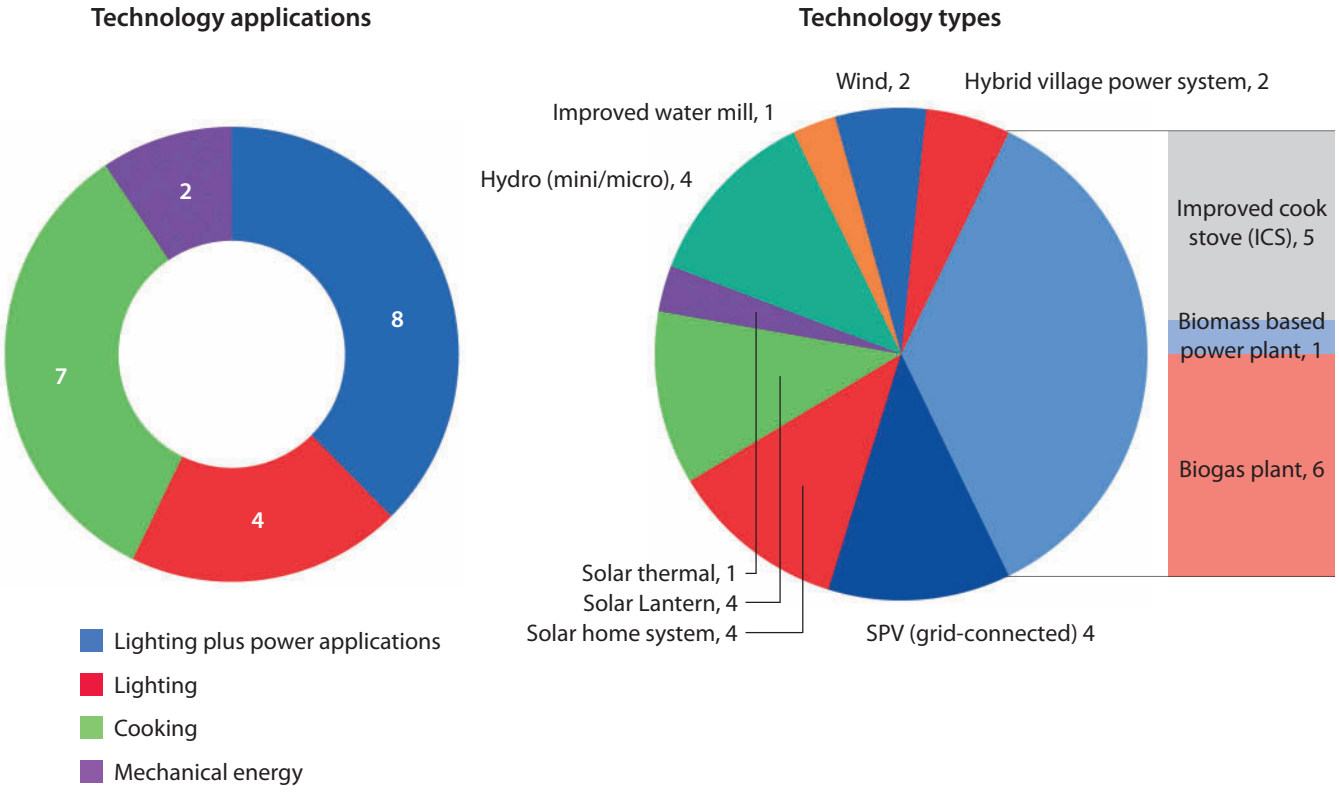
Spectrum of experiences covered

The Review covered the following spectrum of regional experiences:

- the energy access projects under review primarily addressed energy needs for cooking, heating, lighting and other power applications (see Figure 3);
- the projects developed and/or disseminated a range of clean(er) energy technologies through government, the private sector and non-governmental organizations (NGOs) as implementing organizations;
- the projects represented various geographies, financing models and funding sources (government, private sector, development partners and communities);
- individual project funding ranged from under USD 100,000 to over USD 10,000,000, and the focus ranged from single communities to national industries with global reach;

- most projects demonstrated a strong social orientation, focusing on the poorer social groups, and a drive to extend energy services to the un-served; and
- the projects represented various delivery mechanisms, including different institutional arrangements, and a combination of market and non-market measures. These are summarized in Table 3. Annex 1 presents brief profiles of the reviewed projects.

Figure 3: Project profiles: applications and technology types[42]



[42] In addition to these technologies, the Fiji Rural Electrification Programme (FREP) and CRE China conducted demonstration projects on bagasse cogeneration and biofuels. Improved water mills replace traditional parts with more efficient ones and use running water to produce 3-4 kilowatt (kW) of mechanical energy and electrical energy. Solar photovoltaic (SPV) technology converts light directly into electricity using large-area semi-conductors, including silicon cell arrays and thin films. Hybrid village power systems are centralized systems employing a combination of energy sources (wind and solar energy, with backup fossil fuel units) to produce electricity for a community mini-grid. Solar home systems (SHSs) power small-scale lighting and other equipment such as radios, televisions, cassette players, fans and sewing machines. Solar lanterns are efficient lights (compact fluorescent lamps or high-brightness light emitting diodes) with small SPV units that charge their batteries.

Table 3: Delivery models of reviewed programmes and projects

Programme/Project	Institutional Setup	Energy Service Delivery Model
Accelerating Community Electricity Services using Solar (ACCESS) – Philippines (2006-2011)	Government-led energy programme (with donor support)	Electrification of *barangays* through SHSs[44]
StoveTec Improved cookstoves – worldwide (2007-ongoing)[43]	Commercialization model	Centralized mass production, market development and worldwide sales of improved cookstoves
Building Economic, Social and Technological Opportunities and Foundations to Promote Renewable Energy Nationwide (BEST-OF-PREN) – Philippines (2006-2011)	Commercialization supported by civil society	Improving access to RE technologies for poor households through micro-credit
Biogas Support Programme (BSP) – Nepal (2003-ongoing)	Commercialization model	Dissemination of household-size biogas plants through provision of technical assistance and marketing support to the private sector
Development and promotion of biogas utilization in rural China (DPBURC) – China (2006-2010)	Government-led energy programme	Large-scale dissemination of domestic biogas plants
Capacity Building for the Rapid Commercialization of Renewable Energy (CRE) – China (1999-2008)	Government-led energy programme (with participation of the private sector)	Commercialization of RE through capacity development, facilitation of new policy initiatives and pilot projects
Fiji Rural Electrification Programme (FREP) – Fiji (1974-ongoing)	Government-led programme	Extension of rural electrification to Fijian islands
Improved Water Mill Programme (IWM) – Nepal (2003-2012)	Commercialization supported by civil society	Improvement of traditional water mills for agro-processing and electricity generation to improve rural livelihoods
Providing energy access to remote areas in India through women's empowerment – Jagriti, India (2002-ongoing)	Commercialization supported by civil society	Dissemination of energy-efficient cooking and water-heating devices through rural women's self-help groups
Rural Energy Development Programme (REDP) – Nepal (1996-2012)	Public-private partnership for community-based RE system	Enhancement of rural livelihoods through community-managed micro-hydro and other decentralized RE systems
The Energy Services Delivery Project (ESD) (1997-2002) and the Renewable Energy for Rural Economic Development (RERED) Project – Sri Lanka (2002-2011)	Government-led energy programme (with donor support)	Expanding energy access through off-grid and grid-connected RE solutions, using commercially viable delivery channels and microfinance
Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY) – India (2005-2012)	Government-led energy programme	Provision of electricity access to poor households
Community Micro-hydro for Sustainable Livelihoods – Sengor, Bhutan (2005-2009)	Public-private partnership for community-based RE system	Community empowerment through livelihoods promotion and capacity development (community-based micro-hydro project)

[43] *Barangays* are the smallest administrative divisions in the Philippines.

[44] Manufacturing in China, sales worldwide.

Table 3: Delivery models of reviewed programmes and projects (continued)

Programme/Project	Institutional Setup	Energy Service Delivery Model
Sunlabob Solar Lantern Rental System (Sunlabob) – Lao People's Democratic Republic (2006-ongoing)	Commercialization model	Dissemination of solar lanterns in rural areas using a rental, fee-for-service model
Diffusion of biomass utilization technologies in the informal industries in Karnataka and Kerala, TIDE – India (1998-2008)	Commercialization supported by civil society	Support to entrepreneurs to build and sell energy-efficient devices to informal biomass-based industries
Participatory Rural Energy Development Programme (PREDP) – Timor-Leste (2004-2009)	Donor supported project	Piloting of low-carbon energy technologies in rural communities
Vanuatu's Community Powerhouse Rural Electrification Model, Vanuatu Renewable Energy and Power Association (VANREPA) – Vanuatu (2007-2013)	Commercialization supported by civil society	Provision of decentralized, wind and solar-generated electric power through a series of micro-grids and battery charging stations

UNDP/Energy Access for Poverty Reduction/PRDP – Timor-Leste

Explaining the use of solar photovoltaic panels. Project: Participatory Rural Energy Development Programme (PREDP) – Timor-Leste.

2 Impacts of energy access projects

UNDP/Energy Access for Poverty Reduction/Sengor – Bhutan

Electric rice cookers being used in Sengor village, Bhutan. Project: Community Micro-hydro for Sustainable Livelihoods – Sengor, Bhutan.

- Energy access projects lead to improvements in the lives of the poor in terms of fuel savings, health, education, and access to information. Impacts on livelihoods and incomes are less visible.
- Projects that implement energy interventions from a poverty-reduction perspective – providing energy services in combination with business development support, access to finance and market linkages – show promise in bringing people out of poverty. However, these strategies are yet to be scaled up.

2. Impacts of energy access projects

This chapter presents review findings evaluating the impacts of the 17 energy access programmes and projects according to the following criteria:

- contribution to the attainment of the MDGs; and
- the extent to which projects have been able to expand, reaching large numbers of people.

2.1 Project impacts on the attainment of MDGs[45]

The Review assessed project impacts on the basis of their contributions to the attainment of the eight MDGs.[46]

Focus-group discussions with project managers generated a set of objectives for each MDG that best reflected the contribution of a given project. Each project then reported on the achievement of these objectives in both qualitative and quantitative terms.

MDG impacts, as reported by at least one third of the projects, illustrated by one or more examples, are discussed below.

2.1.1 MDG 1: Reducing extreme poverty and hunger[47]

Impact on MDG 1	No. of projects reporting impact
Fuel-efficiency gains leading to monetary savings	12
Productive uses of energy	13
Employment creation and improved labour productivity	9
Improved asset ownership	12

Fuel-efficiency gains in homes

Monetary and opportunity-cost savings. Phasing out traditional energy technologies and fuels – for example, through the use of improved cookstoves – can result in significant monetary and opportunity-cost savings. StoveTec stoves demonstrated savings of 40-50 percent on fuelwood and reductions of 20-40 percent in cooking time.[48] Thus household expenditures on wood, kerosene and charcoal were reduced.

An assessment of rural electrification in Fiji revealed that:

> (T)he most immediate and direct… impact on the poor is in reducing cash expenditure on traditional forms of commercial energy, such as kerosene and dry-cell batteries. Un-electrified households spend more on all sources of energy than households with electricity from any source. This is despite the fact that households with electricity are likely to use a number of (newly acquired) electrical appliances.[49]

45 16 of the 17 projects reported MDG impacts. The China CRE project, which focused primarily on providing capacity-building inputs at various levels, was the exception.

46 See Annex 2 for a list of energy services and their potential contribution towards MDGs.

47 MDG 1 aims to achieve three targets between 1990 and 2015: 1) to reduce by half the proportion of people living on less than a dollar a day; 2) to achieve full and productive employment and decent work for all, including women and young people; 3) and to reduce, by half, the proportion of people who suffer from hunger.

48 StoveTec stoves are designed by the US-based Aprovecho Research Center and manufactured in China by Shengzhou Stove Manufacturer.

49 ADB, 2005.

Box 2: Solar lanterns: catalyst for local-enterprise development

The Sunlabob Solar Lantern Rental System (SLRS) includes a central solar lantern charging station managed by a rural entrepreneur. Local technicians are encouraged to establish their own microenterprises to service and maintain the charging station and the rechargeable lanterns, with training provided by Sunlabob. The safeguards of an economically viable model, combined with targeted skills improvement, encourage these villagers to start up and run their own sustainable businesses, supplementing other income sources. From a single charging station of 50 lanterns, the village technician receives a net income of about USD 400 in the first year of operation.

The SLRS also introduces a fee-for-service concept into rural communities, which may be adopted by other local enterprises as a model for their own operations. Through their contacts with Sunlabob, rural households also gain exposure to other products and services they may want to develop. These include coolers, telephones, laptops with internet connections, UV-sterilized bottled drinking water, televisions and screen projectors.

In Sengor village, Bhutan, electricity from a micro-hydro plant enabled the use of rice cookers (taking advantage of excess power at off-peak times during the day), thereby eradicating the collection of fuelwood and halving the 26 truckloads of fuelwood purchased by the community during winters. The use of kerosene, diesel, candles, liquefied petroleum gas (LPG) and dry cell batteries was reduced by two thirds.

In Sri Lanka, after implementing Village Hydro Project (VHP) electrification, households previously using rechargeable and disposable batteries to operate televisions and radios, reported monthly savings of LKR 66 on batteries and LKR 183 on kerosene.[50] These savings more than compensated for the monthly payment for electricity consumption.

In Mindoro Province, the Philippines, solar lanterns led to savings of some PHP 25 per day per household in kerosene expenses. This is a significant achievement given the daily costs of PHP 40 for wick lamps and PHP 200 for pressure-pumped kerosene lamps that only offered 2-3 hours of light.[51]

Improved quality of service. This outcome was observed with solar lanterns distributed under the BEST-OF-PREN project in the Philippines. Solar lanterns were lighting homes more effectively and, unlike the kerosene lamps they replaced, were non-polluting.

Productive uses of energy

Augmenting incomes and livelihoods. Modern energy services augment incomes and livelihoods in the following ways:

- energy inputs to irrigation improve agricultural productivity;
- efficient lighting enables income generation beyond daylight hours. A user survey in Ban Phonlek village, Lao People's Democratic Republic, revealed that half of the households with solar lanterns used extended work hours for income-generating activities, including the sale of animals and handicrafts (see Box 2); and
- new energy-based enterprises become viable. For example, energy-efficient stoves promoted by Technology Informatics Design Endeavour (TIDE), an Indian NGO, led to significant energy savings among small industries, translating into monetary savings of INR 29 million[52] per year. Between 2000 and 2007, 14 entrepreneurs realized a cumulative collective turnover of INR 66.6 million and a profit of INR 10 million. These stoves also make the working environment cleaner, safer and smoke-free, improving worker efficiency and reducing days and wages lost due to ill health.

Obstacles to developing productive uses of energy. Given limited production capacity, the erratic quality of electricity supply and the difficulty of transporting products from remote locations to markets, setting up energy-based economic activities in rural locations is not always an attractive option for investors. Thus, even though 13 of the 17 projects highlighted productive uses of energy as a strategy, the number of people that have benefited from these activities has been small.

50 LKR 1 = USD 0.00908, as of 9 September 2011 (www.xe.com).

51 PHP 1 = USD 0.02355, as of 9 September 2011 (www.xe.com).

52 INR 1 = USD 0.02177, as of 9 September 2011 (www.xe.com).

Box 3: Developing capacities at the 'bottom of the pyramid'

BSP Nepal employs around 2,000 biogas masons, who in turn employ trainee masons. BSP aims to improve working conditions and skills of masons in the following ways:

- conducting biogas construction training for masons, who are then examined and certified by the national Council for Technical Education and Vocational Training;
- by linking skills enhancement with authority to employ trainees, BSP encourages skilled masons to become entrepreneurs. A BSP mason can easily earn NPR 62,000 (USD 837) in six months; many go on to become master masons in other construction work; and
- working with private-sector companies to protect basic worker rights among masons. The minimum wage for biogas masons is specified in bids, disseminated widely and factored into biogas company codes of conduct and used to assess company performance.[53]

In Sri Lanka, for example, villagers have shown little interest in setting up energy-related economic activities, despite the fact that the RERED project provides USD 1,000 grants to project developers to develop economic activities using generated activity. A 2005 survey in rural Fiji found that few rural households used electricity for income-generating activities; among those that did, the main activity was selling ice blocks and ice cream, while some shop owners used electricity to store frozen goods or fish.[54]

Thus energy access is a necessary, but far from sufficient, precondition in moving people out of poverty. Other essential inputs include market access, capital availability and business skills.[55] Section 5.2 discusses what good practices and strategies are needed to scale up the impact of productive uses of energy.

Employment creation and increased labour productivity

Most RE projects create employment for resident communities. In the RERED project in Sri Lanka, employment is generated through construction, operation and maintenance of mini-hydro projects. Each project generally employs 8-11 local people during construction (of up to 18 months), providing 3,600 to 4,950 person-days of local employment. Each project also employs three to four people for maintenance, generating another 90 to 120 person-days of employment per month. In addition, the 106,116 SHSs installed under RERED created about 477,000 person-days (19,300 person-months) of employment.

In several projects, skills development has led to increased employment opportunities. TIDE India has created an on-the-ground delivery mechanism for fuel-efficient stoves, generating new opportunities for masons, welders and transporters. Similarly, RERED Sri Lanka was instrumental in building the capacity of a whole cadre of professionals and organizations specializing in RE. Impacts of BSP Nepal on employment and working conditions of masons are described in Box 3.

Asset ownership and improved quality of life

Electricity brings about lifestyle changes, making home life more comfortable and housework easier. Improvements are reflected in increased use of household appliances such as water heaters, clothes irons, cookers and grinders. Many VHP beneficiaries in Sri Lanka, for example, have invested in televisions and electric irons.

The availability of household and community electric lighting improves the sense of security, particularly among women. Impact surveys found 60-87 percent of households with VHPs in Sri Lankan villages reported feeling safer.

53 NPR 1 = USD 0.01350, as of 9 September 2011 (www.xe.com).

54 Government of Fiji, 2006.

55 ESMAP, 2008.

2.1.2 MDG 2: Achieving universal primary education [56]

Impact on MDG 2	No. of projects reporting impact
Improved lighting for home study by children	11
Freeing children's time from fuelwood collection tasks	6

Children's education is the primary motivation for household investment in electrification. Unsurprisingly, while some projects reported an overall increase in literacy in their areas, none were able to attribute this directly to the project itself. Surveys undertaken by projects indicate that children's education remains the primary motivation for households to invest in electrification. Eleven projects reported that improved lighting is enabling children to study in the evenings, although it is not evident whether this translates into improved enrolment and student performance. Up to 90 percent of households electrified through RERED Sri Lanka consider children's ability to study longer an important benefit of electricity, with the mean study time increasing by 1.1 to 1.6 hours. Better lighting also reduces eye strain while studying.

Energy scarcity forces children to assist their parents in collecting fuelwood. Earlier studies show that investment in infrastructure saves time spent collecting water and fuelwood and, importantly, results in fewer interruptions to women's paid work and girls' schooling.[57] This was corroborated by six of the projects, which reported that access to modern fuels and the consequent reduced need for fuelwood collection freed time for school and after-school study, particularly for girls.

2.1.3 MDG 3: Promoting gender equality and empowering women [58]

Impact on MDG 3	No. of projects reporting impact
New training opportunities for women	7
Enhanced role for women in community organizations	5

Access to energy services has a significant impact on women's lives by reducing time spent on household tasks (such as fuelwood collection), improving their health and increasing access to information services such as television, radio and Internet. Access to energy services can also unleash a process of women's empowerment, bringing in changes in gender relations.

Jagriti is an NGO working in the remote hills of northern India. Its experience demonstrates what women can achieve through modern energy services. In 2001-2002, Jagriti began organizing poor women into women's savings and credit groups (WSCGs) to improve their status and give them a collective voice. But it quickly became apparent that if these women were to benefit from Jagriti's programmes, their work burden – some 10 hours per day devoted to cooking and collecting fuelwood and water – would have to be reduced so that they have time to participate in economic activities. Consequently Jagriti, through the WSCGs, introduced improved energy technologies such as LPG and pressure cookers and energy-efficient water heaters. These improved women's lives in the following ways:

- given improved fuel efficiency, trips to the forest were reduced from once daily to between one and four times per week;
- using LPG and pressure cookers saved 1-1.5 hours of cooking time each day;
- the time saved helped women engage in income-generating activities such as weaving; and
- more efficient fuels reduced indoor air pollution, improving health, productivity and general quality of life.

56 MDG 2 aims to ensure, by 2015, that all boys and girls fully complete primary schooling.

57 King and Alderman, 2001, in Modi et al., 2005.

58 MDG 3 sets the target of eliminating gender disparity in primary and secondary education, preferably by 2005 and at all levels by 2015.

The improved energy-efficient devices thus catalyzed the process of women's empowerment and changes in gender relations in ways completely unforeseen by the project. Visible indicators included the following:

- women opening bank accounts;
- increased participation in training activities and interactions with banks and government offices;
- increased intra-group loans to meet women's emergency needs for cash;
- increased participation in village-level meetings and stronger articulation of their needs in such forums; and
- increased support from family members to engage in economic activities outside the home and to participate in community activities.

IWM Nepal and REDP Nepal have also delivered significant improvements in the lives of women. The IWM technology, which involves the improvement of traditional water mills for agro-processing and electricity generation, succeeded in reducing the drudgery of grinding and milling. Agro-processing time (and effort) for women is reduced by more than half, and several use the saved time for farming and weaving. Women have started making use of income-generating opportunities, and are slowly gaining control over their incomes and assets. Similarly, in REDP (which promotes community-managed micro-hydro systems), many women have started small businesses in poultry and weaving. Women in community organizations have a distinct voice in local affairs and their capability for independent and collective action has increased. Some of the micro-hydro schemes in the remote districts in western Nepal (an area where women have the lowest social status) are even chaired by women.

Many energy projects offer women various types of training, and a few involve women directly in project processes (although in general their involvement is restricted to attending project meetings). However, energy services contributing towards women's empowerment – reflected in their participation at higher decision-making levels or in women's organizations – was observed only in exceptional cases. Overall, gender equality and women's empowerment outcomes are more likely to occur when explicitly pursued in project goals and activities.

2.1.4 MDG 4: Reducing child mortality [59]

Impact on MDG 4	No. of projects reporting impact
Reduced respiratory ailments among children caused by emissions from incomplete burning of biomass fuels	10
Reduced ailments among children caused by emissions from kerosene lamps	8

Reduced ailments among children through a reduction of indoor air pollution resulting from improved cookstoves and biogas plants, and from a shift away from polluting kerosene lamps were used as objectives for the attainment of MDG 4. While a number of projects reported benefits, these reports were based on informal interactions with users; no projects had conducted systematic health surveys.

Improved stoves and biogas plants offer multiple health benefits, particularly for children. The reduction of indoor air pollution results in fewer respiratory and eye diseases among children, who spend long hours in the kitchen with their mothers. Laboratory and field tests confirm that StoveTec stoves reduce indoor air pollution by as much as 50-70 percent for particulate emissions and 50-60 percent for carbon monoxide emissions. Three projects reported that given their overall savings in fuelwood, households are now able to boil drinking water.[60] In Sengor, Bhutan, 55 percent of households acquired electric water boilers, which have brought about improvements in health.[61]

[59] MDG 4 aims to reduce by two thirds the mortality rate among children under the age of five years.

[60] Contaminated water is a major source of diarrhoeal infections among children.

[61] UNDP Bhutan, 2008.

2.1.5 MDG 5: Improving maternal health[62]

Impact on MDG 5	No. of projects reporting impact
Improved health and drudgery/labour reduction for women	7
Improved women's health through reduced indoor air pollution	10

The Review determined that energy access directly influences maternal health in the following ways.

Reduced drudgery/labour and time saved. The most commonly experienced energy project impact on women's health was a reduction in the labour and time allocated to fuelwood collection. Information about uses of the saved time was available only for some projects.

Reduced indoor pollution. Most projects, particularly those disseminating cooking technologies, also reported reduced air pollution levels in kitchens. In BSP Nepal, the annual biogas user survey revealed that 98 percent of the women users observed a reduction in indoor air pollution after the installation of biogas plants.

2.1.6 MDG 6: Combating HIV/AIDS, malaria, tuberculosis and other diseases[63]

Impact on MDG 6	No. of projects reporting impact
Improved health through refrigeration of vaccines and lighting for clinical services	6

No direct correlation was observed between delivered energy services and incidence of HIV/AIDS, malaria and other major communicable diseases. An exception was the DPBURC project in China, where a reduced incidence of disease was noted (see Box 4). In any case, energy services generally improve local health infrastructure, which in turn helps reduce the incidence of diseases and improve quality of care.

Box 4: Combating health hazards through biogas plants: DPBURC China

In the middle and lower reaches of the Yangtze River Basin, human and animal wastes are the main transmission route for diseases such as schistosomiasis, fluorosis and swine streptococcosis. Construction of biogas plants (together with the renovation of toilets) proved an effective measure for sanitizing human and animal wastes, and led to the reduced incidence of epidemics in villages. In 2005, during an outbreak of human *Streptococcus suis* in Sichuan Province, no biogas-using households were affected.[64] At the same time, the population density of mosquitoes was reduced by more than 70 percent, and the incidence of digestive diseases among communities declined.[65]

Quality health care energy infrastructure – even in the smallest clinics and health centres – relies on refrigeration for storing vaccines and medicines. Several projects discussed the benefits of quality electric lighting and electricity for refrigerators for vaccine storage, which can help to reduce maternal and infant mortality.

Electric light for patient care after dark and in surgery improves the delivery of medical services. After electrification, the Basic Health Unit in Sengor was able to provide better health services, as it could function effectively at night and had a refrigerator for storing vaccines and medicines. Five other projects reported such benefits.

62 MDG 5 sets two targets: to reduce the maternal mortality ratio by three quarters; and to achieve universal access to reproductive health services by 2015.

63 MDG 6 has three targets: 1)to halt and begin to reverse the spread of HIV/AIDS; 2) to achieve, by 2010, universal access to treatment for HIV/AIDS for all those who need it; 3) and to halt and begin to reverse the incidence of malaria and other major diseases.

64 Zheng, 2005.

65 Xiao, 2008.

Provision of electricity and LPG to rural health clinics can improve the quality of health care to a greater degree if other complimentary inputs – trained staff, equipment, sanitary facilities and running water – are also available. Sunlabob Lao People's Democratic Republic provides solar lanterns that are used in primary health clinics, even though such clinics were not explicitly targeted by the project.

2.1.7 MDG 7: Ensuring environmental sustainability[66]

Impact on MDG 7	No. of projects reporting impact
Reduced fuelwood consumption	8
Reduced fossil fuel consumption	15
Reduced indoor air pollution	13
Improved access to clean water	3

The Review documented the following four objectives of positive environmental impacts of energy access projects:

- reduced pressure on forest resources through reduced fuelwood consumption;
- reduced GHG emissions from the reduced use of fossil and biomass-based fuels;
- reduced indoor air pollution due to reduced quantity and complete combustion of biomass; and
- greater access to clean drinking water, via affordable water boiling facilities.

Technologies disseminated under the projects provided energy services that were previously unavailable; replaced high-emission technologies that use fossil fuels; and reduced the unsustainable supply and use of fuelwood, thereby reducing GHG emissions (see Table 4).

Table 4: Unsustainable energy sources replaced

Technology introduced	Project	Technology replaced	Fuel replaced or saved
Efficient cookstoves (domestic/industrial), LPG, improved water heaters	StoveTec, TIDE India, Jagriti India, BEST-OF-PREN Philippines	Low-efficiency woodstoves	Wood
Biogas plants	BSP Nepal, PREDP Timor-Leste	Low-efficiency woodstoves	Wood
SHSs	RERED Sri Lanka, ACCESS Philippines	Kerosene lanterns, wick lamps and diesel generators	Fossil fuels
Solar lanterns	Sunlabob Lao People's Democratic Republic, BEST-OF-PREN Philippines	Wick lamps, candles	Fossil fuels
Grid electrification	RGGVY India, FREP Fiji	Wick lamps, candles	Fossil fuels
Micro-hydro and other decentralized power generation	REDP Nepal, Sengor Bhutan, VANREPA Vanuatu, RERED Sri Lanka	Kerosene lanterns, wick lamps	Fossil fuels
Improved water mills	IWM Nepal	Diesel mills	Fossil fuels

[66] MDG 7 has five targets: 1) to integrate the principles of sustainable development into country policies and programmes; 2) to reverse the loss of environmental resources; 3) to achieve a significant reduction in the rate of biodiversity loss by 2010; 4) to reduce by half the proportion of people without sustainable access to safe drinking water and basic sanitation; and 5) to achieve significant improvement in lives of at least 100 million slum dwellers by 2020.

Table 5 presents estimates of annual GHG emission savings among the projects. These savings translate into significant local environmental impacts, including reduced indoor air pollution (which most communities identified as a significant benefit) and reduced dependence on expensive and polluting fossil fuels (particularly diesel and kerosene). Similarly, poor people report that they appreciate affordable alternatives to increasingly scarce and expensive biomass, such as biogas plants and improved cookstoves.[67]

Table 5: Estimated GHG emissions savings

Project	Energy technology	Estimated emissions savings[68] (tonnes of CO_2 per year)
BSP Nepal	Biogas plants	613,470
REDP Nepal	Micro-hydro power	191,000
StoveTec	Improved stoves (domestic)	135,000
IWM Nepal	Improved water mills	92,813
TIDE India	Improved biomass stoves (industries)	85,464
RERED Sri Lanka	SHSs and village hydro power systems	4,599
ACCESS Philippines	SHSs	1,830
Sengor Bhutan	Micro-hydro power	53
Sunlabob Lao People's Democratic Republic	Solar lanterns	30

2.1.8 MDG 8: Promoting global partnership for development[69]

Impact on MDG 8	No. of projects reporting impact
Partnerships between communities and development actors	13
Partnerships between development programmes	13
Improved access to information through television, radio and Internet	8

The Review assessed local-, national- and global-level partnerships and linkages created by the energy projects. It also looked at project impacts on access to information (via television, radio and Internet).

Bringing communities together to achieve common goals. Energy projects, particularly those that are community managed, bring people together to work towards common development goals. For example, remote Nepalese communities, using REDP micro-hydro work as a starting point, have undertaken other village development activities, including road-building, renovation of irrigation canals and the construction of toilets. Similarly, the Sengor micro-hydro plant in Bhutan brought several institutions together to work on community development, including the Sengor National Park Authority, regional agricultural marketing services, the Bhutan Tourism Council and the Department of Livestock. The latter established a milk-processing unit and marketing infrastructure for dairy products.

67 A biogas plant on average replaces 2.5-3 tonnes of firewood and around 6.5 litres of kerosene burned annually in a rural household in Nepal (BSP case study).

68 Based on UNFCCC methodologies.

69 MDG 8 has six targets: 1) to further develop an open, rule-based, predictable, non-discriminatory trading and financial system; 2) to address special needs of least developed countries; 3) to address the special needs of landlocked developing countries and small-island developing states; 4) to deal with the debt problems of developing countries; 5) to provide access to affordable essential drugs in developing countries; and 6) in cooperation with the private sector, to make available the benefits of new technologies, particularly information and communications.

Partnerships with other development programmes. Most energy projects forged partnerships with other development programmes. REDP Nepal, for example, collaborated with other RE programmes such as the Energy Sector Assistance Programme, BSP Nepal, IWM Nepal and the national improved cookstoves programme. Several projects – BSP Nepal, Sunlabob Lao People's Democratic Republic, StoveTec and REDP Nepal – succeeded, through partnerships with other development partners and programmes, in replicating their technologies and service delivery models in other countries.[70] A number of projects received international awards, including the Ashden Award for Sustainable Energy, typically reinvesting the prize money in the project.[71]

Improving connections with the larger world. Communities in all project sites gave high priority to improving access to information through television, radio and Internet. With the advent of electricity, households tend to buy television sets as soon as they can afford them. In Lao People's Democratic Republic, solar lanterns serve as effective portable power supplies when equipped with a power outlet, and are used to charge mobile phones and operate small electrical appliances such as radios or mini-televisions.

2.2 Achieving numbers: expansion of energy services to the poor

Factors influencing the expansion of energy projects are described below.

Technology choices. A simple, wood-based improved cookstove is far easier to disseminate in large numbers than gasification-based cookstoves, which require users to switch to other fuel types and undergo training in operation and maintenance.

Geographical location. An energy access project in a sparsely populated country with scattered habitation has a different expansion potential compared to projects undertaken in large, densely populated countries. The challenges faced by island communities such as those found in Fiji, Vanuatu and the Philippines are particularly daunting. High transaction costs mean that energy access projects in these locations are likely to need many years to establish a sustainable service delivery model, and even longer to scale up their services to large numbers of people. Projects in close proximity to urban centres, roads, markets and other infrastructure typically need to expend less effort.

Project objectives. Expansion rates among projects focused on social objectives, for example poverty reduction, are likely to differ from those associated with profit-oriented dissemination of products and services.

Box 5: Expansion impacts of energy access projects

- DPBURC China project built 30 million biogas systems, benefitting around 105 million people (2001-2010).
- RGGVY India extended electricity to 11.8 million households in India (2005-2010).
- BSP Nepal installed over 225,000 biogas plants, covering 1.36 million people (2003-2010).
- FREP increased the proportion of Fiji's rural population with access to electricity from 30.6 to 81.4 percent (1986-2007).
- The Rural Energy Development Programme (REDP) Nepal reached more than 550,000 people living in rural Nepal through micro-hydro systems, SHSs, biogas plants and improved cookstoves (1996-2010).
- RERED Sri Lanka enabled electricity access to 134,000 households (1997-2010).[72]
- Shengzhou Stove Manufacturer disseminated around 100,000 improved stoves around the world in its first year of operation.

Institutional capacity. Institutional capacity to coordinate the efforts of energy services providers (including local governments and authorities, communities and the private sector) and to mainstream energy access into national and sectoral development strategies is one of the necessary conditions for scaling up.

[70] BSP staff has been involved in training and construction of biogas plants in eight countries in Asia and Africa. One of StoveTec's partners is GIZ, which manages two programmes in southern Africa that are disseminating StoveTec stoves of rural and urban markets.

[71] StoveTec, TIDE India, Sunlabob Lao People's Democratic Republic, IWM Nepal and BSP Nepal all received the Ashden Award. Case studies and further documentation of these projects are available at Ashden Awards for Sustainable Energy (2011).

[72] The ESD project, implemented between 1997 and 2002, was followed by the current RERED project. Both have been implemented with assistance from the International Development Association (IDA) of the World Bank and the Global Environment Facility (GEF).

Table 6: Population reached and years of project operation, selected projects

Programme/project	Technology	No. of years in operation	Budget (million USD)	Population reached (million)
DPBURC China	Biogas	5	5,870.000	105.00
BSP Nepal	Biogas	7	19.070	1.36
RGGVY India	Electrification	5	6,400.000	60.00
FREP Fiji	Electrification	20	42.000[73]	0.40
RERED Sri Lanka	Electrification (village hydro, SHSs)	13	123.000	0.67
REDP Nepal	Electrification (micro-hydro)	13	35.000	0.55
ACCESS Philippines	Electrification (SPV)	5	11.300	0.04
TIDE India	Improved stoves (industrial and domestic)	10	0.876	0.14
StoveTec (global)	Improved stoves (domestic)	3	1.500	0.45
IWM Nepal	Improved water mills	7	1.096	1.35

The reviewed projects demonstrate different scales of operation and different expansion paths (see Box 5). Table 6, below, presents data on the number of beneficiaries reached.

Several projects have been replicated in other countries, either completely or in part. Large-scale replication is seen, for example, in the case of the biogas programme supported by the Netherlands Development Organisation (SNV) and the Directorate General for International Cooperation of the Netherlands (DGIS) that started in Nepal and has been adopted in several Asian countries. By partnering with humanitarian agencies, StoveTec has expanded its dissemination of improved stoves around the world, while elements of the REDP Nepal model are being replicated in Afghanistan, Tajikistan and Timor-Leste. Still in pilot form, the Sunlabob solar lantern rental model is being replicated in Afghanistan and Uganda.

All reviewed projects started with relatively modest targets. Their efforts during the initial years focused on pilot activities, market development, establishing necessary institutional structures and progressing on to market expansion and consolidation.[74]

Several conditions need to be in place before significant expansion occurs. The product should be extensively tested and accepted by users. A supply chain that includes at least some reliable technology suppliers needs to be in place, together with well-tested delivery models and end-user financing schemes. There is also a need for a critical mass of competent service providers, including project developers and consultants. A well-articulated government commitment to energy access and assurances of medium- to long-term funding (from the government and/or development partners) are important in eliminating uncertainties in the minds of end-users, technology suppliers and others.

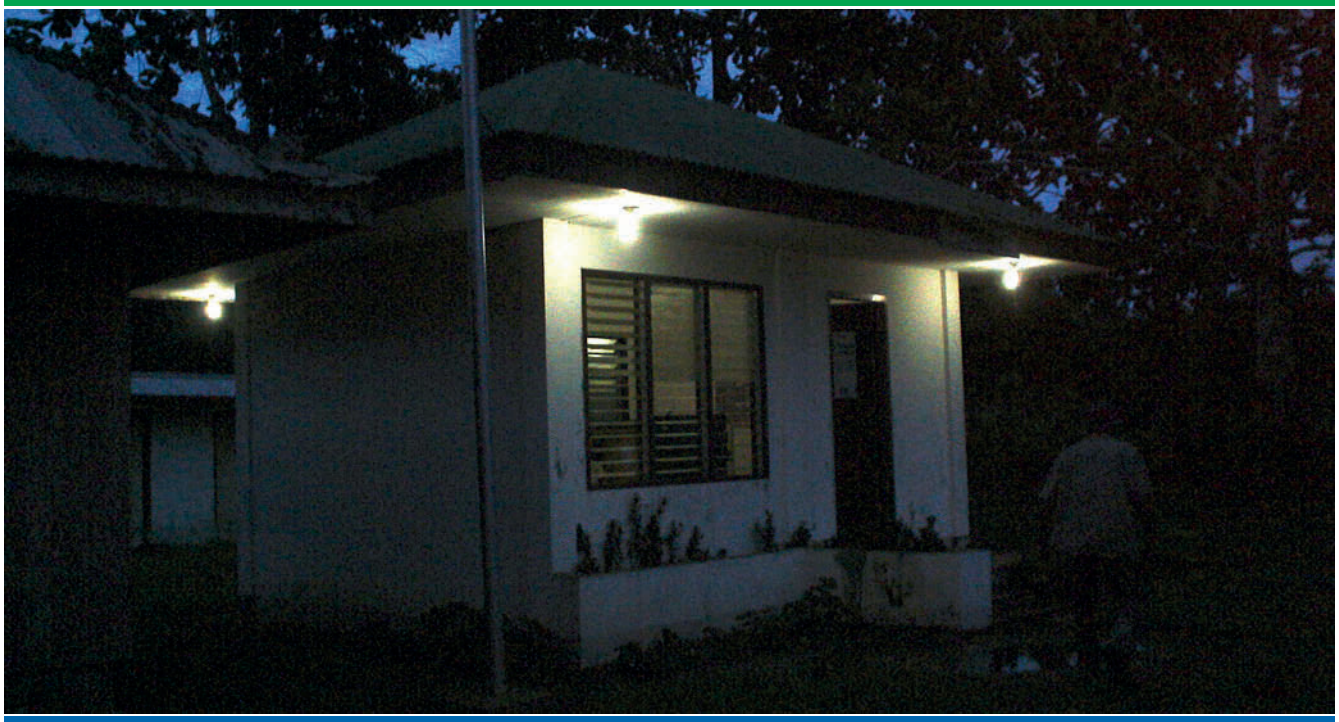
[73] From 1974 until the present.

[74] REDP Nepal, REREDP Sri Lanka, BSP Nepal and TIDE India case studies discuss the expansion paths of these energy access projects in detail.

UNDP/Energy Access for Poverty Reduction/Sengor – Bhutan

Wiring for household electrification. Project: Sengor – Bhutan.

3 Towards an 'Energy Plus' approach



UNDP/Energy Access for Poverty Reduction/ACCESS – the Philippines

Lighting homes through solar home systems. Project: Accelerating Community Electricity Services using Solar (ACCESS) – the Philippines.

- Traditionally, many energy access programmes have employed a 'minimalist' approach, focusing only on the basic energy needs of the poor while providing little opportunities to increase their income.
- The energy-poverty cycle is best addressed using an 'Energy Plus' approach, by combining energy service delivery with other poverty reduction initiatives.

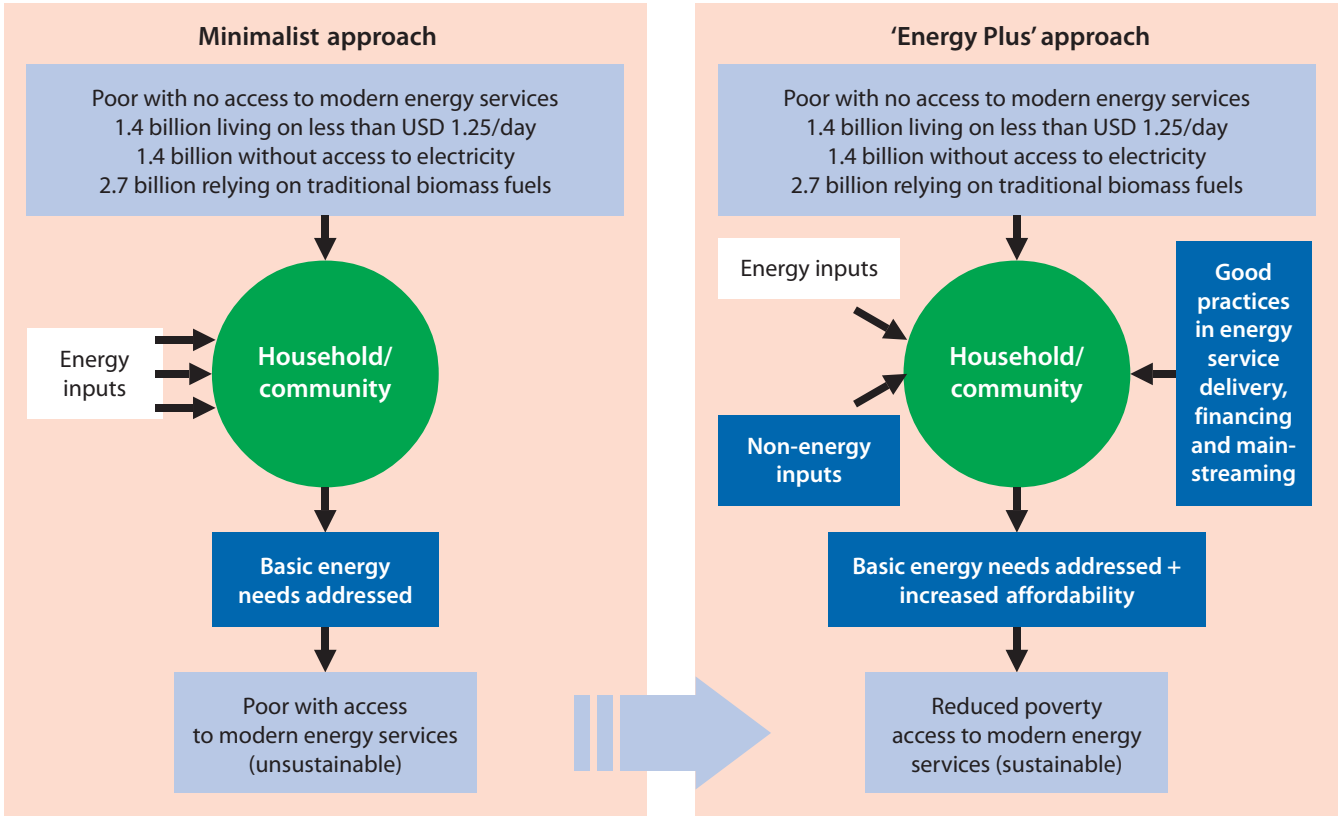
3. Towards an 'Energy Plus' approach

3.1 Minimalist energy access programmes

Traditionally, energy access programmes have employed a 'minimalist' approach, focusing mostly on the basic energy needs of the poor at household and community levels.[75] Rural electrification programmes, for example, primarily provide basic home lighting, rather than electricity for other power applications (e.g. for heating, cottage industries and agro-processing) that would help increase incomes. Other necessary inputs in reducing poverty – among them access to information, market linkages, business development services and capital – do not normally receive the attention they merit.

'Poor with energy access'. Energy services per se do not reduce poverty. Instead, they transform people from being 'poor without energy access' to 'poor with energy access' – a poor family with two light bulbs, or a poor family using an improved cookstove (see Figure 4, left panel). This is because the energy services provided do not open opportunities to poor households to increase their incomes. Therefore, the resources needed to acquire modern energy services continue to be limited, and energy programmes and projects are forced to rely perpetually on unsustainable subsidies.

Figure 4: Transition to the 'Energy Plus' approach



Sources: Data from IEA et al., 2010 and UN, 2010.

By itself, energy can only start a process of rural transformation and poverty reduction.[76] Other inputs are needed to bring about more profound changes. Energy uses are determined first by immediate subsistence needs, and then by the livelihood opportunities and available resources. For the poor, the prospects of using energy services to pull themselves out of poverty are influenced by whether other complementary inputs are available, including:

75 ENERGIA, 2008.

76 Ramani et al., 2003.

- infrastructure (e.g. roads and communications);
- access to markets;
- access to capital;
- availability of information and skills training; and
- social services such as medical facilities and schools.

3.2 Poverty reduction impacts of energy access projects

The reviewed projects showed a marked divergence in poverty reduction impacts. All projects led to improvement in the quality of life of the communities in terms of health, education, access to information and convenience, even though these were not the primary project objectives. With respect to enhancing incomes and livelihoods most projects experienced modest success. On the other hand, projects such as REDP Nepal and IWM Nepal, which used an 'Energy Plus' approach by incorporating complementary inputs, showed promising results in terms of poverty reduction, significantly influencing project sustainability.[77]

3.3 Integrated 'Energy Plus' approaches

The reviewed projects demonstrate that the energy-poverty cycle can be broken more effectively by combining improved energy services with measures that generate cash incomes or improve livelihoods. Energy access projects should therefore include incentives for productive uses of provided energy, and be developed in conjunction with other development activities such as savings and credit facilities, road infrastructure and entrepreneurship development programmes.

This by no means undermines the importance of improving people's lives through benefits that do not always translate into money or income. It only asserts that an intervention strategy that pays equal, if not greater, attention to addressing poverty can go further. Energy service delivery on its own will have little impact beyond meeting subsistence household energy needs.

The transition to more comprehensive, integrated approaches should therefore be a priority. Provision of energy services must be combined with capacity development and productive uses of energy for income generation, which can contribute to improved household living standards and to increased capacity to pay for energy services. The right panel in Figure 4 on the previous page illustrates this approach.

Figure 5 uses the findings of the Review to present a condensed view of the proposed approach for expanding energy services for the poor. The left side of the chart highlights the challenges that energy practitioners are grappling with. The good practices and lessons learned are outlined in the centre panel (and are further elaborated upon in the following chapters). The right panel highlights the impacts that energy access projects have on the life of the poor, as evidenced by the projects reviewed.

Chapters 4-6 outline key ingredients of successful energy access programmes and projects that are necessary for this 'Energy Plus' approach by highlighting good practices and lessons learned from the projects. These are organized into three topics:

- energy service delivery;
- financing (project and end-user); and
- mainstreaming into national development strategies and priorities.

Each of these chapters:

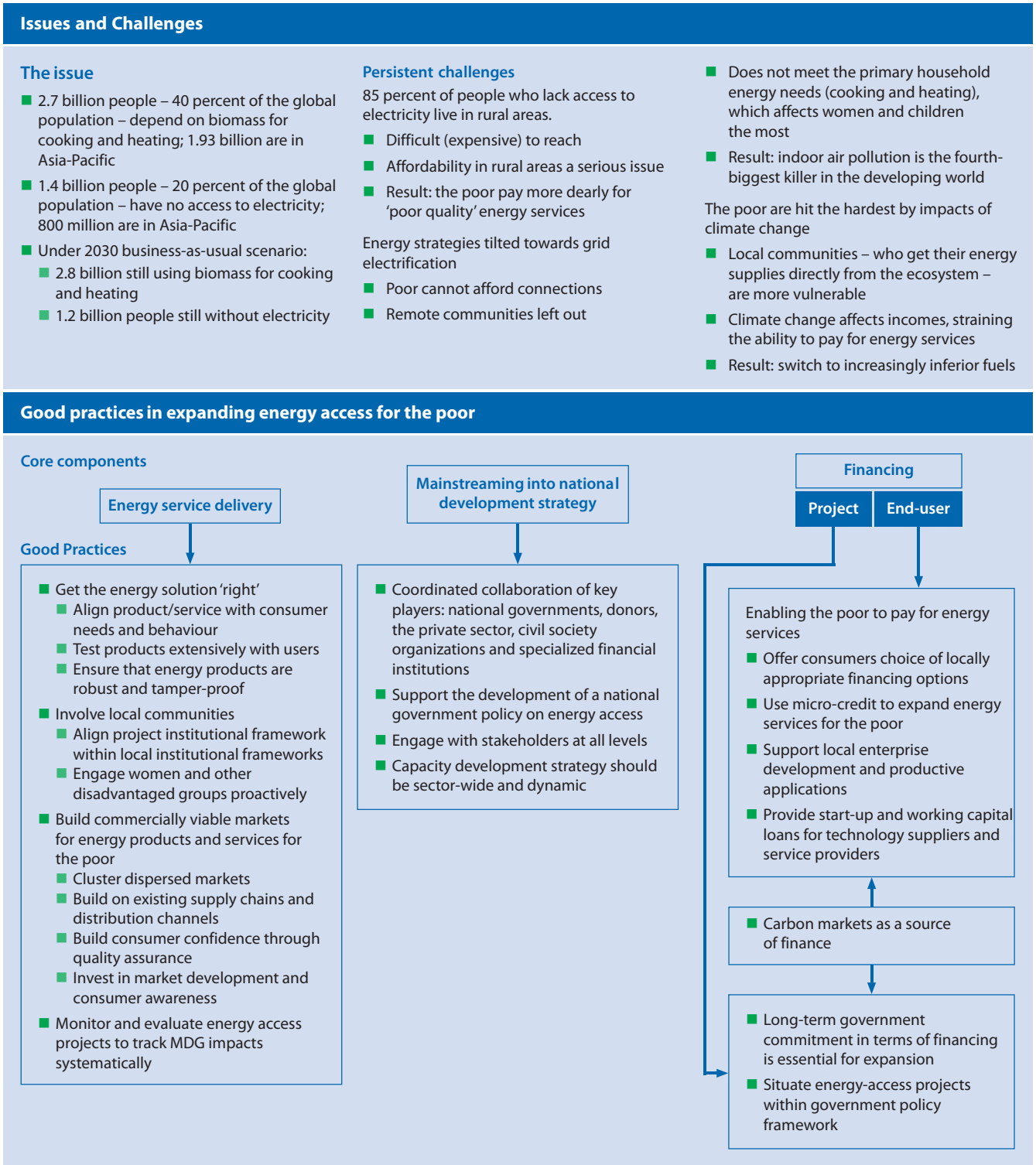
- discusses recent trends in each topic;
- identifies the core challenges to be addressed; and

[77] REDP complements energy access from a community-owned micro-hydro plant with skills training, loans for meeting investment costs of starting an enterprise and information and marketing support to communities.

- presents a set of good practices, with one or more examples from the projects reviewed.

Examples of good practices and lessons learned were selected primarily according to their respective merit or success, and they reflect, to the extent possible, different typologies of technology, geographical location and implementing agency.

Figure 5: Good practices and lessons learned in expanding energy services for the poor



4 Good practices and lessons learned: Energy service delivery

UNDP/Energy Access for Poverty Reduction/ACCESS – the Philippines

Erecting a solar photovoltaic system. Project: Accelerating Community Electricity Services using Solar (ACCESS) – the Philippines.

Identified good practices:

- Ensuring that the energy product/service is 'right', i.e. it is tested extensively, correctly matched with consumer needs and preferences and robust.
- Involving local communities by:
  - aligning the project within the local governance structures; and
  - ensuring that women and other disadvantaged groups participate and benefit at par with others, by:
    - emphasizing these target groups in project goals and objectives; and
    - reporting project results and disaggregating data by gender and community groups.
- Creating commercially viable markets for energy products and services by:
  - clustering dispersed markets;
  - building on existing supply chains, wherever possible;
  - enforcing strict quality control and accountability measures with technology suppliers and service providers; and
  - building consumer awareness, making them fully aware of service providers' obligations.
- Monitoring and evaluating projects and their MDG benefits.

4. Good practices and lessons learned: Energy service delivery

4.1 Mapping energy service delivery models

A number of delivery mechanisms, or combinations thereof, are being applied in the Asia-Pacific region. These are demonstrated in the energy projects under the Review, and are summarized below.[78]

Government-led energy programmes. In this model, national governments, provide subsidized energy services to the poor, as part of their mandate to provide basic services to all citizens. Examples include RGGVY India, FREP, CRE China and DPBURC China.

Commercialization via subsidy support. This model typically involves a public-private-civil society partnership, and has been applied for a range of technologies including improved cookstoves, biogas plants and SHS. The model includes the following features:

- a combination of government and donor funds are used to provide subsidies to meet upfront product costs. Subsidies are routed through technology suppliers, who are pre-qualified to participate in the programme and follow quality-standard guidelines;
- the private sector sells and services energy products under quality guidelines. As long as the company profits, market expansion continues;
- in some cases, the programme provides consumer financing for the purchase of systems through microfinance institutions (MFIs) or technology suppliers; and
- the programme undertakes campaigns to raise consumer awareness, supports market development and provides capacity development support to stakeholders.

Subsidy-supported commercialization approaches are able to increase sales volumes, strengthen the private sector and generate employment. BSP Nepal, which started with one biogas company (a joint venture involving three public organizations), now has 90 licensed private-sector biogas companies with around 200 offices, 16 workshops and a number of MFIs providing loans to biogas users. Other examples of this model include RERED Sri Lanka, IWM Nepal and ACCESS Philippines. These projects do not explicitly target the poor and benefits to the very poor, if any, are often indirect (for example, support for improved rural health clinics and providing community potable water supplies that all can access, regardless of income level).

Commercialization models. In this model, the private sector markets the product in a competitive market environment. The commercial model is challenged by the fact that often only a limited number of people can afford the systems at full cost. Hence, the model may not result in programmes or enterprises that reach the poorest people.[79] The Review has found that, of the 17 projects, StoveTec and Sunlabob Lao People's Democratic Republic most closely approach a commercial model, even though both access some amount of public funding (used primarily to diversify their services and products).

Commercialization supported by civil society. In this model, the private sector markets the product. Public funds are used by NGOs to increase project awareness, provide quality control and reduce capital costs through subsidies, loans and micro-credit. This model has been applied to household cooking technologies, improved cookstoves, biogas and SHSs. Examples include TIDE India, Jagriti India and BEST-OF-PREN Philippines.

78 Adapted from UNDP, 2008a.

79 UNDP, 2008a.

Public-private partnership in community-based RE systems. Like rural-based enterprises, this model meets operations and maintenance costs by collecting monthly tariffs on generated energy, and entrusts management of the technology to community representatives. Technologies include small hydro-power, SPV, wind and hybrid power systems and diesel generators. Project examples include REDP Nepal, Sengor Bhutan and VANREPA Vanuatu.

4.2 Sustainability of reviewed energy service delivery models

In providing energy services to the poor, sustainability is linked to the level of effort needed to continue the service after project completion. The Review suggests that sustainability comprises five dimensions: 1) suitability of technology; 2) social sustainability; 3) institutional sustainability; 4) financial sustainability; and 5) environmental sustainability.[80]

The reviewed projects adopted a range of measures to ensure that provision of energy products and services would continue even after project end. These measures are summarized in Table 7.

Table 7: Sustainability of energy projects

Dimension of sustainability	Issues to address	Good practices used to enhance sustainability (examples from reviewed projects)[81]
Suitability of technology	■ Does the technology meet the needs of end-users? ■ Is the technology reliable, and can it be operated by the users?	■ Precise alignment of product features with user needs (StoveTec, Sunlabob Lao People's Democratic Republic, VANREPA Vanuatu, IWM Nepal). ■ Extensive product testing with users, particularly women (StoveTec). ■ Strict quality control and accountability measures from technology suppliers and service providers (DPBURC China, BSP Nepal, RERED Sri Lanka, REDP Nepal). ■ Technical training of community representatives in systems O&M (BSP Nepal, REDP Nepal, IWM Nepal, ACCESS Philippines)
Social sustainability	■ Does the energy product/service improve the standard of living in the communities? ■ Do disadvantaged segments and women benefit adequately?	■ Stakeholder engagement from the beginning (REDP Nepal, TIDE India, Jagriti India, Sunlabob Lao People's Democratic Republic, VANREPA Vanuatu). ■ Extensive capacity development of communities in operating and maintaining the technologies and in managing the social processes (REDP Nepal, IWM Nepal, Sengor Bhutan, VANREPA Vanuatu).
Institutional sustainability	■ Will the institutions that have been set up continue to function once technical and financial support is withdrawn?	■ Capacity development of local institutions and national-level stakeholders (PREDP Timor-Leste, CRE China, REDP Nepal, RERED Sri Lanka). ■ Handing over project functions to non-project partners (BSP Nepal, IWM Nepal, TIDE India). ■ Integrating the project institutional mechanism into the national and local governance systems (REDP Nepal, IWM Nepal, VANREPA Vanuatu, Sunlabob Lao People's Democratic Republic). ■ Establishing systems for community-based monitoring (REDP Nepal, Sunlabob Lao People's Democratic Republic, VANREPA Vanuatu, Sengor Bhutan).

[80] Impacts on environmental sustainability are discussed in detail in Section 2.1.

[81] Details of these practices are presented in the respective case study reports.

Table 7: Sustainability of energy projects (continued)

Dimension of sustainability	Issues to address	Good practices used to enhance sustainability (examples from reviewed projects)[81]
Financial sustainability	■ To what extent has the project been able to motivate financial institutions to support energy services? ■ To what extent have the innovative financing mechanisms demonstrated been mainstreamed in partner organizations? ■ To what extent has the project been able to increase development support from outside sources? ■ Are the revenues enough to cover capital cost and cost of replacement? ■ Is the technology affordable to the end-user? ■ Is the delivery mechanism viable? ■ Does it cover at least the recurring costs?	■ Encouraging financial institutions and MFIs to finance energy technologies (RERED Sri Lanka, BEST-OF-PREN Philippines, BSP Nepal). ■ Increased government ownership of donor-funded projects over time (REDP Nepal, IWM Nepal, CRE China and DPBURC China). ■ Long-term financial commitment from the national government (RGGVY India, FREP, DPBURC China). ■ Strengthening linkages with other projects (REDP Nepal, CRE China, IWM Nepal). ■ Use of carbon finance, including the Clean Development Mechanism (CDM) (BSP Nepal). ■ Promoting productive uses of energy including business development, marketing support and low-interest loans to meet investment costs to set up enterprises (REDP Nepal, IWM Nepal). ■ Providing access to microfinance for end-users and to supplies of equipment and services (BSP Nepal, RERED Sri Lanka, BEST-OF-PREN Philippines).
Environmental sustainability	■ To what extent has the project promoted technologies that rely on renewable resources? ■ To what extent has the project promoted technologies that replace or reduce the use of fossil fuels and biomass? ■ To what extent has the project reduced indoor air pollution? ■ In what ways does the project contribute towards improved hygiene and sanitation?	■ Focus on the use of locally available and RE resources (REDP Nepal, RERED Sri Lanka, CRE China, IWM Nepal, Sengor Bhutan, VANREPA Vanuatu, PREDP Timor-Leste). ■ Promotion of technologies that reduce use of fossil fuels (IWM Nepal, TIDE India, DPBURC China, BEST-OF-PREN Philippines, Sunlabob Lao People's Democratic Republic, RERED Sri Lanka, REDP Nepal, ACCESS Philippines, VANREPA Vanuatu, PREDP Timor-Leste). ■ Promotion of technologies that reduce dependence on fuelwood (BSP Nepal, StoveTec, Sengor Bhutan, DPBURC China, Jagriti India). ■ Effective utilization of animal dung through biogas plants, hitherto a source of local pollution and ill-health (BSP Nepal, DPBURC China).

4.3 Getting the energy solution 'right'

Appropriately designed, practical energy products and services can change the lives of users. While the service may represent more than simply the hardware, the product itself must be proven cost effective and meet a specific need. Good practices in getting the energy product right are summarized below.

4.3.1 Aligning the product with consumer needs and behaviour

Energy needs vary according to geographical location, community demands and even individual household requirements. Successful delivery of products and services has to take account of these factors.

Innovate, yet keep it as familiar as possible. In general, products that do not require users to make major behavioural changes are accepted quickly and used more effectively. Sunlabob solar lanterns, for example, meet a need of rural poor in Lao People's Democratic Republic for reliable lighting and low-power charging (e.g. for mobile phones), and incorporate an affordable fee based on usage level rather than a fixed monthly charge. Similarly, VANREPA Vanuatu, through its centralized battery charging stations in Vanuatu's remote island of Futuna, meets two specific features that the people demand; portability and pay-as-you-go. This is compatible with traditional custom, where community houses (rather than individual households) serve as the centre of social activities and domestic chores that require portable lighting. In a limited cash economy, this also helps community members to pay a fee to recharge batteries as and when needed.

Avoid stigma of 'products for the poor'. Designing products that explicitly target the poor can be risky. Perception as a 'product for the poor' and inferior product quality can drive away customers. Good products are not merely useful tools they represent a lifestyle, and impart feelings and values.[82] The StoveTec experience indicates that users want attractive and convenient stoves, and are willing to pay for them as long as they meet their needs. Conversely, low-cost stoves of inconsistent quality, such as those mass-distributed under many government programmes, soon tend to lapse into disrepair because of lack of interest.

4.3.2 Testing products extensively with users

A fundamental marketing maxim is that one should understand precisely what the consumer needs and can pay for. This is impossible without systematic market research. Product development for energy services demands an interactive process that takes the poor seriously as customers, and understands their needs and constraints.

Engaging end-users in design. The design of StoveTec stoves is the result of design committees engaging with women in Central America, Africa and Asia. Extensive field-testing precedes stove dissemination in any new location. Before the stoves were launched in India in 2005, cooks in 10 villages participated in six-month design sessions, and prototype stoves incorporated their suggestions. The stoves had to please both the cooks and meet fuel-use and emission benchmarks of performance, first in the field and then in the Aprovecho Lab.[83]

4.3.3 Ensuring energy products are robust and tamper-proof

Product design should address ease, and economy of use and maintenance in remote locations. The product must prove robust, particularly in remote locations where servicing facilities may not be readily available. Some critical components thus may need to be centrally manufactured under strict quality control, as with StoveTec stoves. This reduces per-unit production costs and complements the continuous product improvement (for example, by involving extensive field tests with real-world cooks, as discussed above). Sunlabob, meanwhile, has kept the construction of its solar lanterns as simple as possible, at the same time ensuring versatility, robustness and ease of use (see Box 6). The lantern unit, disseminated in rural Lao People's Democratic Republic since 2000, comprises an energy-efficient lamp, battery and control electronics.

Box 6: Sunlabob Solar Lantern: robust yet user-friendly

Sunlabob used the following specifications for its solar lantern:

- a robust, tamper-proof casing to protect internal components;
- a polypropylene cover for additional light bulb protection;
- repositioning of electronic components to the top of the lantern to avoid potential water damage; and
- additional LED indicator to indicate the number of remaining hours of light.

The company also added a function to the lantern's microprocessor to measure each lantern's usage in terms of hours (essential for carbon-trading opportunities).

Sunlabob also applies good practices in product development, an approach illustrated in Figure 6. The project began by disseminating SHSs through a rental model, but soon recognized the associated pitfalls and transitioned to rental-based solar lanterns for poor households, charged at a central station operated by village entrepreneurs.

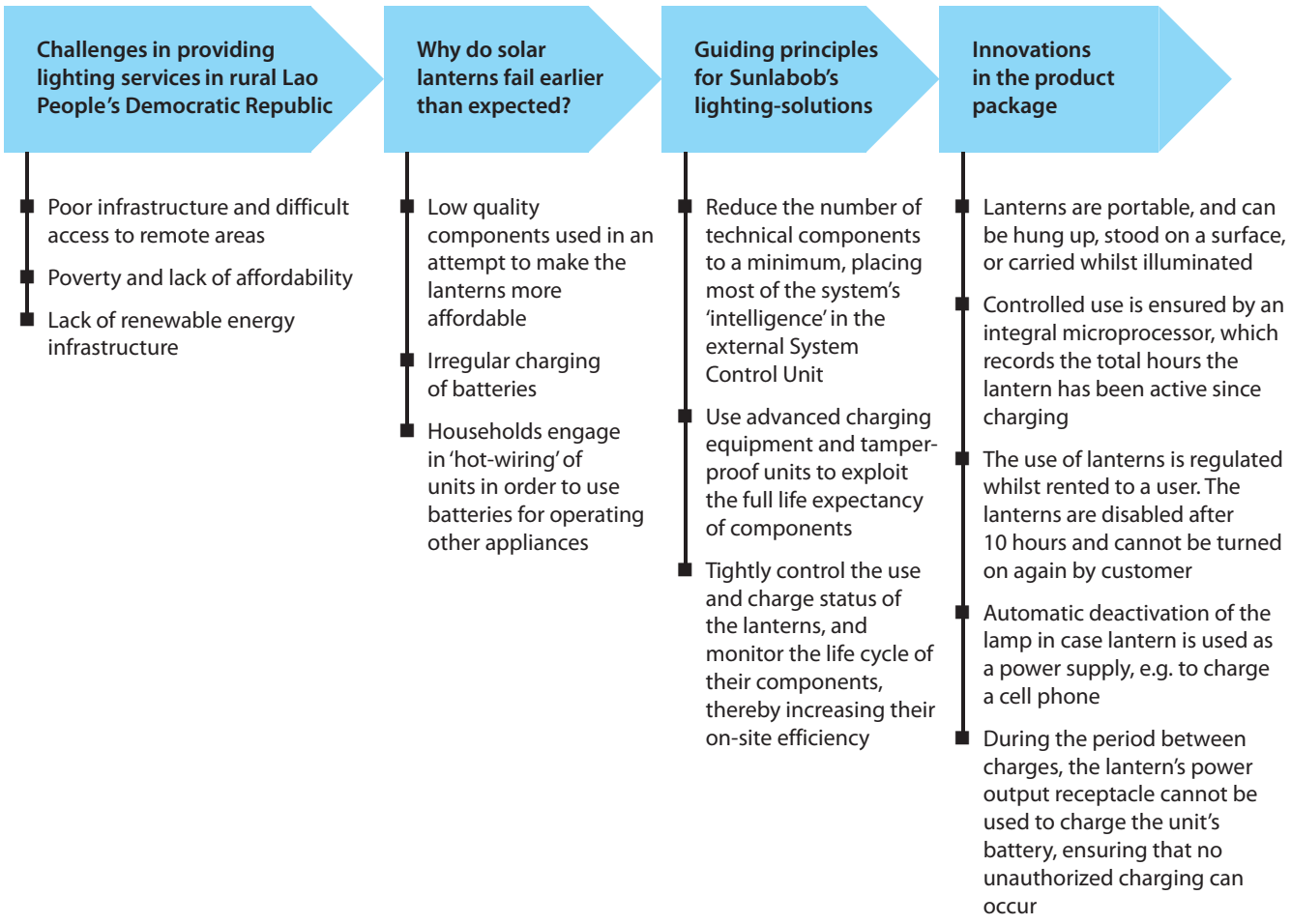
4.4 Involving communities and addressing gender issues

Peoples' participation can differ in different project contexts. For example, StoveTec mass-markets improved stoves; involving communities means incorporating the preferences of women as potential stove users through product testing, awareness campaigns, staying in touch with users to solicit feedback on stove performance and engaging with local distributors.

82 Hieirli, 2000.

83 The stove design went to manufacturing only after it was approved by the cooks. It uses less than 850 grams of wood to boil five litres of water and then simmer it for 45 minutes, and it can be sold for USD 10-15. While heating water, the stove has to emit fewer than 20 grams of carbon monoxide and fewer than 1,500 mg of particulate matter.

Figure 6: Sunlabob solar lanterns: Good practices in product development



Installation of village hydro systems under REDP Nepal or RERED Sri Lanka, on the other hand, calls for a different type of engagement. REDP and RERED involve community members in discussions of VHP system potential; site selection; planning, installing and commissioning the system; and embedding mechanisms for management, including setting tariffs, hiring operators and developing capacities in operating and troubleshooting. Key elements of REDP Nepal's successful community mobilization strategy are outlined in Box 7.

Box 7: Community-driven micro-hydro development in Nepal: the REDP model

Rural communities are central to REDP's model of promoting micro-hydro power plants. REDP does not merely build the plants and hand them over to the community upon completion. Instead, it develops community members' capacity to manage and operate the plants themselves, including fund management. After construction, REDP's roles are limited to facilitation, technical assistance, and monitoring and evaluation. REDP's community mobilization process applies six basic principles:

- Empowerment of vulnerable communities, which include women, *dalits* (persons traditionally regarded as low caste), ethnic communities and poor households;
- Mandatory participation of 100 percent of community households in programme activities;
- Mandatory participation of one man and one woman from each household in programme activities;
- Formation of separate male and female community organizations in programme communities, which meet weekly and are provided targeted capacity development;
- Prioritization of women in human resources development initiatives; and
- Inclusion of vulnerable communities, through their representatives, in all community-based organizations (CBOs) and in the district and central management systems.

The impacts of REDP's community mobilization are visible. All households contribute to and have a sense of ownership regarding the micro-hydro or energy system, and they share the benefits (electricity and tariff revenues) equally. If some poor households are unable to contribute cash or raise collateral for a bank loan, they are allowed to contribute in kind and labour. If they are unable to pay the electricity tariff in cash, they can work at canal cleaning or repairs, for example, with wages being applied to electricity tariff payments.

The experiences from the reviewed projects suggest the following good practices in involving communities.

4.4.1 Aligning project institutional set-up within existing local governance structures

Aligning the institutional set-up for energy projects within existing local governance structures offers several advantages:

- it helps the project get 'buy-in' from the community and from local governance institutions;
- it increases the involvement and accountability of local representatives by assigning them key responsibilities; and
- it can assure the project a degree of social sustainability.

Sunlabob's SLRS makes full use of existing governance structures in rural Lao People's Democratic Republic. A Village Energy Committee is established to manage the project, which replicates existing governance systems and harmonizes with traditional village management of community-level affairs. At the village level, there are three representatives of the central government: a village chief, a representative of the Lao Women's Union (LWU) and a representative of the Lao People's Revolutionary Youth Union (LPRYU).[84] All three representatives are elected by their community and their authority is recognized. Hence, by including at least these three people in the Village Energy Committee, the SLRS model ensures good governance of village services.

In DPBURC China, the Chinese Ministry of Agriculture (MoA) has a complete network of RE services, from the central to the provincial, municipal and county levels. Almost every provincial government and more than 90 percent of county governments have set up a special authority dedicated to rural energy administration and new energy/technology promotion. Each of the five levels of governance institutions has its unique and well-defined role in the execution of DPBURC China.

4.4.2 Engaging women proactively

Failure to target. Service delivery models used by the reviewed projects paid inadequate attention to the energy needs of women in the project communities. Only seven of the 16 reporting projects tracked and were therefore able to present data disaggregated by gender.

Potentially significant impacts. As suggested in Section 2.1, energy services have potentially significant impacts on women's lives. The engagement of women is all the more important because they are the principal energy users and planners in households across most communities. In most projects these impacts are incidental: they are neither planned for nor monitored systematically. On the other hand, in projects such as REDP Nepal, where women are identified as specific target groups, and concrete measures are implemented towards involving them, the impacts reported are greater (see Box 7).

More clarity of gender focus needed. In spite of REDP Nepal's various gender-focused activities, greater clarity of focus is needed in realizing its overall gender policy. Nowhere – neither in the programme documents, nor to the knowledge of programme personnel as reported – is it clear whether REDP Nepal aims to ensure that women's basic energy needs are met, to empower women through energy services or to do both. In the absence of clarity on goals, monitoring gender outcomes and tracking the effectiveness of strategies for the programme becomes difficult.[85]

In summary, good practices to address gender issues through energy programmes include:

- clearly articulating the emphasis on women as a target group in programme objectives; and
- reporting project results and disaggregating monitoring data by gender.

[84] The Lao Women's Union provides the national machinery for the advancement of women in Lao People's Democratic Republic. It is a mass organization with a network extending from central to grassroots levels. The Lao People's Revolutionary Youth Union is a mass organization dedicated to mobilizing youth throughout the country to contribute to national development.

[85] Dutta et al., 2007.

4.5 Building commercially viable production systems, supply chains and markets

The problem. Market creation is a long-term process which is successful only when it reaches a critical mass of demand, particularly in poor areas. Yet market development does not happen by itself. Most often the private sector steps in only when the volume of goods sold allows a profitable supply chain. Experience shows that markets for energy services will continue to grow as long as the private sector meets a demand and profits from the sale of energy products.

The challenges. In developing energy markets for poor communities, the challenge is how to support viable private-sector enterprise while ensuring that benefits of the commercial energy services reach poor households. Another challenge is to ensure that the poor receive high-quality products and service and maintenance support.

Good practices in creating commercially viable production systems, supply chain and markets are provided below.

4.5.1 Clustering dispersed markets

SPV systems have a long history in the Philippines, with more than 3,000 SPV systems installed thus far. The market has been mainly restricted to public facilities, and households have benefited only on a small, fragmented scale. Extremely dispersed habitations and fragmented markets have meant high transaction costs, low sales and unviable business prospects for SPV companies.

ACCESS Philippines was launched by the Department of Energy (DoE) in 2003 to electrify remote and poor *barangays* (local administrative units). Learning from experience, ACCESS has introduced several measures to enhance the viability of the private sector in providing energy services to poor, remote locations. These include 'bundling' *barangays* into viable units, ensuring a minimum baseload for each operator and supporting a host of market support activities. ACCESS's implementation strategy includes these key elements:

- the DoE maintains a database of un-electrified *barangays*, categorized according to market demand, social acceptability of SPV in the social/cultural environment and availability of financing through MFIs;
- contiguous *barangays* are clustered into commercially viable Sustainable Solar Market Packages (SSMPs) and bid out to private sector service providers on a competitive basis;
- each SSMP comprises a baseload from community facilities (e.g. *barangay* halls, health facilities, schools and public streetlights). The contractor also has to electrify at least 25 percent of households within a community and meet minimum equipment and service standards; and
- a single SSMP contractor is selected through competitive bidding for each cluster. Each contract covers a cluster of contiguous communities, providing sufficient scale for the contractor to sustain after-sales maintenance, repairs and spare parts services. A contractor may win multiple SSMP contracts, and is eligible to bid for additional contracts for supply or maintenance in the same areas.

Clustering to reach 'last mile' areas. Through these strategies, ACCESS has motivated the private sector to enter and serve a market segment – remote *barangays* with poor populations – traditionally considered commercially unviable and thus unattractive. Systematic market surveys provide a good basis for the contractors to make informed decisions about their client profile, what challenges to expect, which marketing strategies to adopt and which partners to link with. Clustering of demand also makes it viable for the private contractors to invest in repairs and maintenance infrastructure, and to train local staff (essential for the sustainability for SPV systems). The clustering approach is thus helping to reach the 'last mile', un-electrified *barangays* situated in remote, far-flung rural areas. The government is about to achieve its 100 percent *barangay* electrification target and will be working on the secondary objective of 90 percent household electrification.[86]

[86] A *barangay* is said to be electrified if facilities exist to accommodate customer requests for connections, even if no connections have yet been made. When extending the grid, a *barangay* is considered electrified if the distribution line has reached the *barangay*, or at least one public facility or 50 percent of potential households are connected. In off-grid areas a *barangay* is considered electrified if at least 20 households have availed themselves of electricity services. Thus, 100 percent *barangay* electrification means that all the *barangays* fall into one of these two categories (Castalia, 2004; DoE personal communication, 2010).

4.5.2 Building on existing supply chains

Establishing a supply chain to reach end-users can be a long process. Local institutions and companies involved need employees with knowledge of products, markets, and installation and maintenance processes. Such employees can be difficult to find and expensive to keep. Rather than trying to create large-scale production and distribution chains from the ground up, projects have found that using established distribution channels has worked well, particularly with improved cookstoves.

For example, the StoveTec marketing strategy involves identifying local distribution partners who use a variety of financing mechanisms, depending on their market and their mission. Regional distribution hubs are being established with partners in India, the Republic of Haiti, the Republic of Kenya, the Republic of the Marshall Islands, the United Mexican States, the Republic of Nicaragua, the Federal Republic of Nigeria, the Republic of South Africa and the Republic of Uganda. Recently, SPV stores in Nicaragua have begun selling StoveTec stoves, while a utility in Botswana is offering the stoves to their consumers. In Nigeria, Kadsol Ltd., a logistics company, is a StoveTec partner. In Uganda, a partnership is being developed with Micro Energy International, a large MFI which plans to target small retailers that can distribute improved cookstoves. StoveTec also has linked with the German Agency for Technical Cooperation (GTZ) Programme for Basic Energy and Conservation, and uses its existing distribution chains for scaling up.[87] A network of 40 energy stores in South Africa now offers the stoves for sale. By relying on multiple distribution channels, StoveTec is able to tap far-flung markets in developing countries, while avoiding investment in developing these *de novo*.

In southern India, the NGO Envirofit has sold more than 100,000 biomass stoves in four states. Envirofit stoves are sold through a multi-tier distribution strategy involving dealers, distributors, village entrepreneurs and not-for-profit organizations. Envirofit has over 500 channel partners with roughly 1,500 outlets throughout southern India.

Advantages of using existing supply chains, in the experience of StoveTec, are manifold:

- StoveTec is able to avoid the challenges of high set-up costs, management requirements, resource availability and productivity constraints;
- strong distribution partners help StoveTec gain user acceptance;
- the strategy helps to increase the profitability of local businesses and generate employment; and
- in many cases, it encourages new entrepreneurs (motivated by the profits) to enter the market.

4.5.3 Building consumer confidence through quality assurance

A common element in projects that have adopted commercialized approaches is the emphasis on quality control. These projects help the private sector through support with market development, but in return clearly expect quality services. For example, BSP Nepal believes the quality of biogas plants determines the level of user satisfaction, and that satisfied customers make the best promoters of biogas technology. BSP Nepal has thus instituted the following strict quality control measures:

- **Standardized design.** BSP allows only one biogas plant design, which comes in four standard sizes. All companies must follow design specifications;[88]
- **Technical standards.** BPS has developed technical standards for biogas plants (specifying more than 80 parameters) that are incorporated in agreements with biogas companies;
- **Monitoring.** BSP inspects a minimum of 5 percent of newly constructed plants within the two-year guarantee period. Based on these visits, BSP sends early warning reports to biogas companies on required improvements and repairs;
- **Assigned enterprise responsibilities.** BSP requires all biogas companies to provide warranties on the plants built, currently through the ISO 9000 certification process;
- **Grading and sanctions of enterprise performance.** BSP grades biogas companies based on the field performance of their plants. Penalties and bonuses are imposed according to grades awarded; and

87 In January 2011, the GTZ became a part of the German Agency for International Cooperation (GIZ) comprising German Development Service (DED), German Agency for Technical Cooperation (GTZ) and Capacity Building International (InWEnt).

88 UNDP, 2008a.

- **Counselling and support.** BSP provides counselling and support for weak companies, helping them to improve their performance. If a company receives the lowest grade for two years, it must quit the biogas sector.

BSP's carrot-and-stick approach has been instrumental in developing the market. On the one hand, it has invested public funding in market development and subsidizing biogas plants. On the other, it has imposed strict qualification mechanisms for biogas companies, together with subsequent performance evaluations followed by rewards and penalties.

Sustainability and efficient scaling up among the benefits. Advantages have proven considerable in terms of sustainability and efficient scaling up. According to BSP, about 97 percent of total plants installed since 1992 are operational.[89] Similar examples are available from RERED Sri Lanka, REDP Nepal and ACCESS Philippines. Other common elements in successful projects include:

- pre-qualification of technology suppliers to make them eligible for subsidies and incentives;
- strict enforcement of technical standards and guidelines;
- inclusion of performance guarantees in contracts with suppliers; and
- education of consumers, thoroughly acquainting them with service-provider obligations.

4.5.4 Investing in market development and consumer awareness

Well-targeted product promotion is critical to reaching poor communities. Product promotion often begins well before commercialization, raising awareness among prospective customers and promoting the product among potential technology suppliers and dealers.

BSP Nepal has different sets of marketing strategies. In areas with a developed market for biogas plants, it allows biogas companies and MFIs to control all promotional and marketing activities. In areas where the market is undeveloped, it works with local government bodies, or with networks of NGOs, CBOs or cooperatives to create demand through awareness building, training, demonstrations and piloting. Once a basic awareness is created, the biogas companies start construction of biogas plants and provide aftersales service.

DPBURC China has an extensive promotional programme which relies on a variety of means including television, radio, newspapers, books, brochures, posters, banners, streamers and mobile loudspeakers. A project website established by the MoA publicizes relevant state policies, incentives and technical codes to promote biogas technology, and announces meetings organized by local project-executing agencies. At the central level, the MoA organizes a conference on biogas construction every year, and similar meetings are organized at local levels.

Existing market infrastructure determines the choice of delivery model. The choice of the most suitable delivery model will be determined by the stage or level of development of the existing market infrastructure. At one extreme, an energy project may be initiated in an area with poor physical infrastructure and where the private sector is non-existent. Remote islands with subsistence, barter-type economies in the Pacific Island countries fall into this category. In such locations, building a market for energy services is tantamount to creating the market from start. In general, a rudimentary market infrastructure is a minimum prerequisite for developing markets for energy services.

The market for biogas plants in Nepal may be taken to represent the other extreme. Launched in 1992, the first 10 years of BSP Nepal saw a steady increase in construction of biogas plants. After 2000-2001, market growth slowed down. The main reasons for this shortfall include political conflict, rises in raw material costs, a decline in the level of subsidy and market saturation. Since 2003, the BSP market has consolidated. Contributory factors include the end of the political conflict, an increased regular subsidy (adjusted upwards for inflation), introduction of new modalities for the private sector aiming to improve enterprise performance (including enforcement of codes of conduct), increased availability of micro-credit, and additional subsidies for poor, socially oppressed and indigenous communities.

Table 8 summarizes the type of activities appropriate and most relevant – given the experiences of the projects reviewed – for providing energy services at various stages of market development.[90]

[89] Acharya et al., 2005.

[90] The stages of market development are derived from Hieirli, 2000.

Table 8: Good practices at different stages of market development

Good practices in energy service delivery	Level of market development			
	Undeveloped markets and non-existent private sector	Existing market infrastructure, but no energy service markets		
		Product development and introduction[91]	Maturation[92]	Saturation[93]
1. Develop the 'right' energy solution				
a. Assess consumer needs	●	●		
b. Design and test products for usefulness and robustness	●	●		
c. Build awareness about energy product and service	●	●		
2. Institute financing mechanisms for the end-user (discussed in Chapter 5)	●	●	●	
3. Assess alternative service-delivery models, including assessment of existing market infrastructure and supply chains and institutional and community capacities				
a. Commercialization model (building sustainable energy markets)				
– Strengthen supply chains (build on existing chains or create new ones)	●	●		
– Help the private sector to create critical mass of demand (cluster demand)			●	
b. Assess alternatives (government- or civil society-led)	●			
4. Institute quality control mechanisms	●	●	●	
5. Introduce new products and diversify				●
6. Involve communities				
a. Assess consumer needs and product development	●	●		
b. Build capacity of community to operate and maintain energy systems	●		●	
c. Involve women and disadvantaged groups	●	●	●	●

91 At this stage, prototypes for new products and services are tested and tried.

92 This is the stage when the market picks up, demonstration effects lead to higher sales and higher profits, and new units join the delivery channel.

93 Here, the product sales decline and profits and some units may withdraw. Introducing new products or moving to new markets may be needed to sustain sales.

Table 9: MDG benefits of energy access projects

MDG	Project outcomes
MDG 1: Reducing extreme poverty and hunger	■ Improved fuel efficiency reduces household expenditure on energy ■ Energy used for productive purposes increases incomes ■ Renewable energy projects create employment for communities ■ Electricity brings about lifestyle changes and makes housework easier
MDG 2: Achieving universal primary education	■ Improved lighting enables children to study in the evenings ■ Freeing children from fuelwood collection enables them to study and attend school
MDG 3: Promoting gender equality and empowering women	■ Access to modern energy frees women's time formerly devoted to fuelwood and water collection ■ Electrification increases women's access to information through television and other media ■ Energy services bring new training opportunities for women and men
MDG 4: Reducing child mortality	■ The use of improved cookstoves and biogas plants reduces ailments among children through reduced indoor air pollution ■ Improved lighting reduces exposure to polluting kerosene lamps ■ Affordable energy makes it possible to boil water, making it safe for consumption
MDG 5: Improving maternal health	■ Reducing labour of fuelwood collection and reducing exposure to smoke from the burning of biomass fuels in kitchens improve women's health ■ Affordable energy makes it possible to boil water, making it safe for consumption
MDG 6: Combating HIV/AIDS, malaria, tuberculosis and other diseases	■ Electrification makes possible the refrigeration of vaccines and lighting for clinical services ■ Reduced exposure to smoke from inefficient burning of biomass and solid fuels in kitchens improves health outcomes
MDG 7: Ensuring environmental sustainability	■ Reduced fuelwood consumption has a potentially positive impact on forest resources ■ Reduced use of fossil and biomass-based fuels can reduce GHG emissions ■ Improved burning of biomass reduces indoor air pollution
MDG 8: Promoting global partnerships for development	■ Community-managed energy projects bring communities together to work towards common development goals ■ Electrification makes it possible for communities to benefit from new technologies, particularly those related to information and communications (television, radio and internet) ■ Energy programmes and projects can collaborate with other non-energy development programmes

4.6 Monitoring energy access projects and tracking their MDG benefits systematically

Tracking MDG benefits. Monitoring comprises an integral component of project design. It begins with the setting of indicators for project objectives, outcomes, outputs and activities in the logical framework and continues throughout the project. Evaluation occurs periodically, usually at mid-term and at the end of the project. For energy access projects, the monitoring and evaluation frameworks should incorporate measureable outcomes to capture the MDG benefits. As part of the Review, a set of such outcomes was developed, from which data was collected from the projects reviewed (see Table 9). This may be used by future energy access projects.

Tracking changing market needs. Systematic monitoring enables projects to respond to changing market needs. The RERED (formerly ESD) project in Sri Lanka presents a good example. Project efforts in the first few years focused on the following measures:

- establishing and developing a legal framework for power generation through renewable resources;
- overcoming the financing barriers; and
- developing a critical mass of market players, including technology suppliers, consultants and project developers.

Phased market expansion in light of prevailing conditions and changing needs. Only after these measures were implemented did markets begin to expand. In fact, in many ways the ESD project may be considered a preparatory phase for RERED, which started five years later and which accelerated market expansion. Similarly, the first two phases of BSP Nepal focused on market development and on establishing necessary institutional structures and regulations, while the third phase (1997-2003) was geared towards market expansion, and the current phase (from 2003) focuses on further market consolidation.

Instrumental to the evolution of these and other such projects has been a tight monitoring and evaluation system, one that keeps reviewing risks and issues; and continuously gauging changing needs and aspirations of target beneficiaries.

UNDP/Energy Access for Poverty Reduction/IWM – Nepal

A woman operating a rice husker using an improved water mill. Project: IWM – Nepal.

5 Good practices and lessons learned: Financing

UNDP/Energy Access for Poverty Reduction/RGGVY – India

Electricity access to poor houses. Project: Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY) – India

Identified good practices:

- Situating energy access projects within national development frameworks.
- Providing consumers with a combination of locally appropriate financing options.
- Integrating productive uses of energy within larger project goals of livelihood enhancement and poverty reduction. A few projects show promising results for productive uses of energy, but have not yet scaled up these achievements.
- Providing start-up and working capital loans for technology suppliers and service providers.

Lessons learned:

- Long-term government commitment is the most important driver for financing expansion of access to energy services.
- Provision of micro-credit, supported by capacity development and long-term concessional financing, is instrumental in expanding access to energy services. Carbon finance does not currently provide an easily accessible financing option.

5. Good practices and lessons learned: financing

Major trends in project and end-user financing in the Asia-Pacific region include the following:

- government and donor financing continues to form the core of energy access projects;
- equipment subsidies, financed through public finances from governments and development partners, remain the primary financing mechanism for energy projects. Understandably, reliance on subsidies is highest in government-led programmes. In commercialization approaches, 30-40 percent of the upfront cost is met through subsidies;
- in donor-supported government energy projects, the government's contribution to subsidy is generally small but rising;[94]
- microfinancing has been instrumental for energy service expansion for the poor, but successful implementation is difficult to achieve; and
- a few projects show promising results with productive uses of energy, which is an effective strategy for making energy more affordable for end-users. However, these are yet to be scaled up.

In the following sections, the issue of financing is examined at two levels:

- project financing for energy service delivery; and
- end-user financing, or making energy services affordable.

5.1 Project financing for energy service delivery

5.1.1 Secure recurrent and sufficient government funding

The importance of commitment of national governments to provide energy services as a basic right cannot be overemphasized. Among the projects reviewed, those able to achieve a significant expansion have been backed by a commitment from their national governments – a commitment reflected in policy documents and supported by budgetary allocations and sub-national strategies necessary for large-scale expansion. A case study on the FREP observed:

> Where progress in getting energy to the poor has been made, it has usually resulted from political will and appropriate public policies, not from market forces… Developing the energy technologies needed seem to present less of a challenge than mustering the political will and developing the human capacity to employ them effectively.[95]

FREP, which nearly doubled overall access to electricity in Fiji in two decades, exemplifies the attitude that, given "…political commitment articulated in terms of national energy access targets and investments, we can achieve dramatic improvements in the provision of energy services for the poor…."[96] Over the years, the Government of Fiji's priority of rural electrification has been reiterated through various policy documents and setting of quantitative access targets (see Table 10). This well-articulated mandate has enabled the Government to make the necessary budgetary allocations.[97] Between 1994 and 2007, this allocation was FJD 54.3 million, for a yearly average of FJD 3.6 million.[98] For 2009 alone, almost FJD 20 million was made available to the programme.

94 For example, with BSP Nepal, a government-owned programme, 27 percent of the subsidy fund comes from the national coffers and is increasing annually. Also in Nepal, the IWM programme provides subsidies of up to 45 percent of cost of the water mill system. The Government's contribution is 20 percent; the rest comes from development partners.

95 UNDP, 2002, pp. 4, 12.

96 UNDP, 2007a.

97 Between 1994 and 2007, this allocation was FJD 54.3 million, for a yearly average of FJD 3.6 million. For 2009 alone, a total of FJD 7.795 million was made available to the programme, with another FJD 12 million added in October 2009.

98 FJD 1 = USD 0.56570, as of 9 September 2011 (www.xe.com).

Table 10: Government electricity access targets in Fiji

Access targets	Document	Year
'…electrify all rural villages within a period of approximately 11 years' (i.e. by 2004)	Rural Electrification Policy (1993)	1994
'95 percent of the urban population have access to electricity by 2005'	Strategic Development Plan 2003-2005	2002
'90 percent national electrification coverage by 2011 with urban increased from 95-100 percent and rural areas from 70-85 percent'	Strategic Development Plan 2007-2011	2006
'Pursue a 100 percent electrification coverage by the year 2016'	National Energy Strategic Action Plan	2006
'88 percent national electrification coverage by 2010 with urban areas increased from 95-98 percent and rural areas from 70-80 percent'	Sustainable Economic and Empowerment Development Strategy 2008-2010	2007

Box 8: CRE China: combining public, private and development financing

Backed by strong government commitment to the commercialization of RE, the CRE China project combined financing from various sources:

- market-based instruments that increased the financial attractiveness of investments in RE, attracting the private sector;[99]
- capital mobilized from national and local funds by combining the hybrid village power component of the project with the National Township Electrification programme; and
- donations from organizations such as WWF, Energy Foundation, UN Foundation, and bilateral and multilateral agencies.

Rural electrification is also a priority in the Philippines and is a clearly stated component of the Government's Medium Term Philippine Development Plan. The Government is encouraging greater private-sector participation in rural electrification activities by involving them in the provision of electricity services. As part of its Corporate Social Responsibility Programme, the DoE imposes a tax/levy to direct one centavo per kilowatt-hour (PHP 0.01/kWh) of electricity sales towards the electrification of un-electrified rural areas. At the same time, ACCESS Philippines clearly fits into this overall framework, and appears consistent in supporting the overall government policy framework regarding rural electrification.

Uncertain policy environment a potential impediment. Conversely, an uncertain policy environment can present a bottleneck to expansion. In Sri Lanka, RERED faces a challenge as a result of government plans to extend the national grid to at least 95 percent of the population by 2015. Although the plans themselves are laudable, many un-electrified villages are now uninterested in implementing off-grid schemes and investing in SHSs because of the expectation of grid electrification in the near future.

5.1.2 Situate energy access projects within national development frameworks

Mainstreaming energy projects into national development planning and securing long-term financing is easier when the projects are seen to contribute directly toward the broader development agenda.

REDP Nepal complements the Government's grid electrification schemes by extending electricity to areas unlikely to have access to the grid. Similarly, ACCESS Philippines is seen to contribute to the government mandate of 100 percent *barangay* electrification by 2009, and 90 percent household electrification by 2017.

[99] These instruments include concessionary financing arrangements, targeted credit lines, financing support to investors and standardized power purchase agreements for RETs.

In India, RGGVY was launched by the Government in 2005, with the goal of electrifying all villages and providing electricity access to all rural households by 2010. The role of rural electrification in poverty reduction was strongly articulated in *Bharat Nirman* ('Building India'), a time-bound national development plan (2005-2009) focused on rural areas. *Bharat Nirman* includes a target of extending electricity to 125,000 villages, offering free electricity connections to 23 million households below the poverty line and providing telephone connectivity to more than 66,800 villages.[100]

RGGVY is well-positioned within this framework, enabling it to operate more quickly than would otherwise be possible. Most importantly, INR 287 billion (USD 6.21 billion) has been invested in the programme.[101] Unlike with earlier schemes, RGGVY funding comes from the Central Government (90 percent of the project cost). Although India has a long way to go in providing universal access to electricity – and RGGVY has not yet achieved its set targets – its achievements are significant compared to all past programmes. The latest results suggest that 79,135 villages – two thirds of un-electrified villages at project onset – have been electrified.

5.1.3 Carbon markets as a source of finance to expand access

CDM, a Kyoto Protocol instrument to mitigate climate change by encouraging investments in low-GHG technologies, presents a potential pathway for bringing clean energy technology to developing countries. A clean energy project based in a developing country that has been approved by the CDM Executive Board and has had its emission reductions verified, can sell those certified emission reductions or carbon credits. CDM credits can have a significant impact on the viability of a project; for biogas, CDM revenues can improve the internal rate of return up to 25-60 percent.[102]

Two of the reviewed projects (BSP Nepal and REDP Nepal) succeeded in accessing CDM funds. BSP Nepal, having registered two CDM projects, was the first organization in the country to do so. 19,396 biogas plants constructed under BSP Phase-IV have been approved by the CDM Executive Board. An Emission Reduction Purchase Agreement (ERPA) for the two projects was signed with the World Bank for seven years starting 2004-2005. The annual carbon revenue from these two projects (net of verification expenses) is expected to be around USD 400,000. Annual CDM revenue is expected to be as much as USD 4.35 million by 2013, which could meet 70-80 percent of the annual BSP budget.

REDP Nepal has been assisting the Alternative Energy Promotion Centre (AEPC) with a micro-hydro-based CDM project. In 2007, AEPC and the Government of Nepal signed the ERPA for the project with the World Bank as the Trustee for the Community Development Carbon Fund. The project is expected to increase electricity access for people in rural areas with the installation of 15 MW by 2011 from micro-hydro systems. After several rounds of review, this project was registered as a CDM project in October 2010.

Obstacles to effective carbon finance instruments. Carbon finance instruments, such as the CDM and voluntary carbon markets, contain considerable challenges, including high transaction costs and lengthy complex processes.[103] The greatest challenge to the CDM is the prevailing uncertainty, with the current protocol expiring in 2012. Furthermore, there are at least four major constraints in utilizing CDM funds for household projects:

- carbon credits are only obtained after the project's registration under CDM, and upon verification of emission reductions over the operational phase of the project. Since household projects have limited access to lending, and therefore generally require upfront funding, this represents a significant barrier for implementation;
- CDM transaction costs are quite independent from project size. Therefore, for household projects (typically small), the percentage of the project budget spent on transaction costs is much higher than it is for larger projects, amounting to as much as 50 percent of potential CDM benefits;
- the CDM project cycle is bureaucratic and time-consuming. For household projects, where the availability of accurate data can be limited, this can present a challenge (as with BSP Nepal, where the monitoring data produced was considered 'too generic').[104] Moreover, host country approval of the project can be difficult to obtain in countries without efficient administrative structures; and

100 Government of India, 2005.

101 INR 1 = USD 0.02163, as of 9 September 2011 (www.xe.com).

102 Aaron, 2009.

103 Validation costs for a project can range between EUR 15,000 and EUR 50,000, far too high for small projects (Muller, 2010). EUR 1 = USD 1.40438, as of 9 September 2011 (www.xe.com).

104 BSP, 2010.

- household projects comprise many small units/interventions; they are also often located across remote locations where accessibility is limited due to inadequate infrastructure. These factors make it difficult to apply the highly formalized and rigorous CDM project-cycle procedures, including detailed monitoring.[105]

CDM project limitations. A June 2010 analysis showed that household projects accounted for only 1.17 percent of all CDM projects in the pipeline worldwide.[106] The current portfolio of registered CDM projects has only 22 projects that deal with household-level technologies (18 lighting projects, three stove projects and one project combining lighting with other applications).[107] CDM has therefore been largely ineffective as a mechanism for small-scale energy access programmes.

In summary, CDM is currently not an easily accessible funding source for energy access programmes. This situation is unlikely to change, unless the following measures are taken:

- the existing Kyoto mechanisms, particularly CDM, provide separate and specific focus on household projects;
- approval procedures are simplified;
- relative transaction costs are reduced; and
- upfront grants are made available to meet CDM project development and transaction costs.

5.2 End-user financing: enabling the poor to pay for energy services

The projects under the Review used a range of mechanisms to finance energy services, including subsidies on capital equipment, fee-for-service, bank loans, micro-credit and, in a few cases, CDM funds (see Figure 7).

Figure 7: Combinations of end-user financing mechanisms[108]

Project	End-user financing mechanism used					
	User contribution	Direct subsidy	Micro-financing	Loan	Retailer finance	Fee for service
DPBURC China	●	●		●		
StoveTec	●		●		●	
TIDE India	●			●	●	
RGGVY India	●	●				●
IWM Nepal	●	●	●	●		●
BSP Nepal	●	●	●	●		
REDP Nepal	●	●	●	●		
RERED Sri Lanka	●	●	●	●		
Sunlabob Lao PDR	●					●

As energy projects expand, they proceed through different phases of market development, and typically rely on a combination of funding sources and financing mechanisms (described below).

105 Muller et al., 2010.

106 Muller, 2010.

107 For a complete list of current CDM projects, see UNEP, 2011.

108 In the case of RGGVY, full subsidy is available only for households below the poverty line.

Development partners' support for market development. Building a new market involves an immense amount of uncertainty and large financial outlays for research, development of regulations, and education of consumers – all of them market-building 'common goods', measures that purely commercial organizations will not adopt. Grant-based support for these functions has been of critical importance.

RERED Sri Lanka used donor funds to create a financial services sub-sector for funding RE within Sri Lanka's existing financial system. Long-term concessional financing and capacity development support were provided to the financial sector. As a result, a large number of financial institutions today extend credit for RE projects.

Subsidies to prime the pump. Experience suggests that the poor are likely to need subsidies on capital costs for most energy products and services even after a market has been established. The reasons for this are many, including the fact that poverty limits purchasing power for energy products, and the high costs of providing rural energy services.

Microfinancing for expansion. Wherever access to credit has been available (e.g. BSP Nepal and RERED Sri Lanka), market creation has proceeded faster. For the latter, the Sarvodaya Economic Enterprise Development Services (SEEDS), an MFI, financed around 44 percent of all SHSs sold under RERED's predecessor (the ESD project), and about 63 percent of credit sales under the RERED project. In Nepal, more than 30 percent of biogas plants are installed with financing from MFIs.

Community-level pro-poor project mechanisms. For the poor, two additional mechanisms make it possible to access energy services:

- contributing their share of project costs through labour (e.g. during construction of micro-hydro plants); and
- the institution of 'inclusive' cost-sharing mechanisms in some communities, (e.g. whereby families with higher incomes invest a larger amount than poorer households).

Emerging lessons and good practices in end-user financing are provided below.

5.2.1 Offer consumers a combination of locally appropriate financing options

Financing mechanisms should be designed in a locally appropriate manner, aligning repayment amounts and schedules with consumers' incomes and expenditure cycles. They should also provide alternative collateral requirements and have simple loan application procedures. Early in its work in Lao People's Democratic Republic, Sunlabob learned that, if solar lanterns were to be adopted by the poorest rural households, their costs had to be competitive with kerosene prices. Sunlabob consequently created a public-private partnership for renting solar lanterns to poor households in remote villages. Taking account of kerosene prices and typical rural household incomes, the recharging fee for the solar lanterns was set at LAK 4,500 (USD 0.56) for a full charge (10 hours of lighting). Equally importantly, the consumer does not have to take the responsibility for upkeep, repair and maintenance of the lantern.[109]

Most poor people in Nepal find it difficult to pay upfront costs of biogas plants. Under BSP Nepal, the issue of costs was addressed through a combination of subsidies and loans. Subsidies covered roughly 30 percent of plant costs, while 20 percent could be contributed by the user in kind (e.g. labour or locally available construction materials). The remaining 50 percent was supplied through cash contributions from users, which is where loans offer support. The Vanuatu community powerhouse model also exemplifies the need to clearly identify community energy needs and develop solutions in response (including pay-as-you-go financing packages).

In expanding energy services to the poor, the most widely used financing option is a combination of subsidies with some form of microfinancing, provided through women's self-help groups, specialized MFIs (as in RERED Sri Lanka and BSP Nepal) or a community-managed fund (as in REDP Nepal).

5.2.2 Using micro-credit to expand energy services

Nine of the 17 reviewed energy projects relied on micro-credit as a financing mechanism, with three (RERED Sri Lanka, BSP Nepal and BEST-OF-PREN Philippines) delegating financing to microfinance and other specialized institutions competent to provide financial services to the poor.

[109] LAK 1 = USD 0.00013, as of 9 September 2011 (www.xe.com).

The BSP Nepal experience shows the critical role that micro-credit can play in making biogas plants affordable to the poor. BSP works with Grameen banks and other MFIs to extend loans of about USD 358 per biogas plant, at a maximum14 percent interest rate and with a three-year repayment period.[110] Around 30 percent of the users currently take loans, with this trend on the rise.

When the Sri Lankan ESD project was launched, lack of credit presented a critical barrier to popularizing RE. Financing of SHSs posed a particular challenge, since large banks found small-loan appraisals cumbersome. At first, SHS vendors themselves tried providing micro-credit services, but soon recognized how difficult it was to assume specialized credit evaluation and collection functions. The project then turned to MFIs such as SEEDS, which had a large rural outreach. Over time, and with considerable capacity development efforts, a host of financial institutions beyond MFIs – including finance companies, leasing companies and merchant banks – were brought in as participating credit institutions. These institutions receive refinancing from the programme for extending micro-credit services. Overall, involvement of MFIs has had an immense impact on SHS sales.

In general, microfinance helps to expand access to modern energy services. At the same time, lending for energy appears to make good business sense for the financial institutions. What normally constrains expansion are the risks that financial institutions perceive with regard to the technologies and the delivery models. Energy technologies tend to be poorly understood by financial institutions, and it is therefore essential to have a reputable energy enterprise supplying a high-quality product backed up by reliable service. This is most important in rural areas, where a lack of awareness of options and misperceptions about technologies appropriate for rural areas prevail.[111] Once these preconditions are met, financial institutions can improve their bottom line while increasing the number of people with access to modern energy. Key ingredients in making micro-credit a viable option for expanding energy services to the poor include the following:

- providing refinancing facilities to MFIs;
- building MFI capacities in basic technical aspects of the energy product/service;
- establishing functional linkages between MFIs and technology suppliers;
- involving NGOs in mediating commercial bank credit and assisting in identification of beneficiaries, conducting of credit checks and mediating for loans; and
- using group loans and group guarantee schemes to reduce transaction costs.

Table 11 maps strategies used by the three reviewed projects using micro-credit.

5.2.3 Productive applications of energy as a financing mechanism

Encouraging the poor to use energy services productively (for livelihood and income gains) can be an effective strategy in expanding energy access. In general, energy products are better accepted when people can see local opportunities for productive uses.[112]

REDP Nepal has shown promising results on this basis, albeit on a small scale. Besides providing energy services, REDP Nepal promotes the establishment of at least one enterprise per household (with a motto 'One household, one enterprise'). This objective is pursued through specialized skills training and loans through community organizations. At a minimum, a household enterprise provides the wherewithal to pay the monthly electricity tariff (NPR 25) for the minimum connection capacity of 25 watts. Raising and selling at least one chicken a month, for example, can bring in more than NPR 200, more than enough to cover the tariff.

As already discussed in Section 2.1, project experience of productive energy applications has been mixed. While most projects highlight it as a good practice, few have succeeded in scaling it up. The two projects that show the greatest potential are REDP Nepal and IWM Nepal; Table 12 maps their strategies for promoting productive uses of energy.

110 Grameen banks cater mainly to rural populations.

111 UNDP, 2009a.

112 ESMAP, 2008; Kapadia, 2004; Shrestha et al., 2005; UNDP, 2008b; Modi et al., 2005.

Table 11: Strategies used for extending micro-credit for energy products

Challenges in extending micro-credit for energy services for the poor	Strategies used for extending micro-credit for energy products		
	RERED Sri Lanka	**BSP Nepal**	**BEST-OF-PREN Philippines**
High transaction costs of providing small loans in rural areas.	A range of MFIs (including SEEDS) provides micro-credit for SHSs.	Four types of MFIs are involved in extending credit to biogas users: Grameen banks and their branches, cooperatives, financial intermediary NGOs and rural women's self-help groups.	■ Prioritize poor *barangays* through mapping of poverty indicators. ■ Search for commercially available RE technologies that can be microfinanced for the target clientele.
Commercial banks do not have necessary infrastructure and networks in rural areas to provide loans to dispersed clientele or undertake appraisal of such small loans.	MFIs receive refinancing under RERED.	A revolving, AEPC-operated Biogas Credit Fund of USD 3.5 million is used to provide wholesale loans to MFIs for on-lending to farmers for biogas plant construction.	■ Package financing/ marketing projects to make the technologies accessible to poor households in targeted priority off-grid communities. ■ Conduct social marketing to reach out to potential microfinancing organizations.
Lack of technical expertise among MFI staff.	SHS vendors and MFIs are provided basic training in credit evaluation and technical matters.	MFIs offer 'credit-plus' services, including credit through group collateral, information sharing and counselling. The Biogas Credit Fund has a cumulative loan recovery rate of 92 percent, and the biogas enterprises have played a crucial role in motivating customers to repay biogas plant loans on time.[113]	■ Provide capacity development for the microfinancing project implementers and client households or community groups.

Good practices emerging from these experiences include the following:

- both projects emphasize livelihoods enhancement in their programme goals, and this focus informs all project activities. In fact, REDP Nepal positions itself more as a livelihoods enhancement and community empowerment programme than an energy project; and
- both projects provide a range of complementary inputs in addition to energy services, carefully selected and tailored to meet the needs of rural entrepreneurs.

5.2.4 Providing start-up and working capital loans for technology suppliers and service providers

Providing financial support to technology suppliers to develop the market and for working capital has proved a useful strategy in the initial stages of market development. During the market development phase, capital subsidies on investment are useful, particularly when high commercial interest rates are making investments in a new sector risky. For example, ESD working capital loans in Sri Lanka were instrumental in bringing in new technology suppliers and service providers for the SPV market. Working capital loans extended to biogas companies to purchase plant accessories and appliances have also proven useful.

[113] UNDP, 2009a.

Table 12: Key elements of 'productive use' strategies

REDP Nepal	IWM Nepal
Programme goal: enhancement of rural livelihoods through promotion of community-managed micro-hydro and other decentralized RE systems. **Technology:** micro-hydro for lighting and power applications. **Strategies to promote productive uses:** ■ loans to set up enterprises are provided to poor households through an Enterprise Development Fund and from weekly savings of community organizations; ■ each household is encouraged to start at least one enterprise (energy or non-energy); ■ potential entrepreneurs are provided with information, enterprise development training and exposure visits; and ■ rural entrepreneurs are linked with city-based markets.	**Programme goal:** to improve living conditions in rural areas by increasing productivity and addressing energy needs. **Technology:** improving traditional water mills to increase the efficiency of agro-processing and generating electricity. **Strategies to promote productive uses:** ■ local service centres, which operate as business units, install improved water mills and look after sales service and promotional activities; ■ improved water mill owners run the mills as microenterprises, providing a range of fee-based services, such as grain grinding and hulling, to communities; ■ mill owners are organized into CBOs known as Ghatta Owners Associations (GOAs). The GOAs and the service centres provide a range of capacity development inputs in areas of technology, business development and planning, and marketing; ■ action research and piloting of new end-use possibilities resulting in 13 different types of end-uses that are currently in practice; ■ establishment of demonstration sites to visually highlight project impacts to other potential owners (electricity, hulling); and ■ facilitation of credit support (either encouraging MFIs to invest in improved water mills or through the provision of a revolving fund).

UNDP/Energy Access for Poverty Reduction/ACCESS – the Philippines

Local communities being trained to install solar home systems. Project: Accelerating Community Electricity Services using Solar (ACCESS) – the Philippines.

6 Good practices and lessons learned: Mainstreaming energy access

UNDP/Energy Access for Poverty Reduction/Sengor – Bhutan

A view of the intake diversion canal. Project: Community Micro-hydro for Sustainable Livelihoods – Sengor, Bhutan.

Identified good practices:

- An appropriate institutional partnership framework for expansion includes the following:
  - government provides an enabling environment and regulatory framework;
  - development partners co-finance 'common goods' that benefit the whole sector;
  - the private sector manufactures, sells and services energy products;
  - civil society organizations lead community mobilization, consumer awareness and information broad-basing; and
  - financial institutions provide loans and micro-credit.
- Supporting the development of a national government policy on energy access and making policy change an integral component of project strategy.
- Investing in building institutional leadership in the energy sector.
- Engaging with stakeholders at all levels to ensure a broad base for project information dissemination, ensure project support and achieve national consensus on the importance of energy access.
- Investing in developing capacities of all key stakeholders.

6. Good practices and lessons learned: mainstreaming energy access

6.1 Mapping experience with mainstreaming energy access

An impressive achievement of all projects under the Review was their role in bringing a lack of energy access to the fore at the national level. This includes drawing the attention of national policymakers to the issue, demonstrating innovative solutions and helping governments to incorporate these in national policies and programmes. Project experiences from China, Sri Lanka and Timor-Leste best demonstrate how this was achieved.[114]

The CRE China project promoted commercialization of RE and was instrumental in the design and promulgation of the Renewable Energy Law.[115] This law sets targets to accelerate the scaling up of RE, and requires the Central Government to build off-grid RE power systems. In addition, the Central Government established a dedicated fund for RE development, focusing on projects in remote rural areas. CRE project results prompted the Government to establish a national target of building 100 commercially run biogas-based power plants, and helped to develop a long-term strategy for wind power and promote the use of biomass pelletization in rural areas. The project also disseminated international best practices in RE in partnership with international organizations.

In Sri Lanka, overall electrification stood at only 42 percent in the mid-1990s, when the ESD project was launched. Despite a long history of hydro projects, off-grid energy sources were not considered a credible means of providing energy access to rural people, and no policies for RE promotion were in place. In addition, the Electricity Act of Sri Lanka at the time did not allow the sale and distribution of electricity by any party other than the Ceylon Electricity Board. In order to launch community-based hydro systems, the concept of Electricity Consumer Society (ECS) was introduced. ECSs own and manage village hydro-power systems which generate electricity to be used exclusively by the community.[116] Through a concerted effort spanning more than a decade, the ESD (and, subsequently, RERED) has supported the visible enhancement of government commitment to RETs. This commitment is reflected in several measures, including a government target of achieving 10 percent of electricity generation from RE sources by 2015;[117] introducing net metering[118] for electricity generated from renewable sources; and allowing communityowned VHPs to distribute electricity to its own members.

In Timor-Leste, the UNDP-supported PREDP was successful in creating a framework for dissemination of rural energy technologies. The project worked with the State Secretariat for Energy Policy to develop a Rural Energy Policy based on experience from RE pilot projects. The Rural Energy Policy serves as an overarching planning tool, creating space for future activities. Replicating the project, the Government is formulating concrete plans to scale up activities, particularly in biogas and SPV technologies.

6.2 Institutional partnership framework: who should do what?

An appropriate institutional partnership framework for expansion requires the respective actors to do what each does best.

[114] More examples of this can be found in the following case studies: REDP Nepal, BSP Nepal, Project ACCESS Philippines and IWM Nepal.

[115] The Renewable Energy Law can be viewed at NDRC, 2005.

[116] Sale and distribution of electricity outside the community is prohibited.

[117] The share of non-conventional renewable energy sources (excluding large hydro) in electricity generation in 2009 stood at 5.5 percent, with generation of 525 gigawatt hours (Ceylon Electricity Board, 2011).

[118] This is the practice of generating electricity locally, usually by alternative means, and offsetting the draw from the local grid. Net metering fosters the concept of 'running the meter backwards' to lower the consumer's electricity expenses.

Box 9: Who does what?

Governments and development partners serve as facilitators, and must support the implementing organizations and private sector. As facilitators, they should co-finance 'common goods' that serve a variety of ends, including product, market and capacity development; policy dialogue; and advocacy. Energy programmes and projects, along with the private sector, should act as efficient, effective suppliers of energy products and services. The private sector should manufacture, sell and install the products profitably and on a large scale. NGOs and CBOs should take the lead in support functions, including promotion, awareness raising and oversight.

The above credo works well when a critical mass of demand already exists for energy products and services. Before such a market is in place, facilitating organizations themselves need to become 'doers'. They have to perform the roles of developing markets, creating an initial demand, educating the consumer and setting in place quality-assurance mechanisms.

The experience of the energy programmes and projects under the Review suggests that at least six groups of stakeholders need to be involved in expansion of energy service delivery to the poor, each playing its own unique role:

- government (national and local);
- project implementing agencies;
- the private sector;
- civil society organizations;
- financial institutions; and
- development partners.

Governments (national and local)

The basic function of the government is to create enabling conditions and provide a framework for the development of energy services. Government is the most important stakeholder in ensuring access to energy services for the poor. Governments therefore need to proactively create an environment within which all stakeholders may interact and contribute towards energy access objectives. In particular, governments need to encourage the private sector, including energy service providers and manufacturers, through subsidies and other financial support, and through regulating financial institutions that provide loans and assistance to the private sector. Government should also encourage NGOs and civil society organizations to create awareness among consumers regarding the benefits of modern energy services. Governments should be active in the following areas:

- incorporating energy access commitments explicitly into national development strategies, in terms of national energy access targets and investments;
- incorporating energy access into national poverty-reduction strategies;
- ensuring that the overall energy access framework is pro-poor and gender-sensitive, including subsidies designed to exclusively target the poor;
- designing tax incentives and duties to support energy service delivery for the poor;
- setting technical and quality standards to eliminate substandard products;
- pre-qualification of technology suppliers (establishing eligibility for subsidies and incentives); and
- engaging NGOs and other civil society groups in advocacy and dialogue.

Programme and project implementing agencies

As facilitators, implementing agencies need to support sector development activities, including policy dialogue, generic product promotion and capacity development. Other important functions include bringing actors together within functional partnerships and ensuring that all institutions perform their respective tasks. The coordination function links national and local levels, ensuring that government plans and policies match the needs of consumers, owners and technology suppliers. Specific functions include the following:

- providing appropriate guidance and support to governments in policy formulation;
- building capacities of NGOs and CBOs to assist planning and implementation of pro-poor and gender-sensitive energy projects;
- facilitating financing;
- providing guidelines for community-based planning and assessment of energy needs of men and women;
- assessing capacity development needs;
- running training courses for technology suppliers, project developers, operators, local government and communities; and
- facilitating networks within the sector to guide communities to sources of advice, expertise and equipment.

Private sector (including technology suppliers, service providers and their associations)

The private sector's main role is to manufacture and sell (or install) energy products and services profitably at a scale that is financially viable. Without involving the private sector, and particularly without using the marketing channels of the private sector, it is virtually impossible to reach a significant number of end-users.

In addition, business associations can undertake capacity development activities and generic product promotion. In Nepal, these associations play a key role in all three projects covered under the Review (BSP Nepal, REDP Nepal and IWM Nepal). Such associations include GOAs in Nepal and the Nepal Micro Hydro Development Association of manufacturers and component suppliers. IWM Nepal supports the formation and initial management of the local GOAs, after which they become independent and take over a number of coordination roles for the project. GOAs are also trained to provide member services such as business management and marketing of products. Fifteen GOAs have been registered with the District Administration Office so far.

NGOs and CBOs

NGOs and CBOs with on-the-ground presence can play a role as distribution partners, product designers, microfinance partners and social marketers. Specific roles include the following:

- organizing communities – community-based energy projects such as REDP Nepal favour the role of CBOs in organizing communities, creating equitable payment models, and creating functional relationships among communities, energy project management and the government;
- targeting specific groups within the community – CBOs such as women's self-help groups can help projects reach specific target groups (e.g. poor women);
- providing microcredit for energy products and services – CBOs with microfinance arms, women's associations and self-help groups can extend credit for energy systems to expand access;
- social marketing and awareness building on energy access issues and around health/social benefits such as the dangers of indoor air pollution; and
- providing oversight functions – as representatives of communities, CBOs (including women's groups) are effective at community-level monitoring.

Financial institutions

As demonstrated by projects such as RERED Sri Lanka, BSP Nepal and BEST-OF-PREN Philippines, microfinancing helps address the affordability barrier. This is also demonstrated by similar experiences of the Self Employed Women's Association (SEWA) in India and Grameen Shakti in Bangladesh. At the most decentralized level (village communities), microfinancing can be provided through women's self-help groups (as seen in the case of BSP Nepal and Jagriti India). More often, national-level MFIs and development banks are more effective vehicles for providing small loans.

Development partners

Development partners must play the role of project facilitators and co-finance 'common goods', including:

- building sector-wide capacities, thus improving the capabilities of national stakeholders to design and implement energy projects;
- supporting enabling energy policy and regulation. By working with governments on sector policies and regulation, development partners can help develop the frameworks that support gender-sensitive and pro-poor energy solutions;[119]
- providing refinancing support for MFIs to extend micro-credit; and
- creating the following platforms and mechanisms for knowledge sharing:
  - initiating replicable models, supporting policy dialogues and scaling up of potential projects in cooperation with other partners;
  - compiling and disseminating examples of good practices, and developing norms and guidelines for energy access for the poor; and
  - encouraging the media, in both developed and developing countries, to provide more coverage of energy access issues.

6.3 Supporting national policies on energy access and renewable energy

A long-term, well-articulated national policy on energy access for the poor is the most important enabler for expansion. Such policy must be situated within the overall government policy framework of development and poverty reduction, and must be inclusive of sub-national strategies. Given the importance of RE in energy access, national RE policies are also essential.

Where such policies or strategies are missing, their development can be initiated by energy access projects. Projects that have a distinct, clearly planned and financially supported component designed to support policy change are best able to influence national policies.

The CRE China project illustrates how a project can influence national policy. The project provided crucial input and support for the development of the Renewable Energy Law, including facilitation of the initial decision, in October 2003, to start the process of developing the law. The project's early advocacy of RE, from as early as 1999, contributed significantly to a change of attitude towards RE among senior policymakers and planners.[120] The project provided key personnel and secretariat services to support the formulation of the RE law, which in turn led to an acceleration of new RE projects, particularly in wind, solar and biomass. Passed in 2005, the law established a national framework for the development of all sectors of the RE industry. Together, these actions contributed to a dramatic shift in the broad political and social atmosphere regarding RE. During the initial project stages, it was difficult to attract attention to the Project and to RE, even at the vice-ministerial level. Today, the President and Premier of China are actively discussing China's RE future, and this discussion extends to provincial leaders and industry. The law has also had important implications for other countries looking to the development of RE legislation.

In Nepal, under a UNDP TTF project activity, REDP supported the National Planning Commission and AEPC in the formulation of the Rural Energy Policy, which was approved by the Government in 2006. The policy paper was prepared and discussed extensively with stakeholders at regional consultations in Nepal's five development regions. More than 450 experts, implementers, academics and community representatives participated. The development of the Rural Energy Policy took almost four years of continuous effort, persuasion and follow-up. Key features of the policy, which draws heavily from the REDP Nepal experience, include the following:

[119] Among the projects reviewed, UNDP provided such policy-development support through Thematic Trust Funds (TTFs) in Bhutan, Nepal and Timor-Leste. In Nepal, the policy-level support of UNDP, along with several national projects, led to development and adoption of the national Rural Energy Policy by the government. RERED, a donor-funded project in Sri Lanka, was supported by the government in the development of regulations such as the Small Power Purchase Agreement (SPPA) and the non-negotiable Small Power Purchase Tariff.

[120] UNDESA, 2007.

- pro-poor focus;
- decentralized planning, institutions and operations;
- focus on holistic development and poverty reduction;
- 'smart' subsidies for targeting poor and vulnerable communities;
- mechanism for mobilization of internal resources;
- capacity development at all levels;
- mainstreaming of issues relating to gender and vulnerable communities;
- continuing assessment for improvement based on emerging sectoral needs; and
- creation of a Renewable Energy Fund.

In addition, several of the project's good practices and modalities have been institutionalized by AEPC. This include the creation of District Energy and Environment Sections in 72 District Development Councils by AEPC, a strategy launched by REDP Nepal. The following REDP modalities have been adopted by AEPC and are applied to all donor-funded projects, irrespective of their own implementation procedures:

- **The use of a Technical Review Committee (TRC)**. REDP requires that all detailed project reports are approved by a TRC before a subsidy/grant is released. The TRC is an independent committee comprising AEPC representatives, REDP, technical experts and key stakeholders. In 2003, AEPC expanded mandatory approval by a TRC for all micro-hydro plants seeking subsidies from the Renewable Energy Fund or donor-funded programmes/projects;
- **Adoption of the Enterprise Development Fund** in the AEPC subsidy policy, begun in 2009-2010, ensures sustainability of micro-hydro plants.[121]
- Incorporation of a social mobilization component is for promoting renewable technology systems.

6.4 Building national institutional leadership in the energy sector

Creating and nurturing institutional leadership is an important strategy in bringing about policy changes in the energy sector, particularly the RE sector.

Lead RE institutions needed. Several development partner-supported initiatives that started as small or medium-sized projects soon recognized the need to have nodal/apex institutions steer desired policy changes in the sector and establish cross-sectoral linkages. In the 1990s, a number of countries in the region lacked public and private institutions dedicated to RE development. Institutions such as the AEPC in Nepal, the Sustainable Energy Authority (SEA) in Sri Lanka and the Chinese Renewable Energy Industries Association (CREIA) have since emerged as lead focal points in their respective countries. Projects such as BSP Nepal, REDP Nepal and ESD Sri Lanka were instrumental in setting up these institutions under the aegis of the national governments.

With the support of the CRE China project, CREIA was set up in 2000 in partnership with the Central Government and the Energy Research Institute. The project assisted CREIA with establishing its objectives, setting up a governance structure, planning activities and creating links with key stakeholders, both within China and internationally. With more than 200 members, CREIA is internationally recognized as a leader in the RE field, and serves as the Renewable Energy and Energy Efficiency Partnership (REEEP) East Asia Secretariat. Independent, self-financed and business-led, it brings together national and international project developers and investors, while promoting technology transfer and raising awareness of RE investment opportunities through an online Investment Opportunity Facility and regional networking and training.

[121] The Enterprise Development Fund is a revolving fund providing enterprise loans to poor households.

6.5 Engaging with stakeholders at all levels

Expansion and mainstreaming of energy access for the poor requires project information dissemination and continuous engagement with stakeholders at all levels. These activities are necessary to ensure project support, and also help achieve national consensus on the importance of energy access. This has been demonstrated by several projects, including REDP Nepal, BSP Nepal, RERED Sri Lanka and CRE China.

For example, REDP Nepal strives to meet this good practice through:

- proactive information dissemination at all levels, including community-based elected bodies, NGOs, the private sector, development partners and the Government;[122]
- continuous dialogue at the local level to create bottom-up demand for the projects, through chairpersons of District Development Committees and micro-hydro equipment manufacturers associations;[123]
- regular project updates shared in development partner coordination committee meetings;
- capacity development to assist the local government to promote and disseminate RETs through the District Development Committees;
- involving partners in project documentation and dissemination through assessment reports, newsletters, student theses, case studies, and national and international recognitions and awards;
- ensuring broad-based and realistic stakeholder ownership of the project, such as through extensive consultations in five regions during development of the Rural Energy Policy; and
- providing technical support to AEPC to integrate the REDP experience into the national planning system for RE.

CRE China also employed a core strategy of engaging with high-level policymakers and leading-edge industry representatives. This not only helped secure early government interest and commitment (reflected in the Government providing more than half of the project funding) but also ensured sustainability of activities after project completion.

At the project level obtaining regular feedback from target groups allows for improvement of energy products and services offered. BSP Nepal conducts user and refresher training courses, which helps the project identify needs and preferences of users (mainly women) and guides product improvement.

6.6 Developing capacity for expansion of energy access to the poor

UNDP defines capacity development as 'the process through which individuals, organizations and societies obtain, strengthen and maintain the capabilities to set and achieve their own development objectives over time'.[124]

Capacity development strategies adopted by the reviewed projects are mapped in Table 13.

While project managers acknowledge the importance of capacity development, capacity assessment was not undertaken as a separate step in most reviewed projects. Capacity development mostly emerged from needs identified during implementation, rather than a prior, systematic step-by-step assessment. The majority of the programmes and projects first focus their attention on training project staff, followed by capacity development of the private sector/service providers, NGOs, CBOs and local governments (see Table 14). Several of the strategies outlined in Table 13 are not regarded by energy projects as 'capacity development activities', even though they play a significant role in building awareness levels and capacities among various stakeholders.

Table 14 provides a summary of targets of capacity development intervention and the strategies employed by four reviewed projects.

Emerging lessons and good practices for capacity development are discussed in the following paragraphs.

[122] The Association of District Development Committees of Nepal and National Association of Village Development Committees in Nepal are two important partners that play strong roles in policy advocacy and capacity development of their members.

[123] The chairpersons of District Development Committees have been among the main promoters of REDP.

[124] UNDP, 2009c.

Table 13: Capacity development strategies adopted by the reviewed projects

Capacity development area	Capacity development strategies emerging from the reviewed projects	Examples of capacity development activities
Build awareness and ensure political commitment	■ Include policy change as a concrete project activity from the start. ■ Engage stakeholders through widespread consultations at all levels. ■ Provide 'hand holding' support to national governments to adopt good practices and lessons learned from programmes and projects.	■ National conferences, workshops and study tours for policymakers, establishment of showcase demonstration projects and media coverage (CRE China). ■ Capacity development for national government agencies in policy development and planning, providing support through policy studies, and establishment of guidelines and standards (ACCESS Philippines; REDP Nepal; PREDP Timor-Leste; and CRE China). ■ Regular project updates shared with key stakeholders (REDP Nepal, PREDP Timor-Leste). ■ Support to national agencies to integrate project elements into the national planning system (REDP Nepal, IWM Nepal).
Consensus building	■ Ensure that project information, progress and achievements are widely disseminated.	■ Continuous engagement with high-level policymakers and industry representatives (CRE China, ACCESS Philippines, REDP Nepal and Sunlabob Lao People's Democratic Republic). ■ Information dissemination through community-based elected bodies and civil society organizations (REDP Nepal, BEST-OF-PREN Philippines and VANREPA Vanuatu). ■ Extensive local consultations during policy development processes (REDP Nepal, PREDP Timor-Leste).
Energy needs assessment	■ Develop capacity to analyse energy needs and to develop specific energy access targets within various sectors.	■ Support to market assessment studies (BEST-OF-PREN Philippines). ■ Systematic market assessment studies undertaken by the government (ACCESS Philippines). ■ Extensive market research to identify consumer needs and preferences (Sunlabob Lao People's Democratic Republic, StoveTec, TIDE India, VANREPA Vanuatu).
Designing financing packages	■ Ensure that financing packages are well suited to the needs of the community. ■ Establish functional linkages between MFIs and technology suppliers.	■ Awareness-raising of financial institutions including MFIs, finance companies and leasing companies (RERED Sri Lanka, BEST-OF-PREN Philippines). ■ MFIs supported in the development of appropriate financial services for potential customers (BSP Nepal, Jagriti India).
Energy service delivery	■ Enhance the effectiveness of local governments and authorities, community representatives and the private sector to deliver energy services.	■ Wide-ranging support for masons, supervisors and managers (with additional support for women trainees) through working capital, material support, quality control, institutional support, exposure visits, marketing incentives to work in remote areas, coaching and counselling and annual reviews (BSP Nepal). ■ Training technology suppliers and MFIs in credit financing and technical matters (RERED Sri Lanka, ACCESS Philippines, BEST-OF-PREN Philippines and BSP Nepal). ■ Developing capacity of local implementing organizations to identify and proactively support disadvantaged sections (REDP Nepal). ■ Building technical capacities to test and design improved stoves, using internationally approved standard testing protocols (StoveTec).

Table 13: Capacity development strategies adopted by the reviewed projects (continued)

Capacity development area	Capacity development strategies emerging from the reviewed projects	Examples of capacity development activities
		■ Assisting biogas companies in promotion and marketing, particularly in new markets (BSP Nepal). ■ Specialized skill training for households to utilize energy for productive applications (REDP Nepal, IWM Nepal). ■ Building capacities of local government and manufacturers' associations to participate in and eventually take over project functions (BSP, IWM and REDP Nepal). ■ Training users, including women, in technology use and maintenance (REDP Nepal, BSP Nepal, StoveTec, VANREPA Vanuatu, PREDP Timor Leste).

Table 14: Capacity development strategy adopted by energy access projects, categorized by stakeholders

Target for capacity development	Capacity development strategy	RGGVY India (rural electrification)	REDP Nepal (community-based micro-hydro)	BSP Nepal (biogas plants)	RERED Sri Lanka (SHSs, off-grid hydro power)
Government agencies (national)	Support for formulating pro-poor energy policies and implementing mechanisms.	●	●		●
	Awareness-raising of government officials through workshops, regular project updates and media coverage.		●		●
Government agencies (local)	Orientation on programme objectives and methodology.	●	●	●	●
	Developing capacity of local government officials to plan and implement energy access projects.	●	●		
Private sector and entrepreneurs	Orientation regarding programme details, technical standards and performance obligations.	●	●	●	●
	Training on how to check credit worthiness of potential microfinancing clients.				●
	Support for conducting market-assessment studies.			●	●

6.6.1 Sector-wide capacity development

All projects that have expanded have emphasized the need for sector-wide capacity development among technology suppliers, financiers, governments and civil society. Unless the capacities of all these stakeholders are comprehensively developed, expansion is likely to proceed slowly.[125]

[125] UNDP identifies three levels of capacity development: systemic (enabling environment and policy development), institutional (organizational development) and individual (human resources development).

Table 14: Capacity development strategy adopted by energy access projects, categorized by stakeholders (continued)

Target for capacity development	Capacity development strategy	RGGVY India (rural electrification)	REDP Nepal (community-based micro-hydro)	BSP Nepal (biogas plants)	RERED Sri Lanka (SHSs, off-grid hydro power)
NGOs, CBOs	Community mobilization, including organizing awareness generation campaigns on technologies/ services provided; developing skills required to set up and manage community-based groups such as organizational development, leadership, group dynamics, book keeping and funds management.	●	●		●
Financial institutions	Basic technical training in products/services.		●	●	●
	Assistance in developing financing packages for energy products and services.			●	●
Community and their representatives	Technology operation and maintenance.	●	●	●	●
	Enterprise development.		●		
	Leadership skills, group management and funds management.		●		●

The CRE China project, with its objective of capacity development for commercialization of RE, provides a good example of sector-wide capacity development. The project strengthened the RE sector of China through complementary measures at the macro, meso and micro levels, direct training and other actions:

Macro-level activities focused on the development of policies and regulations. The project provided crucial support for the development of the Chinese Renewable Energy Law, the Biogas National Action Plan and the development of guidelines for the Wind-power Concessions Programme that have since been adopted as China's national standards.

Meso-level activities focused on institutional development and capacity-building of key stakeholders, through international and local workshops, and training.

The project developed the skills and capacities of policymakers. It established the CREIA, which currently coordinates national RE development with the Government, industry and academia.

Training, study tours, pilots and workshops were applied to improve the capacities of organizations working on RE, most significantly in the wind energy sector, through training in field installation and data acquisition, quality control and validation procedures, and exposure to international good practices.

Almost 3,000 individuals working in the area of RE directly benefited from capacity-building activities, 29 percent of them women. In 2003, a village wind/solar resource measurement was initiated as part of the project with 30 meteorological towers installed at 20 sites. Field operators were trained in wind data collection, and local residents were involved in the site survey and training workshops.

Micro-level actions, in which pilot projects were implemented, provided support for the above activities. Pilot project financing came mainly from contributions from the Government of China and international development partners, and partly from business loans. Today, China's solar water heater (SWH) industry is the largest in the world, larger than all the other national SWH industries combined. China's utility-scale wind turbine manufacturing sector has grown rapidly to assume a world leadership position, and it is fully commercial. The same is true of the industrial-scale biogas for cogeneration applications industry. Development partner support was required in the establishment or upgrading of three solar thermal-test facilities, in introducing advanced wind resource monitoring technologies and techniques, and in other capacity development activities, although not in the commercialized operations that the CRE China project facilitated.

RERED addressed many of the industry barriers in Sri Lanka simultaneously, establishing broad acceptance of all the technologies the project intended to promote. On the policy front, it worked towards developing a conducive policy framework for off-grid RE, supported by an awareness-building campaign for the public sector. Financing barriers were addressed by establishing a long-term financing package, making it attractive for the financial sector to lend and by including MFIs in the project. RERED addressed the lack of technical skills and experience in the country by identifying, on a large scale, potential personnel and building their capacities.

6.6.2 Dynamic capacity development strategy

As projects evolve from pilot to expansion phases, the capacity development needs of stakeholders change. This means continuous assessment is required to guide responsive adaptation.

BSP Nepal, which considers the capacity development of its partners to be of central importance, offers a case in point. BSP's exit strategy is to gradually downscale its project activities so that government bodies and the private sector take up more and more of them. Following capacity development, almost all training activities and some promotional activities have already been handed over to the private sector. Private-sector capacity has also been enhanced through organizational strengthening initiatives targeting training, skills certification, market development and credit financing. However, some specialized functions (among them subsidy administration and quality monitoring) are likely to remain with BSP.

UNDP/Energy Access for Poverty Reduction/Aprovecho Research Centre

Using a StoveTec Stove. Project: StoveTec improved cookstoves – worldwide

7 The way forward

UNDP/Energy Access for Poverty Reduction/IWM – Nepal

A discussion among members of a Ghatta Owners Association. Project: Improved Water Mill Programme (IWM) – Nepal

- Energy for economic and human development.
- Integrated approach to breaking the energy-poverty cycle.
- Need for government commitment.
- Necessary conditions for effectively addressing energy poverty.
- Coordinated collaboration of key stakeholders.

7. The way forward

7.1 Key messages

Energy for economic and human development. Energy poverty is a complex, multidimensional phenomenon. Addressing it in a sustainable way means viewing energy services as a vehicle to support economic and human development. In other words, pro-viding access to energy services is a means towards an end and not an end in itself.

Integrated approach to breaking the energy-poverty cycle. Traditional energy programmes and projects have often adopted a minimalist approach, one that focuses on delivery of energy services to meet basic energy needs. This approach has only had a moderate impact on poverty reduction.

Breaking the energy-poverty cycle is best achieved by combining improved access to energy services with measures that generate cash incomes or improve livelihoods. For the most effective impact, energy access projects should adopt an integrated approach, which would include strengthening of conducive policies, institutional capacity development, private sector support, entrepreneurial skills development, productive uses of energy for income generation and the facilitation of access to finance and markets. Such an integrated approach will lead to improved household living standards while increasing the capacity to pay for energy and other services. Poverty reduction impacts can be maximized only when such measures are built into the energy access programmes.

Need for government commitment. Expansion of energy services to the poor at a large scale is unlikely to happen through existing market mechanism routes alone. Rather, it requires government intervention through budget allocations and enabling policies. Effective energy access programmes are best integrated within a suite of other key essential services, including information and telecommunications, all-weather roads, schools, health facilities, agricultural extension services and enterprise development.

Necessary conditions for effectively addressing energy poverty. Several conditions need to exist before significant expansion will occur, including:

- a product that has been extensively tested and demonstrably accepted by users;
- a supply chain that has at least a few reliable technology suppliers;
- well-tested delivery models and end-user financing schemes, and a critical mass of competent service providers, including technology suppliers, project developers and others; and
- assurance of medium- to long-term funding, either from the government and/or development partners (eliminating uncertainties in the minds of end-users, technology suppliers and others).

Coordinated collaboration of key stakeholders. An appropriate institutional partnership framework for expansion requires the respective actors to do what each does best:

- governments should create an enabling environment and regulatory framework;
- development partners should co-finance 'common goods' that benefit the whole sector, including capacity development and technical assistance;
- the private sector should manufacture, sell and service energy infrastructure and products;
- civil society organizations, including NGOs, should mobilize communities and disseminate project information; and
- specialized financial institutions should provide low-interest microfinancing.

7.2 Recommendations

This section provides a number of recommended action points for key stakeholders. These points are based on the good practices and lessons learned (summarized in Annex 3).

7.2.1 For governments and development partners

Governments should incorporate explicit energy access commitments into national development strategies through national energy access targets and investments. The single greatest enabler for expansion of energy services to the poor is long-term government commitment to providing energy access for its citizens. Government commitment must be reflected in policy documents and be supported by budgetary allocations.

Expansion of energy services to the poor requires sector-wide capacity development among programme implementing agencies, the private sector (including technology suppliers and service providers), financial institutions and civil society organizations.

Energy access programmes and projects must go beyond immediate service delivery for basic needs and aim to contribute to human development and income poverty reduction. They should provide support for the enabling environment (policy, capacity, market, access to credit, etc.).

Energy access programmes and projects should include a clear focus on women. This emphasis must be articulated in programme goals and strategies. Monitoring data must be disaggregated by gender.

7.2.2 For project implementing agencies

Energy access programmes and projects should foster institutions that can champion the cause of energy access for all. The latter includes influencing government policy, streamlining development partner activities in the sector and developing human resources.

It is important to ensure that the product/service offered is clearly aligned with user needs and behaviour. Products must be extensively tested among the purported users (including women) before launching, and they should be robust and tamperproof, particularly when disseminated in remote rural locations.

Production systems, supply chains and markets for energy technologies must be commercially viable. Clustering/bundling of markets has worked well in remote, dispersed markets. In addition, building on existing supply chains can sometimes be more effective than creating large-scale production and distribution chains from the ground up. This helps to increase profitability among local businesses and generates local employment.

Projects should also incorporate strict quality control and accountability measures for technology suppliers and service providers. Effective strategies include pre-qualification of technology suppliers as a criterion of eligibility for subsidies and incentives; development of strict guidelines and technical standards; and inclusion of performance guarantees in contracts with suppliers. At the same time, consumer awareness of service-provider obligations needs to be raised.

Local communities should be engaged in the project. An effective way of accomplishing this is through existing local governance institutions, which helps the project get a 'buy-in', increases the accountability of local representatives and assures a degree of social sustainability. Projects should also build capacities of men and women in the communities to a) engage with project planners to ensure that their needs and views are incorporated, and b) to manage the energy technologies.

Project design should promote the productive uses of energy through targeted measures, including business development and marketing support (for example, providing loans to meet investment costs for new enterprises). Poverty reduction, livelihood enhancement and women's empowerment goals must also be strongly reflected in energy access programme goals.

Finally, energy access projects must include gender-disaggregated monitoring and evaluation of their impact on the quality of life of the poor, focusing on MDG achievements.

7.2.3 For financial institutions

Microfinancing proven to be an effective means of expanding the reach of energy products and services. A variety of stakeholders must act if this is to prove a viable option. Governments/development partners must provide refinancing facilities to MFIs to compensate for the high transaction costs of operating in dispersed, low-income communities. They also need to establish functional linkages between MFIs, technology suppliers and local institutions including NGOs, women's associations and self-help groups that can mediate commercial bank credit and assist in identification of beneficiaries, conducting of credit checks and mediating for loans.

Financing mechanisms for the poor, as elsewhere, should be locally appropriate in aligning repayment amounts and schedules with consumers' incomes and expenditure cycles.

7.3 Conclusion

Access to energy services improves the lives of the poor communities and is a prerequisite for achieving the MDGs. However, energy service delivery on its own has little impact beyond subsistence household use. Experience in the Asia-Pacific region shows that strategies that pay equal, if not greater, attention to improving income generation can go much further in reducing poverty. Improved access to energy should therefore be accompanied by measures that generate incomes or improve livelihoods which, in turn, enhance the capacity to pay for energy services. Furthermore, access to energy programmes should be complimented by a suite of measures and services strengthening public infrastructure, including information and telecommunications, roads, schools, health facilities, rural enterprise development, agricultural extension services and access to markets.

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Annex 1: Profile of programmes and projects reviewed

1. Project: Accelerating Community Electricity Services using Solar (ACCESS), the Philippines.

Duration: 2006-2011

Costs: USD 11.3 million, funded by World Bank/GEF, Government of the Philippines

Implementing agency: Department of Energy (DoE)

Technology and application: SPV electrification for remote *barangays*.

Population reached: Electrification for 35,000 beneficiaries in remote *barangays*.

Operational model:

The project promotes a market-based model for commercialization of SPV-based electrification, leveraging limited government resources with donor funds. The model's components include:

- 'bundling' of contiguous *barangays* into viable units that are bid out on a competitive basis to private contractors;
- ensuring a minimum baseload from community facilities for each contractor;
- each contractor electrifying at least 25 percent of households; and
- project supporting a host of market support activities.

MDG impacts: Improved health and well-being among household members, given reduced dependence on kerosene for lighting and cooking; less labour and greater convenience for women performing domestic chores; extended study hours for children; more time for productive activities, given availability of quality lighting at night; and augmented social capital and enhanced interaction within communities, since villagers have more time to socialize.

Good practices and lessons learned

- Strong political commitment.
- Synergy between the energy and the development sectors.
- Alignment of the project with overall government policy on poverty alleviation and rural development.
- Combining multiple sources of funding (project funds, government taxation, etc).
- Support to private contractors improving viability of operations in remote areas.
- Strict service and performance obligations by private contractors.

2. Project: StoveTec improved cookstoves (manufactured in China, disseminated worldwide)

Duration: 2007-ongoing.

Costs: USD 1.5 million, funded by Shengzou Stove Manufacturer and Aprovecho Research Center.

Implementing agency: Shengzou Stove Manufacturer, StoveTec Stoves.

Technology and application: Mass dissemination of improved cookstoves to developing countries.

Population reached: 90,000 cookstoves to local entrepreneurs and private households worldwide.

Operational model:

The project is a joint venture of US-based Aprovecho Research Center and Shengzhou Stove Manufacturer, the largest manufacturer of domestic coal stoves and combustion chambers in China, to mass manufacture factory-based, low-emission, low fuel-use and low-cost stoves for worldwide dissemination.

MDG impacts: 40-50 percent fuel saving for users; reduction of indoor air pollution, improved heath and safety, particularly for women and children; and promotion of local business as stove distributors.

Good practices and lessons learned

- Dissemination of a robust, high-quality product under continuous development and improvement.
- Successful joint venture of a development research institute and a local manufacturer.
- Leveraging comparative advantage of both project partners.
- Dissemination of stoves in developing countries cross-subsidized through the sale of stoves at market price to developed countries.
- Stove dissemination through existing distribution channels and local distributors.

3. Project: Building Economic, Social and Technological Opportunities and Foundations to Promote Renewable Energy Nationwide (BEST-OF-PREN), the Philippines

Duration: 2006-2011.

Costs: USD 535,500 through the GEF/UNDP-funded Capacity Building to Remove Barriers to Renewable Energy Development (CBRED) project.

Implementing agency: Poverty and Equity Foundation (PEF).

Technology and application: Microfinance for RETs.

Population reached: Improved cookstoves and solar lanterns for 7,750 people across the Philippines.

Operational model:

The project uses a microfinance scheme to make RETs accessible to poor households in the Philippines. The scheme consists of:

- financial support to microfinance intermediaries, which re-lend to small-scale borrowers; and
- capacity development and support to financial intermediaries to access micro-credits.

MDG impacts: Early appraisal of potential impacts highlights improved access to high quality and cost effective home lighting (through solar lanterns) for poor households; extended working hours through lighting used for cooking/baking enterprises, market stalls and on patrol boats for communities fisheries.

Good practices and lessons learned

- Market-based approach in development and delivery of energy products by using accessible and appropriate RE financing windows.
- Capacity development for MFIs in technology, financing, marketing and risk management to strengthen institutions and assure loan repayments.
- Original fund to be kept intact or preserved in value by project completion term.

4. Project: Biogas Support Programme (BSP), Nepal

Duration: 2003-ongoing.

Costs: USD 19.07 million (Phase IV, 2003-2010), funded by SNV.

Implementing agency: Biogas Sector Partnership Nepal.

Technology and application: Commercialization of biogas plants.

Population reached: 204,490 biogas plants covering 1.36 million beneficiaries.

Operational model:

BSP applied a market-based approach with a pro-poor focus to disseminate biogas plants in Nepal. The programme used a private-public partnership to disseminate biogas plants, which were made affordable through subsidies, loans and micro-credit.

MDG impacts: Reduced drudgery/labour of fuelwood collection and time saving for women; monetary savings in households that purchase fuelwood or kerosene; employment generation among rural youth as biogas masons, labourers, etc; and availability of biogas slurry as high quality organic fertilizer leading to increased agricultural productivity.

Good practices and lessons learned

- Providing market development and other support to the private-sector manufacturers.
- An accountable private sector through a reliable quality assurance system.
- Capacity development of all stakeholders in the biogas sector.
- A combination of financing mechanisms that the biogas users can choose from.

5. Project: Development and Promotion of Biogas Utilization in Rural China (DPBURC)

Duration: 2006-2010.

Costs: USD 5.857 billion, funded by the Government of China, local governments and rural residents.

Implementing agencies: MoA, National Development and Reform Commission (NDRC).

Technology and application: Household biogas digesters.

Population reached: Close to 30 million households.

Operational model:

DPBURC was a government-implemented project that used the 'One Digester Plus Three Renovations' approach, combining biogas digester construction with renovation of kitchens, toilets and animal sheds. Provincial governments and county governments set up special authorities dedicated to the administration of rural energy and the promotion of new energy technology. DPBURC had a clear focus on geographical priority areas facing severe energy shortages.

MDG impacts: Savings in expenditure on fuelwood, electricity, chemical fertilizer and pesticides; use of biogas slurry as high-quality organic fertilizer; increased crop yield; reduction of fuelwood collection labour and cleaner kitchens for women; increased women's participation in community activities such as night school and technical training; improved sanitation and reduced incidence of water-borne diseases; creation of local employment as biogas construction workers; and emergence of new enterprises in biogas appliances.

Good practices and lessons learned

- The DPBURC project was developed within the overall framework of national socio-economic development, particularly rural development.
- Utilization of the existing MoA network from the central to the local, at provincial, municipal and county levels.
- Close monitoring and supervision of project progress through a computerized system.

6. Project: Capacity Building for the Rapid Commercialization of Renewable Energy (CRE), China

Duration: 1999-2008.

Costs: USD 25.8 billion, funded by GEF/UNDP, Government of the Netherlands, AusAID and Government of China.

Implementing agencies: State Environment Protection Agency (SEPA), National Development and Reform Commission (NDRC).

Technology and application: Capacity development for widespread adoption of RETs (hybrid village-power systems, solar water heating, wind, biogas and bagasse cogeneration).

Population reached: Nationwide (a capacity development project, with no direct impact numbers recorded).

Operational model:

The project promoted the widespread adoption of RETs through a comprehensive set of capacity-building measures for key public and private organizations, supported by influencing national policies in the biogas, wind and village-power sectors, and supporting the promulgation of the national Renewable Energy Law.

MDG impacts: The project focused primarily on delivering capacity-building, and hence did not report MDG impacts.

Good practices and lessons learned

- Promoting enabling conditions for market development by encouraging business sector-regulatory authority consultations and reforming energy policy and planning.
- Identifying and working with leading innovative private-sector enterprises, and involving key stakeholders in all project activities.
- Combining financing from multiple sources including the Government, the private sector and development partners.
- Setting up of CREIA which serves as an institutional base for the promotion of renewables in China.

7. Project: Rural Electrification Programme, Fiji (FREP)

Duration: 1974-ongoing.

Costs: FJD 80 million (USD 42 million), funded by the Government of Fiji.

Implementing agency: Government of Fiji.

Technology and application: Expanding electricity access to rural populations through a combination of conventional grid extension and isolated grids with generating plants, primarily based on diesel.

Population reached: Electrification of Fiji's rural population, from 30.6 percent in 1986 to 81.4 percent in 2007.

MDG impacts: Increased home security, enhanced convenience and comfort levels in electrified homes; conducive study environment created for children; reduced expenditure on batteries and kerosene; starting up of small-businesses; women's work made easier; and recreational opportunities through access to televisions.

Good practices and lessons learned

Strong Government commitment to expanding electricity access, reflected in:

- a consistent political goal over several decades to achieve 100 percent electricity access, supported by a succession of Government administrations and Fiji Electricity Authority managements;
- a dedicated government institution that focuses on rural electrification;
- recurrent allocations from the national budget supported by resources from development partners; and
- supportive policies, in particular the Rural Electrification Policy.

8. Project: Improved Water Mill Programme (IWM), Nepal

Duration: 2003-mid 2012.

Costs: EUR 1,316,125 provided by the Government of Nepal and Directorate General for International Cooperation of the Netherlands (DGIS).

Implementing agency: Centre for Rural Technology Nepal (CRT/N).

Technology and application: Improvement of traditional water mills for agro-processing and electricity generation to improve rural livelihoods.

Population reached: Mechanical power and electricity through 6,365 improved water mills benefitting 330,998 households.

Operational model:

The programme promoted a simple and versatile technology that used available water resources to produce 3-4kW of mechanical and electrical power to meet rural energy needs. This included replacement of parts of traditional water mills with more efficient ones and adapting mills to other end-uses, including electricity generation.

MDG impacts: Improved access to milling facilities for rural communities; reduction in the use of fossil fuels such as diesel; emergence of small businesses and enterprises; reduced drudgery/labour for women in grinding and milling; and setting up and strengthening of local community-based institutions, such as Ghatta Owners Associations.

Good practices and lessons learned

- Selection of an appropriate technology – in this case, one that was already well known in rural areas – that offers multiple MDG benefits, enhancing the efficiency of a traditional technology for ease of management, operation and maintenance.
- Selection of a technology that has a strong focus on productive applications of energy.
- A continued focus on capacity development for service providers and other partners (including local governments) to increase the sustainability of the sector.
- A strong government commitment can be instrumental in attracting donor funding.

9. Project: Providing energy access to remote areas in India through women's empowerment, India.

Duration: 2002-ongoing.

Costs: Funded by the Royal Norwegian Embassy and UNDP-GEF Small Grant Programme.

Implementing agency: Jagriti.

T**echnology and application:** Distribution of energy-efficient cooking and water-heating devices (LPG stoves, pressure cookers, traditional water heaters).

Population reached: 6,000 households.

Operational model:

Jagriti, a community-based organization operating in the hilly state of Himachal Pradesh, disseminates energy-efficient devices through more than 100 women's savings and credit groups at the village and hamlet level.

MDG impacts: Reduced fuelwood consumption; time saving for women in fuelwood collection and cooking; improved health for women through reduced indoor air pollution; increased participation of women in economic and community activities; and reduced stress on surrounding forests because of reduced need of fuelwood.

Good practices and lessons learned

- Precise targeting of the poor by applying a set of locally developed poverty indicators.
- Routing energy-efficient devices through women's groups and institutions understood and trusted by rural women.
- Among the poor, targeting households that agree to share costs of the energy-efficient devices.
- A flexible and locally appropriate financing mechanisms including linking installments to monthly savings, intra-group loans and group collateral.

10. Project: The Rural Energy Development Programme (REDP), Nepal

Duration: 1996-2012.

Costs: Approximately USD 35 million for Phase III (2007-2012), supported by Government of Nepal, World Bank, UNDP and a community contribution of USD 10.6 million.

Implementing agency: Government of Nepal.

Technology and application: Micro-hydro plants, SHSs, toilet-attached biogas plants and improved cookstoves.

Population reached: 550,000 people in remote, rural locations.

Operational model:
Enhancement of livelihoods in remote rural communities through decentralized energy systems.

MDG impacts: Improved rural livelihoods through increased income from end-uses of energy; improved health due to reduced drudgery, labour and smoke inhalation; improved education of children through extension of study hours; and enhanced awareness and connectivity among rural communities through telecommunications, computers and televisions.

Good practices and lessons learned

- High priority accorded by the national Government to RET promotion, reflected in its five-year development plans and annual programmes.
- The programme was aligned with Government priorities and policies, and thus took advantage of the enabling environment that the country and the energy sector provided.
- Community-led development and ownership of the community in the construction, planning and implementation process.
- A systematic focus on enterprise development and livelihood improvement through energy services.
- Focus on building institutional leadership and capacities to develop policies and programmes in the energy sector.

11. Project: Renewable Energy for Rural Economic Development Project (RERED), Sri Lanka

Duration: 1997-2011.

Costs: USD 134.7 million, funded by IDA (World Bank), GEF and additional funding from the Government of Sri Lanka.

Implementing agency: Development Finance Corporation of Ceylon, Bank of Sri Lanka.

Technology and application: Grid-connected micro-hydro projects, off-grid village hydro projects and household-based SHSs.

Population reached: 611,110 people through VHPs and SHSs.

Operational model:

RERED and the previous ESD project have aimed to promote the commercialization of RETs through setting up commercially viable delivery and financing channels, and streamlined project management structures.

MDG impacts: Reduced expenditure on kerosene and batteries; emergence of new industries such as food processing and grocery stores; increased use of electronic devices and electric appliances; enhanced ability of children to study in the evenings; generation of local employment; increased unity among villagers; and reduced emissions through reduced dependence on fossil fuels.

Good practices and lessons learned

- Utilization of donor funds to create a financial-services subsector for funding RE within the country's existing financial system.
- Development of a conducive policy framework for off-grid RE, in part through an awareness-building campaign for the public sector.
- Addressing financing barriers by establishing a long-term financing package that makes lending for RE attractive for the financial sector, and provides support for capacity-building and business development.
- Addressing the lack of technical capacity by identifying, on a large scale, potential personnel and building their capacities and skills in the required areas.
- Sector-wide market development support in the form of generic RET campaigns.

12. Project: Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY), India

Duration: 2005-2012.

Costs: INR 287 billion (USD 6.4 billion), funded by the Government of India.

Implementing agency: Ministry of Power.

Technology and application: Rural electrification.

Population reached: Electrification of 11 million households (about 60 million people).

Operational model:

RGGVY is a government-led programme for developing rural electricity infrastructure and expanding household electrification. It envisages the creation of a rural electricity distribution and village electrification infrastructure, and decentralized distribution generation systems based on conventional and RE sources where grid electricity supply is not feasible or cost effective.

MDG impacts: RGGVY is an electrification programme, and MDG impacts on users are neither tracked nor quantified.

Good practices and lessons learned

- RGGVY has shown how effective stakeholder partnerships within Government systems can deliver results, something earlier programmes failed to achieve.
- Unlike in previous programmes, the Central Government takes an important role in funding and implementation.
- Empowered to function as a microenterprise providing energy services, the franchise system created provides a link between consumers and state government utilities, which increases the efficiency and effectiveness of service delivery.

13. Project: Community Micro-hydro for Sustainable Livelihoods, Bhutan

Duration: 2005-2009.

Costs: USD 1,090,000 funded by UNDP/GEF, Government of Bhutan, Sengor community.

Implementing agency: Department of Energy (DoE).

Technology and application: Community-based micro-hydro power.

Population reached: Electrification of 57 households in Sengor village.

Operational model:

The project was community driven, with the community taking ownership of project implementation and maintenance of the micro-hydro plant. A Community Collateral Fund was established to enable community members to access loans for income-generating activities. Capacity-building was undertaken to enable the community to maintain the plant on its own. The project also developed guidelines and manuals to aid development of a micro-hydro policy for the country.

MDG impacts: Reduction in the use of fuelwood (by more than half), kerosene, diesel, candles, LPG and dry-cell batteries; increased study hours for children; setting up of new enterprises and livelihood activities; improved heath services through lighting for a local clinic; improved household health through the use of water boilers in homes; improved lighting facilities for adult literacy; improved communication and information services through access to telephones and televisions; reduced emissions through reduced use of fossil fuels and fuelwood; and reduced pressure on surrounding forests due to reduced demand for fuelwood.

Good practices and lessons learned

- The Sengor project is well aligned with the Ninth Five Year Plan of the Royal Government of Bhutan and the government target of electrifying the country by 2020.
- As demonstrated by the efforts of the various line agencies in Sengor, a variety of development actors and agencies need to synergize their efforts at the local level.

14. Project: Sunlabob Solar Lantern Rental System, Lao People's Democratic Republic

Duration: 2006-ongoing.

Costs: USD 541,695 funded by Sunlabob Renewable Energy Ltd.

Implementing agency: Sunlabob Renewable Energy Ltd.

Technology and application: Rechargeable solar photovoltaic lantern (fee-for-service model).

Population reached: 250 solar lanterns in Lao People's Democratic Republic, 700 in Uganda and 50 in Afghanistan.

Operational model:

Sunlabob Renewable Energy Ltd., a private company, disseminates solar lanterns through the following fee-for-service model:

- end-users do not pay for the hardware (i.e. the lanterns), but rather for the service (i.e. the charging);
- solar lanterns are charged through a central charging station, leased out to village entrepreneurs; and
- a village energy committee is responsible for overall management and oversight.

MDG impacts: Better quality and cost effective home lighting available for poor households; reduced indoor air pollution; reduced dependence on kerosene and resultant reduction in GHG emissions; emergence of new jobs and village-based microenterprises; linking communities with the outside world through improved access to telecommunication systems and information.

Good practices and lessons learned

- The fee-for-service model enables poor households in off-grid areas to buy as many hours of lighting as they require and offers a cheaper, cleaner and safer alternative to the conventional kerosene lamps.
- High-quality, robust products such as these can use advanced charging equipment and tamper-proof units while allowing strict control of their use, charge status and monitoring component life-cycles, thereby increasing their on-site efficiency.
- Ensuring a profitable and sustainable business and ownership for all stakeholders, the rural communities themselves are strongly engaged with service delivery.

15. Project: Diffusion of biomass utilization technologies in the informal industries in Karnataka and Kerala, India

Duration: 1998-2008.

Costs: INR 41.2 million (USD 876,596), funded by India-Canada Environment Facility (ICEF); Swiss Agency for Development and Cooperation (SDC); Government of India; UNDP-GEF Small Grants Project; ETC Foundation, the Netherlands; and Deshpande Foundation.

Implementing agency: Technology Informatics Design Endeavour (TIDE).

Technology and application: The use of energy-efficient biomass technology in micro-, small and artisanal industries.

Population reached: 13,000 stoves per year; 140,000 beneficiaries.

Operational model:

TIDE supports energy efficiency in small industries through the dissemination of energy-efficient stoves and application of the following model:

- an entrepreneurial approach to dissemination of biomass cookstoves for small and informal sector enterprises;
- creation of a network of rural energy entrepreneurs;
- transfer of technical expertise and business know-how to local entrepreneurs; and
- users pay full economic cost of stoves.

MDG impacts: Improved profitability for small enterprises through reduced fuel costs and improved product quality; reduced fuelwood consumption and reduction in indoor air pollution; improved comfort and health in work place in small enterprises; and new income-generating opportunities for local masons, welders and transporters.

Good practices and lessons learned

- Providing the local stove entrepreneurs with interpersonal and selling skills.
- Supporting entrepreneurs with additional marketing support through advertisements and promotional campaigns.
- Working with multiple partners, including grassroots NGOs, industry associations and individual entrepreneurs, pooling a variety of abilities and experiences.

16. Project: Participatory Rural Energy Development Programme (PREDP), Timor-Leste

Duration: 2004-2009.

Costs: USD 523,350, funded by the Government of United Kingdom of Great Britain and Northern Ireland, UNDP Target for Resource Assignment from the Core (TRAC) and UNDP-TTF.

Implementing agency: State Secretariat for Energy Policy.

Technology and application: Improved cookstoves, biogas plants and SPV panels.

Population reached: Energy for cooking and lighting for 1,800 beneficiaries.

Operational model:

The PREDP programme provided energy access to isolated and vulnerable communities, applying a community ownership model where communities identified and prioritized their energy needs. It also supported the development of a Rural Energy Policy, which has been used as a basis for developing a renewable energy strategy by the Government.

MDG impacts: Reduced domestic violence; improved health; time saved due to improved cooking stoves and in fuelwood collection; reduced expenditure on fuelwood, particularly among urban beneficiaries; and improved lighting enabling children to study in the evening and resulting in improved school results.

Good practices and lessons learned

- The State Secretariat for Energy Policy played a leadership role in key project activities. This helped to ensure that outcomes conformed with Government plans and that related activities were sustained after the project ends.
- Activities must be carefully situated within the given social context, and communities must be made aware of their responsibilities as soon as they enter into implementation.
- Capacity development must constitute an integral part of the programme at all levels.

17. Project: Vanuatu´s Community Powerhouse rural electrification model

Duration: 2007-2013.

Costs: EUR 537,284 (USD 752,198), funded by the European Union's ACP-EU Energy Facility and WISION.

Implementing agency: Vanuatu Renewable Energy and Power Association (VANREPA).

Technology and application: Rechargeable LED lighting for household use and micro-grids for public institutions.

Population reached: Lighting for 1,100 beneficiaries.

Operational model:

Applying a community-based model in remote areas of Vanuatu, the project focuses on providing decentralized wind- and solar-generated electric power through a series of micro-grids and battery charging stations and the establishment of community energy utilities.

MDG impacts: This is a relatively new project that has faced delays. Evaluating the impact of its specific energy interventions would be premature.

Good practices and lessons learned

- The Community Powerhouse places great emphasis on community management and capacity development.
- Establishing the Community Powerhouse management system within local governance structures and institutions helps to establish a buy-in and enables long-term social sustainability for the project.
- The project emphasizes the value of working with communities to clearly identify their energy needs and then working together to develop responsive solutions.

Annex 2: Energy services and their contribution towards MDGs

MDG	Energy inputs
MDG 1: Eradicate extreme poverty and hunger	■ Access to energy services facilitates economic development and create employment e.g. microenterprises, livelihood activities beyond daylight hours and locally owned businesses. ■ Energy inputs in irrigation can improve agricultural productivity and diversify crop choices. ■ Mechanized agro-processing can increase food supply with reduced effort. ■ Reallocation of time saved in fuel and water collection can lead to increased food production. ■ Decentralized energy systems can expand small-scale manufacturing, food processing industries and marketing opportunities. ■ Efficient fuel conversion technologies in homes and productive enterprises can bring about energy and monetary savings. ■ Energy is needed to process food (e.g. grinding cereals) and to produce food (e.g. water for irrigating agricultural land).
MDG 2: Achieve universal primary education	■ Access to cleaner fuels and efficient technologies can reduce time spent by children (particularly girls) on basic survival activities (gathering firewood, fetching water, cooking, etc.), and hence freeing up time to attend school. ■ Lighting can improve security and enable the use of educational media in schools. ■ Electric lighting allows children to study in the evenings.
MDG 3: Promote gender equality and empowerment of women	■ Energy can reduce the drudgery or labour of arduous tasks undertaken by women, e.g. fuelwood collection, grinding and food preparation. Time and energy thereby saved can be directed towards other activities such as establishing and running enterprises or pursuing evening education (given available lighting for night classes and study). ■ Residential and public lighting can increase women's safety and their ability to participate in community activities and meetings. ■ Reduced time spent on household chores allows women to play greater roles in the public domain. ■ Radio and other communication technology powered by energy improve access to the outside world. ■ Freed from household chores such as fuelwood collection, girls can attend school.
MDG 4: Reduce child mortality	■ Energy can improve the quality of health facilities through refrigeration of vaccines, and modern the use of hospital equipment. ■ Improved fuels and better conversion devices for cooking can reduce indoor air pollution from household smoke, a major cause of infant mortality. ■ Improved water supply can improve household sanitation and reduce water-borne diseases. ■ Availability of energy makes possible the boiling of drinking water.
MDG 5: Improve maternal health	■ Improved fuels and better conversion devices for cooking can reduce indoor air pollution from household smoke, a major cause of infant mortality. ■ Improved water supply can improve household sanitation and reduce water-borne diseases. ■ Energy can improve the quality of health facilities through vaccination, refrigeration services and modern hospital equipment.
MDG 6: Combat HIV/AIDS, malaria, tuberculosis and other diseases	■ Improved health through refrigeration of vaccines and lighting for clinical services. ■ Improved local sanitation and hygiene from use of biogas plants.

Energy services and their contribution towards MDGs (continued)

MDG	Energy inputs
MDG 7: Ensure environmental sustainability	■ Improved energy efficiency and use of cleaner alternatives can help to achieve sustainable use of natural resources and reduce emissions, thereby protecting the local and global environment. ■ Availability of energy makes possible the boiling of drinking water and improved health.
MDG 8: Promoting global partnership for development	■ Partnerships formed between communities, energy projects and other development actors. ■ Improved access to information through television, radio and Internet (improving connections with the larger world).

Annex 3: Good practice examples from reviewed programmes and projects

#	Good practice	Programme/project representing good practice
A	**Energy service delivery**	
1	Get the energy solution right	
1.1	Align product/service with consumer needs and behaviour	Sunlabob Lao People's Democratic Republic, VANREPA Vanuatu, StoveTec, TIDE India, DPBURC China, IWM Nepal, BSP Nepal, BETS-OF-PREN Philippines, RERED Sri Lanka
1.2	Test products extensively with users	Sunlabob Lao People's Democratic Republic, StoveTec, TIDE India, IWM Nepal
1.3	Ensure that energy products are robust and tamper-proof	Sunlabob Lao People's Democratic Republic, BSP Nepal, DPBURC Nepal
2	Involve local communities	
2.1	Align project institutional frameworks within local institutional frameworks	Sunlabob Lao People's Democratic Republic, DPBURC China, REDP Nepal, VANREPA Vanuatu, Sengor Bhutan, PREDP Timor-Leste
2.2	Engage women and other disadvantaged groups proactively	REDP Nepal, Sengor Bhutan, Jagriti India, BEST-OF-PREN Philippines, VANREPA Vanuatu, Sunlabob Lao People's Democratic Republic, IWM Nepal
3	Build commercially viable markets for energy products and services for the poor	
3.1	Cluster dispersed markets	DPBURC China, ACCESS Philippines, StoveTec, BSP Nepal, Jagriti India, TIDE India
3.2	Build on existing supply chains	StoveTec, TIDE India, BEST-OF-PREN Philippines, BSP Nepal, IWM Nepal
3.3	Build consumer confidence through quality assurance	BSP Nepal, RERED Sri Lanka, REDP Nepal, ACCESS Philippines, StoveTec, TIDE India, BEST-OF-PREN Philippines
3.4	Invest in market development and consumer awareness	BSP Nepal, TIDE India, DPBURC China, RERED Sri Lanka, ACCESS Philippines, BEST-OF-PREN Philippines, CRE China, REDP Nepal
4	Monitor and evaluate energy access projects to track MDG impacts systematically	REDP Nepal, Sengor Bhutan, BSP Nepal

Good practice examples from reviewed programmes and projects (continued)

#	Good practice	Programme/project representing good practice
B	**Financing**	
1	Project financing for energy services delivery to the poor	
1.1	Long-term government commitment in terms of financing is essential for expansion	RGGVY India, FREP, DPBURC China, CRE China, ACCESS Philippines, REDP Nepal
1.2	Combine public, private and development financing	ACCESS Philippines, CRE China, DPBURC China, RERED Sri Lanka, Sunlabob Lao People's Democratic Republic, REDP Nepal, BSP Nepal, IWM Nepal
1.3	Situate energy access projects within national development frameworks	CRE China, REDP Nepal, RGGVY India, ACCESS Philippines, PREDP Timor-Leste, DPBURC China
1.4	Carbon markets as a source of finance to expand access	BSP Nepal, REDP Nepal
2	End-user financing: Enable the poor to pay for energy services	
2.1	Offer consumers the choice of locally appropriate financing options	Sunlabob Lao People's Democratic Republic, RERED Sri Lanka, BSP Nepal, REDP Nepal, BEST-OF-PREN Philippines, Sengor Bhutan, VANREPA Vanuatu, IWM Nepal, TIDE India, Jagriti India
2.2	Use micro-credit to expand energy services	RERED Sri Lanka, BSP Nepal, BEST-OF-PREN Philippines, Jagriti India, REDP Nepal
2.3	Develop productive applications of energy and enterprises	REDP Nepal, IWM Nepal, Sunlabob Lao People's Democratic Republic, TIDE India, Sengor Bhutan
2.4	Provide start-up and working capital loans for technology suppliers and service providers	RERED Sri Lanka, REDP Nepal, Sengor Bhutan, BSP Nepal, IWM Nepal, TIDE India
C	**Mainstreaming energy access**	
1	Coordinate collaboration of key players: national governments, donors, the private sector, civil society organizations and specialized financial institutions	CRE China, RERED Sri Lanka, PREDP Timor-Leste, ACCESS Philippines, DPBURC China, BEST-OF-PREN Philippines, BSP Nepal, Sunlabob Lao People's Democratic Republic
2	Build and strengthen national institutional leadership in the energy sector	BSP Nepal, REDP Nepal, CRE China, ESD Sri Lanka
3	Ensure that policy change is an integral component of project strategy	PREDP Timor-Leste, REDP Nepal, CRE China
4	Engage with stakeholders at all levels	DPBURC China, REDP Nepal, RERED Sri Lanka, CRE China
5	Develop capacity for expansion of energy access to the poor	
5.1	Sector-wide capacity development	CRE China, RERED Sri Lanka, PREDP Timor-Leste, ACCESS Philippines, BEST-OF-PREN Philippines, REDP Nepal, BSP Nepal, DPBURC China, IWM Nepal
5.2	Dynamic capacity development strategy	BSP Nepal, RERED Sri Lanka, BEST-OF-PREN Philippines, DPBURC China

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