Partnerships for Universal Access to Modern Energy Services

A GLOBAL ASSESSMENT REPORT ON PUBLIC-PRIVATE RENEWABLE ENERGY PARTNERSHIPS

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A Global Assessment Report by United Nations Regional Commissions

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PREFACE

At the United Nations Conference on Sustainable Development (Rio+20) in 2012, Member States recognized the critical role that energy plays in development.

Access to sustainable modern energy services contributes to poverty eradication, saves lives, improves health, and helps to address basic human needs. Rio+20 reaffirmed support for the implementation of sustainable policies and strategies, based on individual and national circumstances, as well as development aspirations.

The UN General Assembly also declared 2014-2024 as the Decade of Sustainable Energy for All, underscoring the importance of energy issues for sustainable development, and in the development agenda beyond 2015. The General Assembly called on Member States to make universal access to sustainable modern energy services a priority, noting that 1.3 billion people are still without electricity and that 2.6 billion people in developing countries still rely on traditional biomass for cooking and heating. Even when energy services are available, millions of poor people are unable to pay for them.

In addition, the UN Secretary-General launched his "Sustainable Energy for All" initiative, to mobilize action from all sectors of society in support of three interlinked objectives to be achieved by 2030: 1) providing universal access to modern energy services; 2) doubling the global rate of improvement in energy efficiency; and 3) doubling the share of renewable energy in the global energy mix.

The Secretary-General's High-level Group on Sustainable Energy for All has already catalysed significant commitments to action by governments, the private sector, and civil society in support of the achievement of these three objectives. Commitments to the initiative announced at Rio+20 include, among others, providing more than 1 billion people with access to modern energy during the lifespan of the initiative, and to forming new public-private partnerships on energy access for the poor.

There is an urgent need to mainstream and scale-up our interventions to make households energy-secure, especially in accordance with specific national conditions. Given the complexity of these challenges, partnerships will play an increasingly significant role. This is why the UN is working to assist Member States in developing policy options for fostering partnerships, particular for energy access in rural communities as part of attaining sustainable energy for all.

With support from the United Nations Development Account, the five regional commissions; Economic and Social Commission for Asia and the Pacific (ESCAP), Economic and Social Commission for Western Asia (ESCWA), Economic Commission for Latin America and Caribbean (ECLAC), Economic Commission for Africa (ECA), Economic Commission for Europe (ECE), and the Department of Economic and Social Affairs (DESA) are working together to enhance energy security and improve access to energy services through development of public-private renewable energy partnerships. The initiative is led by the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP), with additional funding from the International Fund for Agricultural Development (IFAD). We hope Member States across the globe are able to leverage the findings from this unique undertaking.

This report finds that successful partnerships actively promote community empowerment through engagement of community members in leading to a higher level of ownership of community based energy projects. It aims to provide examples of practical experiences and good practices, to demonstrate that public-private renewable energy partnerships can play an effective role for improving energy access to the rural poor and help to create the inclusive, resilient, and sustainable future we want.

Noeleen Heyzer
Under-Secretary General of the United Nations
and Executive Secretary of ESCAP

About The United Nations Regional Commissions

The Regional Commissions are the regional outposts of the United Nations in their respective regions. They are also an integral part of their regional institutional landscape. Stationed in five regions of the world, United Nations Economic Commission for Europe (UNECE), United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP), Economic Commission for Latin America (ECLAC), United Nations Economic Commission for Africa (ECA) and United Nations Economic and Social Commission for Western Asia (UNESCWA) share key objectives aiming to foster economic integration at the subregional and regional levels, to promote the regional implementation of internationally agreed development goals, including the Millennium Development Goals (MDGs) and to support regional sustainable development by contributing to bridging economic, social and environmental gaps among their member countries and subregions.

To achieve these objectives, the five Regional Commissions promote multilateral dialogue, knowledge sharing and networking at the regional level, and work together to promote intra- regional and inter-regional cooperation, both among themselves and through collaboration with other regional organisations.

The outcome document of the Rio+20 Conference emphasizes the significant role played by the Commissions in promoting a balanced integration of the economic, social and environmental dimensions of sustainable development and recognizes the need to ensure effective linkages among global, regional, subregional and national processes. More specifically, it entrusts the Regional Commissions, with the support of the UN system, to support the global efforts relating to Sustainable Development Goals (SDGs) through a bottom up approach. In line with the multidisciplinary nature and expertise of the Regional Commissions, their engagement with the Post-2015 development agenda, including the Secretary-General's High-Level Panel and the SDG process is multi-dimensional and, at different levels.

Regional Commissions are also repositioning their Commission sessions to become the most inclusive intergovernmental forums for discussion and decision-making on sustainable development and the post-2015 Agenda at the regional level. One way this will be done is through integrating highly interactive, multi-stakeholder round tables and panel discussions, on various aspects of sustainable development and the post-2015 Agenda, in the Commission sessions.

For more information, please visit: www.regionalcommissions.org/

EXECUTIVE SUMMARY

Energy poverty — lack of access to electricity and reliance on traditional fuels for cooking and heating — remains an enduring problem. Globally, more than a billion people live without electricity and, nearly three billion depend entirely on wood, charcoal and dung for other domestic energy needs. Their search for energy fuels and services is an arduous, daily grind.

Lack of access to modern energy has a broad impact. It not only limits economic opportunities for income generation and blunts efforts to escape poverty; but it also severely impacts living conditions for women and children and contributes to global deforestation and climate change. In a business-as-usual scenario, by 2030, the estimated number of deaths from dependence on traditional fuels will likely be greater than those individually from malaria, tuberculosis and HIV/AIDS, underscoring the necessity of finding more sustainable forms of energy supply.

Although the United Nation Millennium Development Goals do not explicitly refer to electricity access or energy, none can be achieved without the availability of adequate, affordable and modern energy services. In recognition of this omission, the Secretary-General is leading the Sustainable Energy for All initiative that calls for private sector and national commitments to attract global attention to the importance of energy for development and poverty alleviation. As part of this initiative, the United Nations Foundation has launched a new global Energy Access Practitioner Network[1]. Moreover, the United Nations General Assembly designated 2012 as the International Year of Sustainable Energy for All and the next ten years as the International Decade of Sustainable Energy for All. Furthermore, as part of a more integrated approach between energy and other important sustainable development factors, energy issues are recognized as key building blocks in a broader post-2015 sustainable development framework.

Achieving universal energy access, however, will require about $48 billion in global investments per year, or close to $1 trillion between 2010 and 2030. This means that investments in energy access must increase fivefold compared to current level. Public-private partnerships (PPPs), however, offer an innovative way of catalyzing such investment. PPPs are arrangements between Government and private sector entities for the purpose of providing public infrastructure, community facilities and related services. Such partnerships are characterized by the sharing of investment, risk, responsibility and reward between the partners. The reasons for establishing such partnerships vary but generally involve the financing, design, construction, operation and maintenance of public infrastructure and services. The underlying logic for establishing partnerships is that both the public and the private sector have unique characteristics that provide them with advantages in specific aspects of service or project delivery. The most successful arrangements draw on the strengths of partners to establish complementary relationships. For instance, bringing in rural communities as partners, ESCAP has added the pro-poor element to PPPs to enhance access to energy using locally available renewable resources. Despite the differences between models used to meet the target of universal access to modern energy services, successful partnerships are characterized by some common factors.

This report finds that successful partnerships actively promote community participation and ownership. They couple energy services with income generation and employment and they distribute responsibilities among different institutional partners, involving a diversity of important stakeholders. They choose appropriate technologies matched in quality and scale to the energy service desired, often with direct input from communities and users themselves. They do not "give away" renewable energy technologies or over-subsidize technology or research. Successful partnerships do not take consumer awareness about renewable energy for granted and, instead, direct resources at knowledge dissemination, marketing and promotion. Effective partnerships strongly emphasize after sales service and maintenance, ensuring that technologies are cared for by rural populations or technicians.

Though particular experiences will always differ according to culture and context, this report conclusively shows that when designed appropriately, public-private partnerships can quickly and effectively accelerate the adoption of renewable energy technologies and improve incomes and standards of living, in the areas of the world that most urgently need them.

ACKNOWLEDGEMENTS

With support from United Nations Development Account, the five regional commissions and the Department of Economic and Social Affairs (DESA) are working together to enhance energy security and improve access to energy services through development of public-private renewable energy partnerships. The initiative is led by the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) with additional funding from the International Fund for Agricultural Development (IFAD).

The study has been prepared with substantive inputs from various specialists working with regional commissions since 2011: Thuloane B. Tsehlo of the Energy Planning in the Department of Energy in Lesotho, Africa, Benjamin K. Sovacool, Visiting Associate Professor, Institute for Energy and the Environment at Vermont Law School and consultant in the Asia and Pacific region, Juan Gollán, international consultant in the Latin American region, Nida El Helou in the West Asia region, along with Leo McKenna and Isabelle Wachsmuth in the European region.

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supported by Lara Geadah, coordinated the regional component for West Asia. Adam Sek (retired 31 December 2012), Regional Energy Advisor and Gianluca Sambucini, Secretary of the Committee on Sustainable Energy, Economic Affairs Officer, Sustainable Energy Division, contributed from ECE. In addition, Ivan Vera, Senior Sustainable Development Officer at Water, Energy and Strategies Branch of the Division for Sustainable Development, UN-Energy Secretariat at DESA contributed to the review and discussion of the regional reports at the inter-regional forum on Public-Private-Renewable Energy Partnerships held on 20-21 November 2012 in Bangkok, Thailand.

Rae Kwon Chung, Hongpeng Liu and Abhijeet Deshpande at the ESCAP secretariat conceptualized the joint report and provided guidance, expert inputs, and comments. Hongpeng Liu was in charge of the overall production of the study and contributed to the draft, revision and finalization of it. Chaveemon Sukpaibool finalized the version for printing and Jingshu Zhang help to check all references. Aisa Sano provided editorial and coordination support for report design.

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EXPLANATORY NOTES

The term "ESCAP region" in this publication refers to the group of countries and territories/areas comprising Afghanistan; American Samoa; Armenia; Australia; Azerbaijan; Bangladesh; Bhutan; Brunei Darussalam; Cambodia; China; Cook Islands; Democratic People's Republic of Korea; Fiji; French Polynesia; Georgia; Guam; Hong Kong, China; India; Indonesia; Iran (Islamic epublic of); Japan; Kazakhstan; Kiribati; Kyrgyzstan; Lao People's Democratic Republic; Macao, China; Malaysia; Maldives; Marshall Islands; Micronesia (Federated States of); Mongolia; Myanmar; Nauru; Nepal; New Caledonia; New Zealand; Niue; Northern Mariana Islands; Pakistan; Palau; Papua New Guinea; Philippines; Republic of Korea; Russian Federation; Samoa; Singapore; Solomon Islands; Sri Lanka; Tajikistan; Thailand; Timor-Leste; Tonga; Turkey; Turkmenistan; Tuvalu; Uzbekistan; Vanuatu; and Viet Nam

United Nations Social and Economic Commission for the Africa (ECA) was established by the Economic and Social Council (ECOSOC) of the United Nations (UN) in 1958 as one of the UN's five regional commissions, ECA's mandate is to promote the economic and social development of its member States, foster intra-regional integration, and promote international cooperation for Africa's development. Made up of 54 member States, and playing a dual role as a regional arm of the UN and as a key component of the African institutional landscape, ECA is well positioned to make unique contributions to address the Continent's development challenges.

United Nations Social and Economic Commission for Europe (ECE) was set up in 1947 by ECOSOC. It is one of five regional commissions of the United Nations. UNECE's major aim is to promote pan-European economic integration. To do so, it brings together 56 countries located in the European Union, non-EU Western and Eastern Europe, South-East Europe and Commonwealth of Independent States (CIS) and North America. All these countries dialogue and cooperate under the aegis of UNECE on economic and sectoral issues. However, all interested United Nations member States may participate in the work of UNECE. Over 70 international professional organizations and other non-governmental organizations take part in UNECE activities.

United Nations Social and Economic Commission for Latin America and the Caribbean (ECLAC) was established by Economic and Social Council resolution 106(VI) of 25 February 1948 and began to function that same year. The scope of the Commission's work was later broadened to include the countries of the Caribbean, and by resolution 1984/67 of 27 July 1984, the Economic Council decided to change its name to the Economic Commission for Latin America and the Caribbean (ECLAC); the Spanish acronym, CEPAL, remains unchanged. ECLAC, which is headquartered in Santiago, Chile, is one of the five regional commissions of the United Nations. It was founded with the purpose of contributing to the economic development of Latin America, coordinating actions directed towards this end, and reinforcing economic ties among countries and with other nations of the world. The promotion of the region's social development was later included among its primary objectives. In June 1951, the Commission established the ECLAC subregional headquarters in Mexico City, which serves the needs of the Central American subregion, and in December 1966, the ECLAC subregional headquarters for the Caribbean was founded in Port-of-Spain, Trinidad and Tobago. In addition, ECLAC maintains country offices in Buenos Aires, Brasilia, Montevideo and Bogotá, as well as a liaison office in Washington, D.C.

The United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) is the regional development arm of the United Nations for the Asia-Pacific region. Made up of 53 Member States and 9 Associate Members, with a geographical scope that stretches from Turkey in the west to the Pacific island nation of Kiribati in the east, and from the Russian Federation in the north to New Zealand in the south, the region is home to 4.1 billion people, or two thirds of the world's population. This makes ESCAP the most comprehensive of the United Nations five regional commissions, and the largest United Nations body serving the Asia-Pacific region with over 600 staff. Established in 1947 with its headquarters in Bangkok, Thailand, ESCAP works to overcome some of the region's greatest challenges by providing results oriented projects, technical assistance and capacity building to member States

United Nations Social and Economic Commission for Western Asia (ESCWA) was established on 9 August 1973 pursuant to the Economic and Social Council's resolution 1818 (LV). The purpose

of setting up the Commission was to raise the level of economic activity in member countries and strengthen cooperation among them. It was also intended to meet the need of the countries in Western Asia for the services of a regional economic commission to promote the development efforts in the region. In recognition of the social component of its work, the Commission was entrusted with new responsibilities in the social field by virtue of Economic and Social Council resolution 69/ 1985 of July 1985. Its name therefore became the Economic and Social Commission for Western Asia (ESCWA). ESCWA has been located in a number of Arab capitals. It started in Beirut (1974- 1982), moved to Baghdad (1982- 1991), then to Amman (1991- 1997), and returned to Beirut in 1997, its permanent headquarters. ESCWA comprises 17 Arab countries in Western Asia: Bahrain, Egypt, Iraq, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Palestine, Qatar, Saudi Arabia, The Sudan, The Syrian Arab Republic, Tunisia, The United Arab Emirates and Yemen.

Department of Economic and Social Affairs (DESA) works closely with governments and stakeholders to help countries around the world meet their economic, social and environmental goals. DESA's work programme can be categorized into three areas: norm-setting, analysis, and capacity-building. Whether by supporting policy-making bodies, facilitating major UN conferences, projecting trends in demography, publishing top quality economic analysis, or helping countries develop capacity, DESA's influence has reach far beyond the doors of the UN.One of DESA's primary contributions is providing policy research and analysis for member governments to use in their deliberations and decision-making. As mandated by UN Member States, DESA assists countries as they find common ground and take decisive steps forward. In addition, DESA organises and supports consultations with a range of stakeholders, including the private sector and civil society. Upon request, DESA also advises and assists governments in implementing the policies and programmes developed at UN conferences back in their home countries.Specifically, DESA is tasked with supporting deliberations in two major UN charter bodies: the UN General Assembly and UN Economic and Social Council (ECOSOC), as well as ECOSOC's subsidiary bodies. In this regard, DESA's main priorities are promoting progress toward and strengthening accountability in achieving UN development goals. Furthermore, DESA is responsible for ensuring civil society engagement with the UN by way of the ECOSOC body.

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ABBREVIATIONS AND ACRONYMS

AC	alternating current
ADB	Asian Development Bank
AEPC	Alternative Energy Promotion Centre
ASEAN	Association of Southeast Asian Nations
BOT	build-operate-transfer
CBO	community-based organization
CGF	competitive grant facility
CMF	community mobilization fund
DC	direct current
DDC	district development committee
EdL	Electricité du Lao People's Democratic Republic
EEG	Erneuerbare-Energien-Gesetz
ESCO	energy service company
ESI	electricity supply industry
FIT	feed-in tariff
FY	fiscal year
G8	Group of Eight
GDP	gross domestic product
GEF	Global Environment Facility
GHG	greenhouse gas
GS	Grameen Shakti
GTC	Grameen Technology Centre

HIV/AIDS	human immunodeficiency virus/acquired immunodeficiency syndrome
IAEA	International Atomic Energy Agency
IAP	indoor air pollution
IBEKA	Institut Bisnis dan Ekonomi Kerakyatan
ICS	improved cook stove
IEA	International Energy Agency
IED	Innovation Energie Développement
IGOs	intergovernmental organizations
IMF	International Monetary Fund
INGOs	International non-governmental organizations
kgoe	kilograms of grossary oil equivalent
kW	kilowatt
LPG	liquefied petroleum gas
MDGs	Millennium Development Goals
MDSF	market development support facility
MHVE	micro hydro village electrification
MW	megawatt
MWp	megawatt-peak
NDRC	National Development and Reform Commission
NGOs	non-governmental organizations
NOx	nitrous and nitrogen oxides
PESCO	provincial electrification service companies
PMO	project management office
PPPs	Public-Private Partnerships
PSP	private sector participation
PV-ESCO	photovoltaic energy service company

QRF	quick response facility
R&D	research and development
REDP	Renewable Energy Development Project (the People's Republic of China)
REDP	Rural Energy Development Project (the Federal Democratic Republic of Nepal)
REEEP	Renewable Energy and Energy Efficiency Partnership
REP	Rural Electrification Project
S3IDF	Small Scale Sustainable Development Infrastructure Fund
SELCO	Solar Electric Light Company
SHS	solar home system
Solar PV	solar photovoltaic panels
SOx	sulfate and sulphur oxides
SPV	Special Purpose Vehicle
TI	technology improvement
UN	United Nations
UNDP	United Nations Development Programme
UNESCAP	United Nations Economic and Social Commission for the Asia Pacific
VEM	village electricity manager
VDC	village development committee
VOPS	village off-grid performance schemes
Wp	watt-peak
WHO	World Health Organization

Part I: INTRODUCTON

For roughly half of the global population, existence — and energy consumption — is remarkably distinct from the lifestyles most people in industrialized countries have become accustomed to. Imagine a daily ritual without consistently hot showers or baths, no indoor lighting at night, poorly cooked food and debilitating health problems associated with indoor air pollution. Think about life with no steady pumping of water for drinking and irrigation, few televisions, mobile phones, or computers and limited access to the fruits of modern civilization. The search for energy fuels and services is an arduous, daily grind. Women and children spend hours each day carrying fuel and water loads often in excess of their weight, time they could otherwise utilize on productive work or education, with calamitous consequences on their health, their natural environment and their community[2].

Yet many if not most developing countries still lack the capacity and technology to shift to more sustainable and affordable supplies of energy without external assistance. One survey of the 24 least developed countries in the world found that 22 of them each had less than 1 per cent of their region's total energy resources[3]. With scarce energy resources of their own, these countries must rely either on the global trading system or development assistance from middle and upper income countries, frequently a troubled process accompanied by accusations of corruption, rent-seeking, major human rights violations and extreme environmental despoliation[4].

*"One survey of the 24 least developed countries in the world found that 22 of them each had **less than 1 per cent** of their region's total energy resources"*

Indeed, improved access to energy services is arguably the key defining characteristic of economic development. Energy poverty contributes to hunger, with women and children spending long hours gathering fuels rather than earning incomes. The health consequences are dire, with indoor air pollution associated with traditional energy use responsible for more deaths each year than those from malaria and tuberculosis[5]. Environmentally, energy poverty forces its victims to harvest more polluting and less energy-dense fuels such as woody biomass or charcoal, often causing land degradation, deforestation and contamination of soil and water resources. Such depletion instigates conflicts over land, decreases food supply, diminishes sources of traditional medicine and accelerates malnutrition.

This report spotlights a better pathway to energy development through the use of public-private partnerships aimed at improving access to sources of renewable energy. "Enhancing energy security and improved access to energy services through development of Public-Private Renewable Energy Partnerships" is a joint effort among the five United Nations Regional Commissions: the UN Economic Commission for Africa (ECA), the Economic Commission for Latin America and the Caribbean (ECLAC), the UN Economic Commission for Europe (UN-ECE), the UN Economic and Social Commission for Asia and the Pacific (UN-ESCAP) and the UN Economic and Social Commission for Western Asia (UN-ESCWA). One of the activities to be implemented under the project is to conduct regional assessments of the energy situation in each of the five regions. This report offers the assessment of the current situation of energy services in West Asia with a focus on renewable energy (RE) resources and public-private partnerships (PPPs). RE refers to a naturally-replenished resource of energy within a human lifetime i.e. strictly solar, wind, hydro, geothermal and biomass.

Part II: ENERGY ACCESS

GLOBAL ASSESSMENT

"Nearly 1.3 billion people remain without access to electricity and 2.6 billion do not have access to clean cooking facilities"

It is important to note that there are around 400 million people that rely on coal, which is not classified as traditional biomass, for cooking and heating purposes, which causes air pollution and has serious potential health implications when used in traditional stoves. These people are mainly in China, but there are also significant numbers in South Africa and India[6].

As may be observed in figures 1[7] and 2[8] and table 1,[9] developing Asia and sub-Saharan Africa continue to account, together, for more than 95 per cent of those without modern energy access. Across developing countries, the average electrification rate is 76 per cent, increasing to around 92 per cent in urban areas but only around 64 per cent in rural areas. More than eight out of ten people without modern energy access live in rural areas, an important factor when seeking to identify the most appropriate solutions. There are nearly 630 million people in developing Asia and nearly 590 million people in sub-Saharan Africa who lack access to electricity. Just ten countries – four in Asia and six in Africa – collectively account for nearly two-thirds of those deprived of electricity.

In Africa, improvements in electricity access are reported in Ethiopia, Angola, Ivory Coast and Senegal, among others. Those countries with the lowest rate of electrification tend to be in sub-Saharan Africa[10].

"More than eight out of ten people without modern energy access live in rural areas"

In Asia-Pacific specifically, energy situation oscillates noticeably. While India has the largest population without electricity access, it has actually been a driving force in improving the trend in South Asia over the last decade, reducing the number of people without access to electricity by around 285 million[11]. In the South-East Asian subregion, about 63 million people in Indonesia and about 16 million in Philippines continue to live with no access to electricity. In Papua New Guinea in the Pacific subregion, only 10 per cent of households have access to electricity. In the North-East Asian subregion, large numbers of people in China, the Democratic People's Republic of Korea and Mongolia experience problems in accessing electricity. On the other hand, although access to energy services is not the primary energy-related challenge in North and Central Asia, there are concerns in some countries about that subregion. For instance, 98 per cent of the population of Kyrgyzstan have access to the electricity grid, but there are forced blackouts and rationing when hydropower abates during the winter[12]. Likewise in winter, more than 1 million people in Tajikistan, the population of which is fewer than 7 million, have little or no access to an adequate supply of energy[13].

The contrast in Asia-Pacific is dramatic when we consider that five countries of United States, China, Japan, Russian Federation and India (in order of production) collectively account for about 50 per cent of world's total gross production of electricity (minus production from pumped storage)[14]. However, when broken down into per capita figures, houses in New Zealand or Australia consume 100 times more electricity than those in Bangladesh and Myanmar.[15]

Figure 1.
Countries with the largest population without access to electricity, 2010

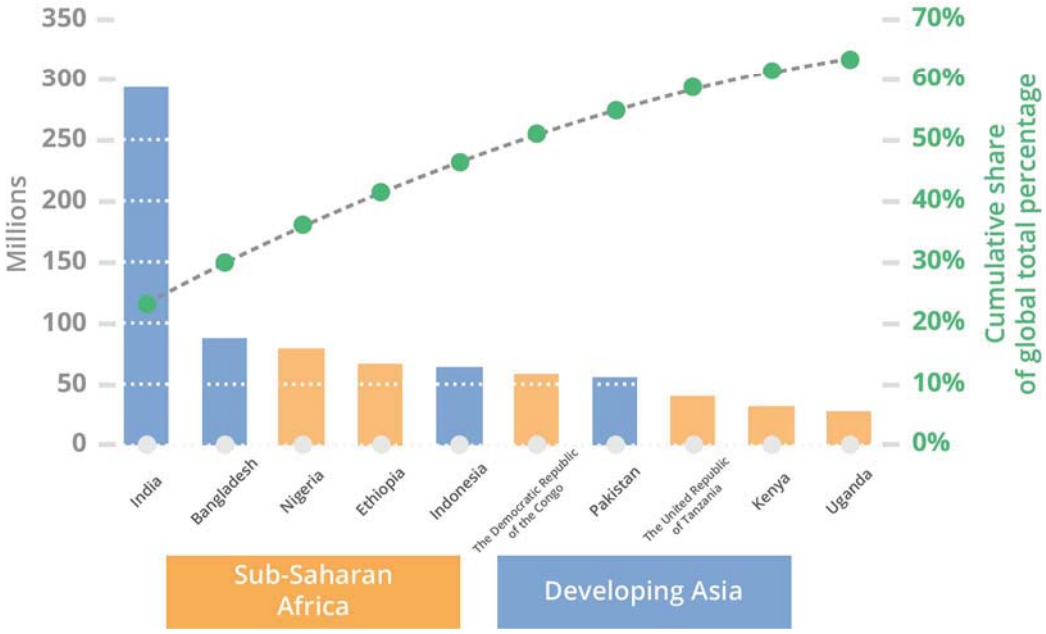


Figure 2.
Countries with the largest population relying on traditional use of biomass for cooking, 2010

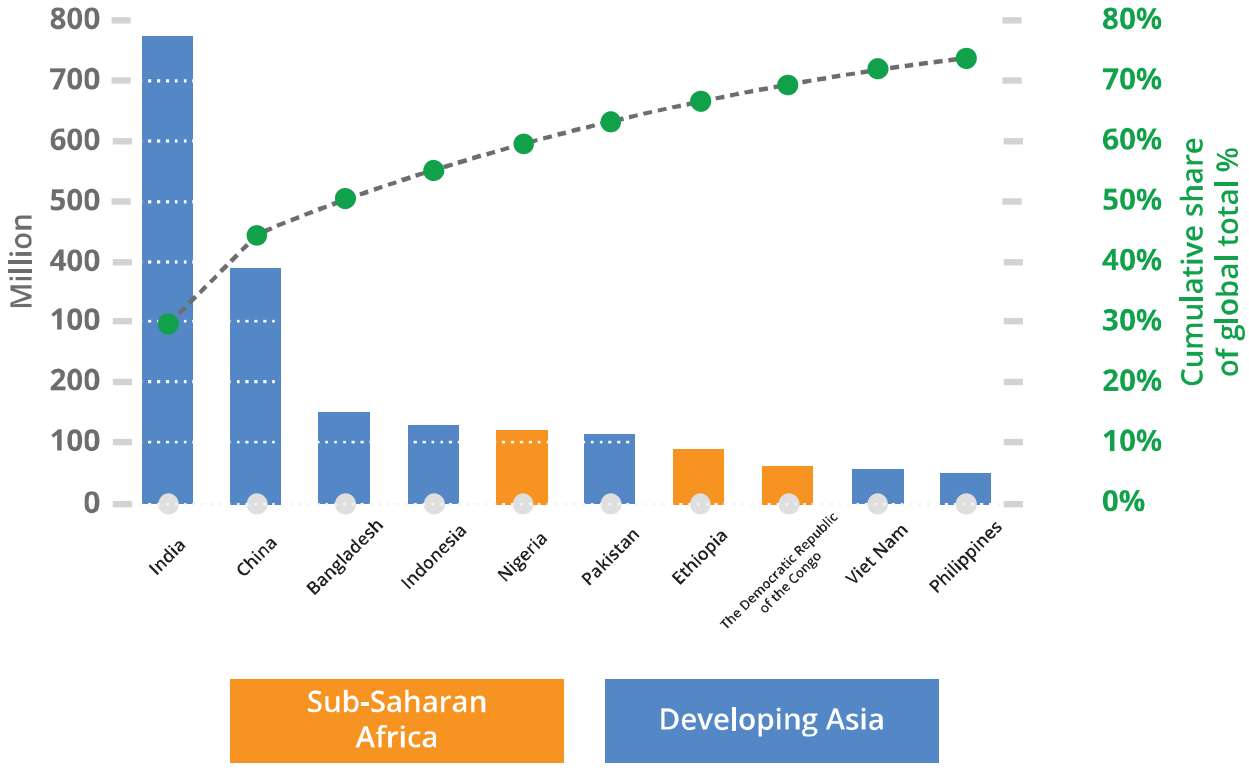


Table 1.

Number of people without access to electricity and dependant on traditional fuels

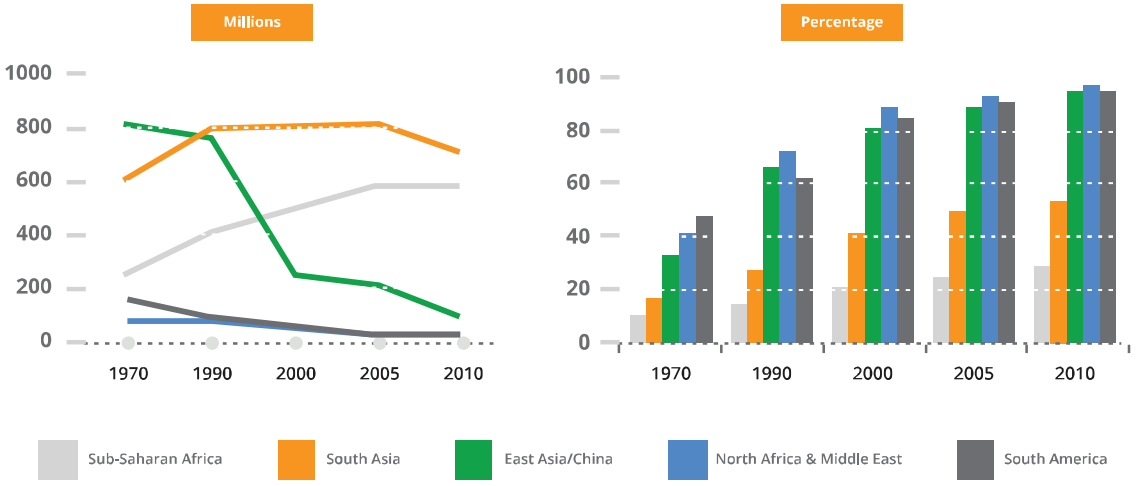
Country/region	Without access to electricity		Traditional use of biomass for cooking*	
	Population (millions)	Percentage of population	Population (millions)	Percentage of population
Select developing countries	1,265	24	2,588	49
Africa	590	57	698	68
The Democratic Republic of the Congo	58	85	63	93
Ethiopia	65	77	82	96
Kenya	33	82	33	80
Nigeria	79	50	117	74
The United Republic of Tanzania	38	85	42	94
Uganda	29	92	31	96
Other Sub-Saharan Africa	286	66	328	75
North Africa	1	1	2	1
Developing Asia	628	18	1,814	51
Bangladesh	88	54	149	91
China	4	0	387	29
India	293	25	772	66
Indonesia	63	27	128	55
Pakistan	56	33	111	64
Philippines	16	17	47	50
Viet Nam	2	2	49	56
Rest of Developing Asia	106	34	171	54
Latin America	29	6	65	14
Middle East	18	9	10	5
World**	1,267	19	2,588	38

IEA and World Health Organization, OCED countries and Eastern Europe Eurasia

Thus, the current situation of energy access is somewhat contradictory: more people have access to electricity as a percentage of the global population, but there are also more people without it in absolute terms in places such as Africa (1970 to 2010) and South Asia (1970 to 2005), as figure 3 illustrates.

Moreover, future trends could make the situation worse. By 2030, the number of people relying on traditional biomass will rise from 2.7 billion today to 2.8 billion[16]. By that same year, according to the newest projections, one-third of the global population will still be dependent on biomass for cooking, 1.3 billion will still lack access to reliable electricity networks and two-thirds of those people will reside in just two regions: Africa and Asia[17].

Figure 3.
Number of people without electricity and electrified population

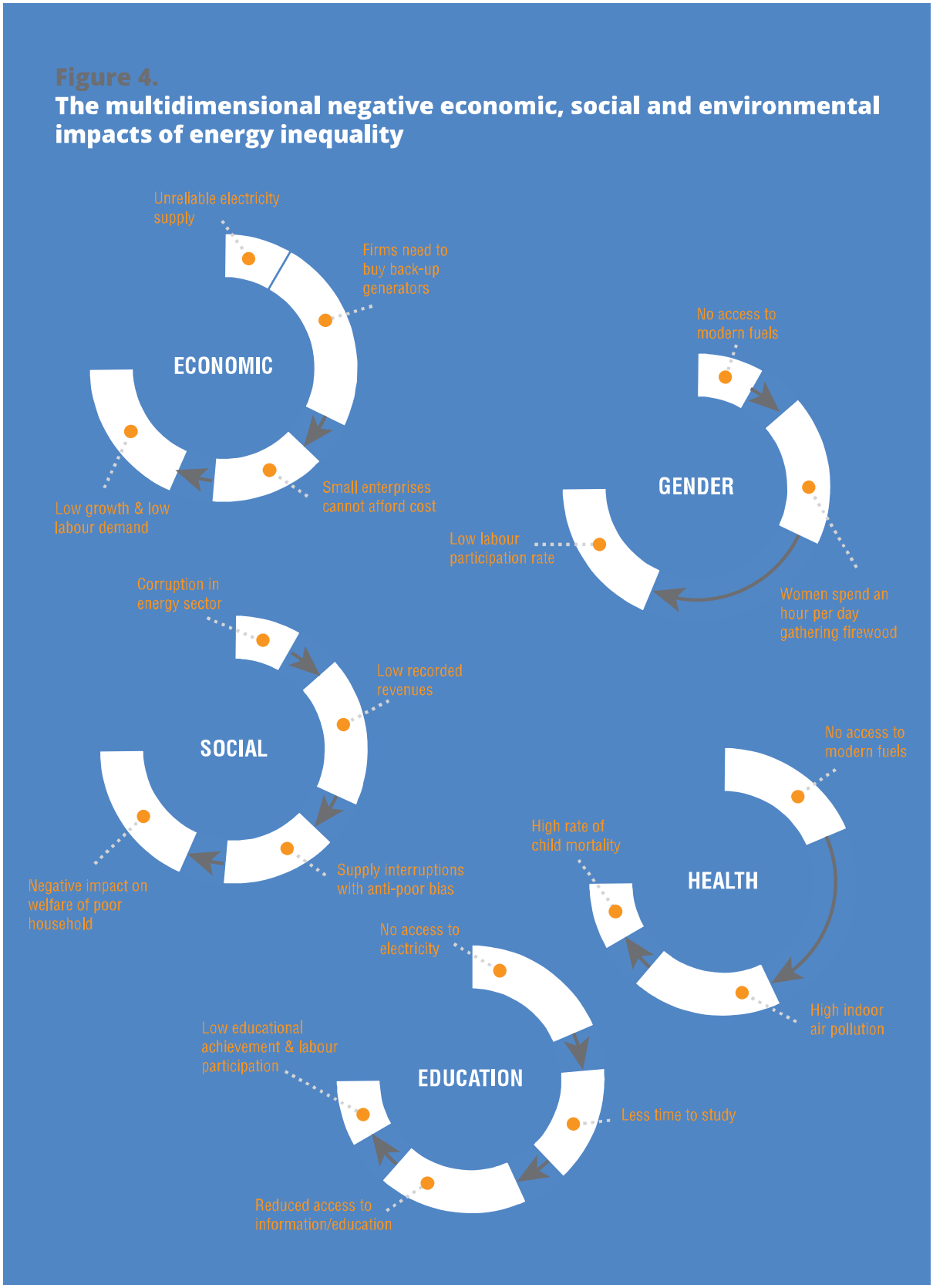


A. THE RELATIONSHIP BETWEEN ENERGY ACCESS AND DEVELOPMENT GOALS

Efforts to improve access to electricity and modern energy as a means to reach economic development date back to the 1950s. In 1954, the United Nations articulated the supply of electricity as a means of achieving "development first" since it improved the economic status of populations living in rural areas by increasing human productivity and welfare.[18] Yet as figure 4[19] shows, lack of access to electricity and dependence on biomass still produce a series of cumulative negative social and environmental consequences. Even though modern energy can alleviate many of these detriments, its provision is not commonly associated with or integrated into broader development and poverty goals. The Millennium Development Goals (MDGs), which consist of the eight goals and eighteen targets[20], do not explicitly deal with energy. Moreover, none of the expressly intended investment clusters needed for these goals — such as increasing food output, promoting jobs, ensuring universal access to essential health services and investing in improved natural resource management — mention electricity or energy specifically.

"Lack of access to electricity and dependence on biomass produce a series of cumulative negative social and environmental consequences"

Figure 4.
The multidimensional negative economic, social and environmental impacts of energy inequality



The World Summit on Sustainable Development (WSSD),[21] which was held in Johannesburg, South Africa in 2002, identified the link between poverty alleviation and access to energy. The key recommendations to the dual achievement of securing energy access and reducing poverty were to:

a. Take gender equality into account when devising policies and planning programs of action given that the majority of the poor are women;

b. Secure energy provision while at the same time enhancing environmental sustainability and safeguarding the natural environment by introducing renewable energy technologies and energy efficiency at both ends of the spectrum of production and consumption of energy services;

c. Raise awareness at all levels and in all sectors on the importance of energy access;

d. Introduce cross-sectoral reform because energy is closely interconnected with other public sectors such as water, health, infrastructure;

e. Galvanize efforts and catalyze action by mobilizing the necessary resources to achieve these ends and consider tapping into the private sector investment potential.

Although none of the MDGs directly tackles energy, the achievement of the eight of them needs an accessible, affordable and reliable energy provision. Energy poverty not only undermines adequate health (maternal and child), education and other public services but also engenders social disorder and conflict which dangerously jeopardize national and regional security.

On the other hand, however, research has shown that the macroeconomic improvement of a country does not unequivocally engender a reduction in income poverty and single-handedly lead to better health, improved education and enhanced gender equality; economic growth at the macro-level should be coupled with social and pro-poor economic policies to lead to micro-economic improvement and achieve progress in non-income MDGs as well.[22,23]

As the next sections show, four broad classes of benefits related to renewable energy access specifically in developing countries exist: poverty and productivity; health and pollution; gender and education and; deforestation, climate change and environmental degradation.

"Achievement of the MDGs needs an accessible, affordable and reliable energy provision"

B. THE BENEFITS OF RENEWABLE ENERGY TECHNOLOGIES

Before considering the benefits, let us first look at the main renewable energy technologies. Operators generally divide renewable power systems into: onshore and offshore wind, solar PV, solar thermal, conventional geothermal, advanced geothermal, combustion biomass, digestion biomass, hydroelectricity and ocean power. These are listed in table2[24] and described next.

a. Wind turbines convert the flow of air into electricity and are most competitive in areas with stronger and more constant winds, such as locations offshore or in regions of high altitude;

b. Solar photovoltaic (PV) cells, also called "flat plate collectors," convert sunlight into electrical energy through the use of semiconductor wafers and are often used in arrays and integrated into buildings. Solar thermal systems, also called "concentrated" or "concentrat¬ing" solar power, use mirrors and other reflective surfaces to concentrate solar radiation, utilizing the resulting high temperatures to produce steam to then power a turbine;

c. An electrical-¬grade geothermal system is one that can generate electricity by means of driving a turbine with geothermal fluids heated by the earth's crust;

d. Biomass generators combust agricultural residues, wood chips, forest wastes, energy crops, municipal and industrial wastes and trash to produce electricity. Biomass generation also includes advanced combustion techniques such as biomass gasification, in which the biomaterial is gasified to increase efficiency prior to its combustion; and co¬-firing, in which biomass burns with another fuel, such as coal or natural gas, to increase its density, as well as the electrical generation from landfill gas and anaerobic digestion;

*"From 2004 to 2010, annual renewable energy investment **quadrupled**"*

e. Two types of hydroelectric facilities exist: large¬-scale facilities that consist of a dam or reservoir impeding water and regulating its flow and run-

-of-river plants that create a small impoundment to store a day's sup¬ply of water. Smaller hydroelectric systems, also referred to as "run-of-the-mill," "micro hydro," and "run-of-the-river" hydro¬power, consist of a water conveyance channel or pressured pipeline to deliver water to a turbine or waterwheel that powers a generator, which in turn transforms the energy of flowing water into electricity. Then the diverted water is sent almost immediately back into the flow of the original source;

f. The category of electricity known as "ocean power" includes shoreline, near-¬shore and offshore "wave extraction" technologies and Ocean Thermal Energy Conversion systems. Because they are a relatively newer technology, comprehensive cost analyses and product reviews are limited.

Growth in global renewable energy markets has been impressive, to say the least. From 2004 to 2010, annual renewable energy investment quadrupled to reach more than $271 billion when large hydroelectric facilities and solar hot water collectors are included[25].

Table 2.
Renewable power generators and associated fuel cycles

Source	Description	Primary energy
Onshore wind	Wind turbines capture the kinetic energy of the air and convert it into electricity via a turbine and generator	Wind
Offshore wind	Offshore wind turbines operate in the same manner as onshore systems but are moored or stabilize to the ocean floor	Wind
Solar pv	Solar photovoltaic cells con¬vert sunlight into electrical energy through the use of semiconductor wafers	Sunlight
Solar thermal	Solar thermal systems use mirrors and other reflective surfaces to concentrate direct solar radiation, utilizing the resulting high temperatures to produce steam that directly powers a turbine The three most common generation technologies are parabolic troughs, power towers, and dish-engine systems	Sunlight
Geothermal (conventional)	An electrical¬grade geothermal system is one that can generate electricity by means of driving a turbine with geothermal fluids heated by the earth's crust	Hydrothermal fluids heated by the earth's crust
Geothermal (advanced)	Deep geothermal generators utilize engineered reservoirs that have been created to extract heat from water while it comes into contact with hot rock, and returns to the sur¬face through production wells	Hydrothermal fluids heated by the earth's crust
Biomass (combustion)	Biomass generators combust to biological material to produce electricity, sometimes gasifying it prior to combustion to increase efficiency	Agricultural residues, wood chips, forest waste, energy crops
Biomass (digestion)	These biomass plants generate electricity from landfill gas and anaerobic digestion	Municipal and industrial wastes & trash
Hydro electric	Hydroelectric dams impede the flow of water and regulates its flow to generation electricity	Water
Ocean power	Ocean, tidal, wave, and thermal power systems utilize the movement of ocean currents and heat of ocean waters to produce electricity	Saline water

1. Poverty and productivity

The provision of modern renewable energy services can expand income generating activities that can greatly reduce poverty and also help diversify the economies of developing countries against fossil fuel shocks and price spikes.

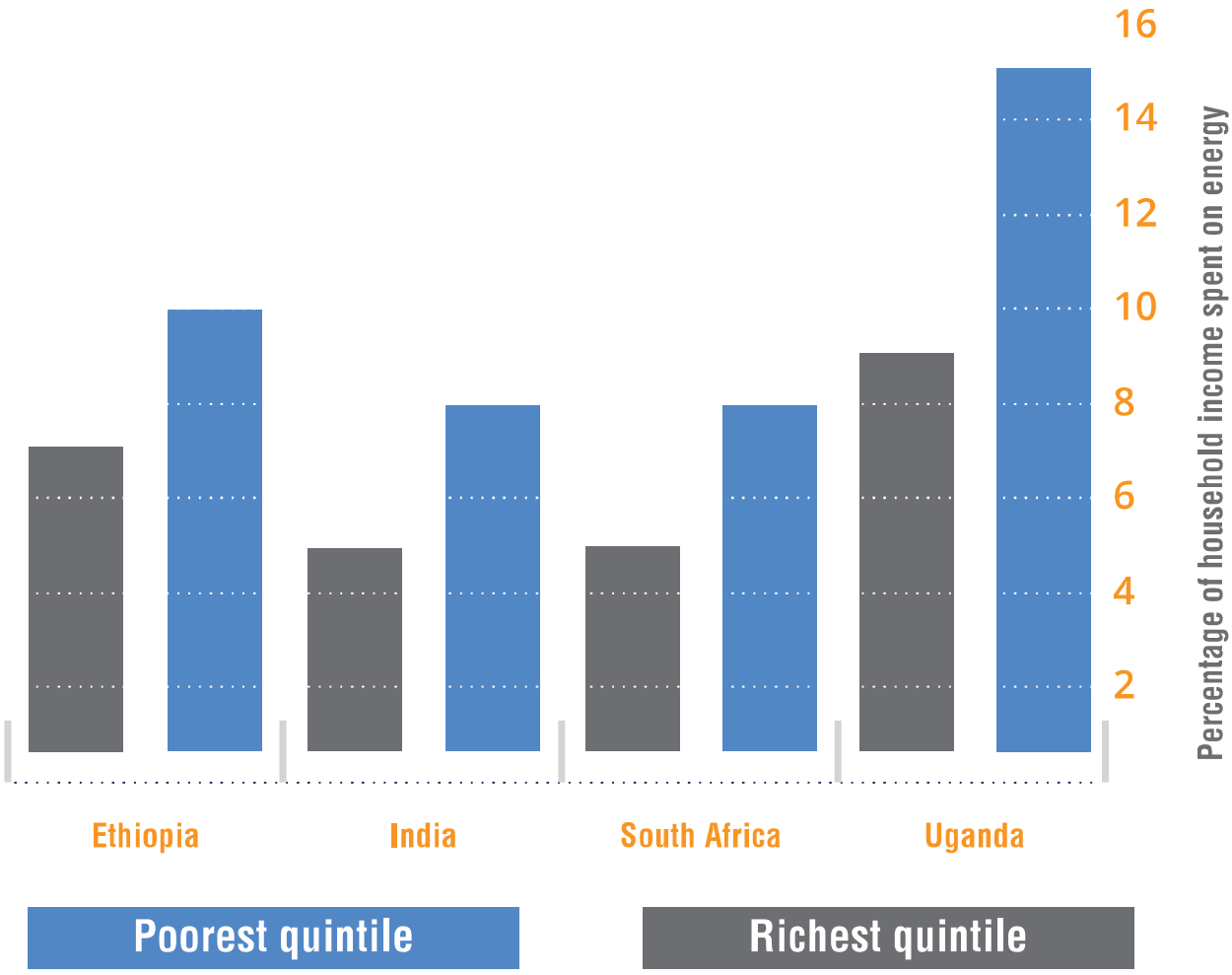
Poverty and energy deprivation go hand-in-hand, with energy expenses accounting for a significant proportion of household incomes in many developing countries. Figure 5[26], for example, shows that in Ethiopia, India, South Africa and Uganda, the poorest in society spend 7 per cent to 15 per cent of their income on energy services, compared to less than 9 per cent for the wealthiest.

A separate global assessment calculated that, generally, 20-30 per cent of annual income in poor households is directly expended on energy fuels and an additional 20-40 per cent is expended on indirect costs associated with collecting and using that energy, such as health care expenses, injury, or loss of time. The study also calculated that the poor pay on average eight times more for the same unit of energy than other income groups[27].

In extreme cases, some of the poorest households directly spend 80 per cent of their income obtaining cooking fuels[28].

"The *poor* pay on average ***eight times more*** for the same unit of energy than *other* income groups"

Figure 5.
Energy as a major expense for poor households



As table3[29] also shows, the relationship between energy consumption and quality of life is almost monotonic — with the countries with the highest GDPs in the world also having the highest levels of energy access. Lack of electricity, conversely, limits the productive hours of the day for business owners and heads of households and also inhibits the types of business opportunities available.

Table 3.
GDP (PPP) per capita and energy comsumption and poverty in selected countries

Country	GDP per capita (2010)	Electric power consumption (kWh per capita, 2010)	Energy use (kgoe per capita 2010)	Population below The poverty line (Percentage source: The World Factbook, CIA)
Luxembourg	103,574	16,834	8,008	..
United States of America	46,612	13,394	7,069	15.1 (2010estimated)
Kuwait	45,437	18,320	12,204	..
Japan	43,063	8,394	3,584	16 (2010estimated)
Republic of Korea	20,540	9,744	5,175	16.5 (2011estimated)
Brazil	10,993	2,384	1,363	21.4 (2009est)
South Africa	7,272	4,803	2,738	31.3 (estimated)
China	4,433	2,944	1,807	13.4 (2011)
India	1,397	616	566	29.8 (2010estimated)
Ghana	1,319	298	382	28.5 (2007estimated)
Kenya	795	156	483	50.0 (2000estimated)
Ethiopia	320	54	400	29.2 (FY09/10estimated)

"Modern renewable energy services can expand income generating activities"

Note: GDP per capita is gross domestic product divided by midyear population. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data are in current U.S. dollars. Electric power consumption measures the production of power plants and combined heat and power plants less transmission, distribution and transformation losses and own use by heat and power plants. Energy use refers to use of primary energy before transformation to other end-use fuels, which is equal to indigenous production plus imports and stock changes, minus exports and fuels supplied to ships and aircraft engaged in international transport.

National estimates of the percentage of the population falling below the poverty line are based on surveys of sub-groups, with the results weighted by the number of people in each group. Definitions of poverty vary considerably among nations. For example, rich nations generally employ more generous standards of poverty than poor nations.

"Use of renewable energy helps insulate economies from fossil fuel price spikes and diversifies the **energy mix**

Furthermore, the broader use of renewable energy helps insulate economies from fossil fuel price spikes and diversifies the energy mix, producing significant macroeconomic savings. For instance, countries with underperforming electricity networks tend to lose 1 to 2 per cent of GDP growth potential due to blackouts, over-investment in backup electricity generators, energy subsidies and inefficient use of resources.[33]

Dependency on fossil fuels, particularly oil, results in severe macroeconomic shocks. One study looked at the world average price of crude oil for 161 countries from 1996 to 2006, when prices increased by a factor of seven and concluded that lower-middle income countries were the most vulnerable followed by low-income countries, even though these countries consumed less oil per capita than industrialized or high income countries34. The reason is that the ratio of value of net oil imports to gross domestic product tends to be higher in lower income countries, meaning they spend a greater share of their GDP on energy imports.

Another study noted that the recently rising oil prices of 2010 and 2011 placed an additional 42 million people in the Asia Pacific region into poverty[35]. A third study assessed the close connection between rising oil prices and food prices and documented an almost perfect relationship between the two. Higher oil prices resulted in rising input costs for agriculture such as oil based fertilizers and fuel for motorized and mechanized equipment, as well as a greater demand for bio fuels which then divert agricultural feedstock to produce fuel rather than food. Both factors created higher food prices and were responsible for increasing the number of malnourished from 848 million in 2004 to 923 million in 2007.[36] Renewable energy, by displacing the use of oil, kerosene and diesel, can ameliorate these negative trends.

Table 4.
Levelized cost of electricity for new renewable power plants, 2010

	Technology	Characteristics	Typical production costs (US Cents, kWh)
Commercial/ utility-scale grid-connected systems	Large Hydro	10MW to 18,000MW	3-5
	Small Hydro	1 to 10MW	5-12
	Onshore Wind	1.5 to 3.5MW (rotor diameter 60-100metres)	5-9
	Offshore Wind	1.5 to 5MW (rotor diameter 70-125metres)	10-20
	Biomass Power	1 to 20MW	5-12
	Geothermal Power	1 to 100MW (binary,single and double flash, natural steam)	4-7
	Rooftop Solar PV	2 to 5kWp	17-34
	Utility-scale Solar PV	200kWp to 100MWp	15-30
	CSP	50-100MW (trough) 10-20MW (tower)	14-18
Hot water, heating and cooling	Biomass Heating	1 to 20MWth	1-6
	Solar Hot Water/Heating	2 to 200 m^2 (evacuated tube and flat plate)	1-20
	Geothermal Heating	1 to 10MWth (heat pumps, cooling, direct use, chillers)	0.5-2
Biofuels	Ethanol (sugar)	Sugarcane and Sugar beets	30-50/litre
	Ethanol (corn)	Corn	60-80/litre
	Biodiesel	Soy, Mustard Seed, Palm, Jatropha and Waste Oils	40-80/litre
Small-scale off-grid systems	Mini-Hydro	100 to 1,000kW	5-12
	Micro-Hydro	1 to 100kW	7-30
	Pico-Hydro	0.1 to 1kW	20-40
	Biogas Digester	6 to 8 m^3	3-14
	Biomass Gasifier	20 to 5,000kW	8-12
	Small Wind Turbine	3 to 100kW	15-25
	Household Wind Turbine	0.1 to 3kW	15-35
	Village-Scale-Mini-Grid	10 to 1,000kW	25-100
	Solar Home System	20 to 100Wp	40-60

Finally, the potential of the renewable energy sector itself to create jobs is increasingly realized. Recent estimates indicate that about 5 million people worldwide work either directly or indirectly in the renewable energy industries. Many significant examples of job creation exist in the developing countries of the Asia-Pacific region. For instance, India estimated 350,000 renewable energy jobs created in 2009. Although there is no distinction between urban and rural jobs, technologies such as off-grid solar, biogas and small-scale hydro, principally relevant in a rural context, account for more than 190,000 of India's renewables jobs. As of December 2011, Bangladesh had installed 1.2 million solar home systems in rural areas, creating an estimated 60,000 jobs in the solar sector. Since 1998 a United Nations Development Programme (UNDP) initiative in Nepal has supported the construction of 323 micro-hydro plants, leading to the equivalent of 3,850 full-time jobs[37].

"About 5 million people worldwide work either directly or indirectly in the renewable energy industries

2. Health and indoor air pollution

Crisscrossing numerous MDG goals — including maternal health, infant mortality and disease epidemics — energy poverty has serious and growing public health concerns related to indoor air pollution, physical injury during fuel wood collection and lack of refrigeration and medical care in areas that lack electricity.

By far the most severe of these is indoor air pollution (IAP). Most homes without access to modern forms of energy cook and combust fuels directly inside their home. Burning firewood, dung and charcoal is physiologically damaging, akin to living within a giant smoking cigarette. Almost three-quarters of people living in rural areas and half (45 per cent) of the entire global population rely on wood and solid fuels for cooking[38]. The World Health Organization (WHO) explains:

The inefficient burning of solid fuels on an open fire or traditional stove indoors creates a dangerous cocktail of not only hundreds of pollutants, primarily carbon monoxide and small particles, but also nitrogen oxides, benzene, butadiene, formaldehyde, polyaromatic hydrocarbons and many other health-damaging chemicals[39].

There is both a damaging spatial and temporal dimension to such pollution. Spatially, it is concentrated in small rooms and kitchens rather than outdoors, meaning that many homes have exposure levels to harmful pollutants sixty times the rate acceptable outdoors to city centers in North America and Europe.[40] Temporally, this pollution from stoves is released at precisely the same times when people are present cooking, eating, or sleeping, with typical women spending 3 to 7 hours a day in the kitchen[41]. Even when these homes have a chimney and a cleaner burning stove (and most do not), such combustion can result in acute respiratory infections, tuberculosis, chronic respiratory diseases, lung cancer, cardiovascular disease, asthma, low birth weights, diseases of the eye and adverse pregnancy outcomes; as well as outdoor pollution in dense urban slums that can make air un-breathable and water undrinkable[42].

Table 5[43] shows the most common and well established, health impacts of IAP.

"Almost three-quarters of people living in rural areas and half (45 per cent) of the entire global population rely on wood and solid fuels for cooking"

Furthermore, IAP ranks third on the global burden of disease risk factors at 4 per cent, coming after only malnutrition (16 per cent) and poor water and sanitation (7 per cent).[44] This places it, individually, ahead of physical inactivity and obesity, drug use, tobacco use, alcohol use and unsafe sex. The most recent data available, presented in table 6,[45] documents that IAP is currently responsible for 1.6 million deaths each year — more than 4,000 deaths per day, or almost 3 deaths per minute. The cost of this burden to national healthcare systems, not reflected in the price of energy, is a whopping $212 billion to $1.1 trillion.[46] Almost all of these deaths occur in developing countries and more than half occur in children.[47] In sub-Saharan Africa, more than 50 per cent of all deaths from IAP can be attributed to the burning of wood, compared to 38 per cent in developing countries overall (the rest come from burning coal and other solid fuels).[48] Put

in perspective, deaths from IAP are already greater than those from malaria and tuberculosis.[49] More worryingly, figure 6[50] shows that by 2030, deaths from IAP will likely be greater than, individually, malaria, tuberculosis and HIV/AIDS.

"Indoor air pollution is currently responsible for 1.6 million deaths each year — more than 4,000 deaths per day, 0r almost 3 deaths per minute"

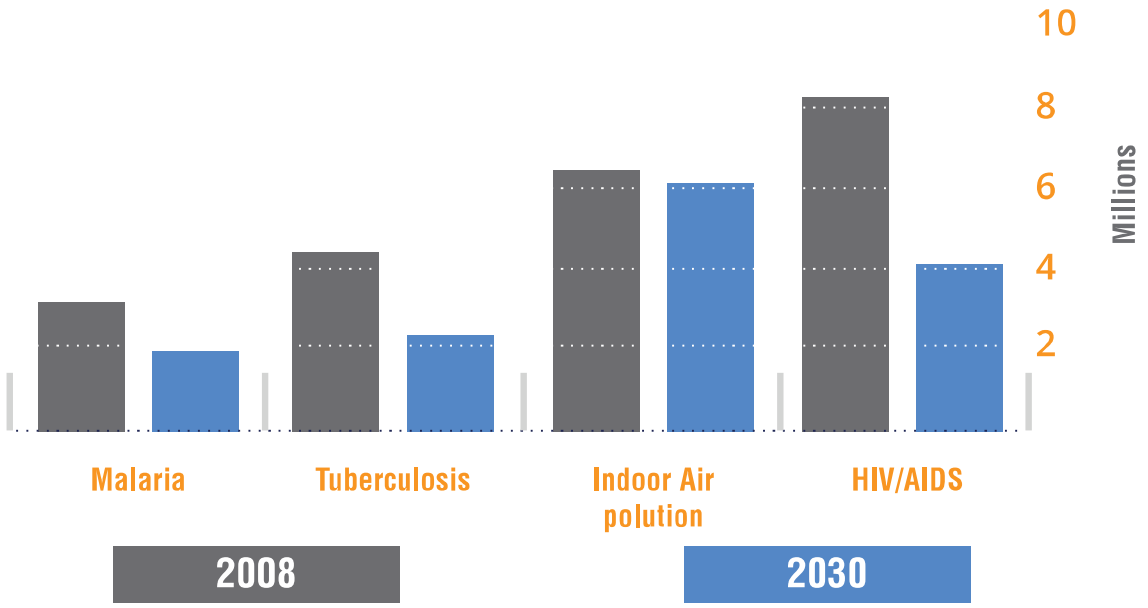
Table 5.
Health impacts of indoor air polution

Health outcome	Evidence	Population	Relative risk
Acute infections of the lower respiratory tract	Strong	Children aged 0-4 years	2.3
Chronic obstructive pulmonary disease	Strong	Women aged more than 30 years	3.2
	Moderate	Men aged more than 30 years	1.8
Lung cancer	Strong	Women aged more than 30 years	1.9
	Moderate	Men aged more than 30 years	1.5
Asthma	Specified	Children aged 5-14 years	1.6
	Specified	Adults aged more than 15 years	1.2
Cataracts	Specified	Adults aged more than 15 years	1.3
Tuberculosis	Specified	Adults aged more than 15 years	1.5

Table 6.
Global health toll of indoor pollution

Level of development	Death in children under the age of 5	Adult deaths	Burden of diseases (thousands of daily adjusted life years)
High-mortality developing (38 percent of the population)	808,000	232,000	30,392
Lower-mortality developing (40 percent of the population)	89,000	468,000	7,595
Demographically and economically developed (22 percent of global population)	13,000	9,000	550
Total	**910,000**	**709,000**	**38,537**

Figure 6.
Annual deaths worldwide classified by cause and compared for 2008 and 2030



Unfortunately, IAP is not the only health consequence of energy poverty. Women and children are both exposed to health related risks during the burdensome and time-intensive process of collecting fuel. Common injuries include back and foot damage, wounds, cuts, sexual assaults and exposure to extreme weather. The large number of daily hours women need to collect and use solid fuel leaves them with no other option than to take young children with them, in essence exposing both to the same health impacts.[51]

Countries without access to modern energy also tend to have more dilapidated health systems; consider that compared to developing countries, infant mortality rates are more than five times higher in energy poor countries, as is the proportion of children below the age of five who are malnourished (eight times higher), the maternal mortality rate (14 times higher) and proportion of births not attended by trained health personnel (37 times higher)[52]. Indirect health effects also occur when traditional fuel becomes scarce or prices rise. Meals rich in protein, such as beans or meat, are avoided or undercooked to conserve energy, forcing families to depend on low protein soft foods such as grains and greens, which can be prepared quickly. In other cases, families stop boiling drinking water when faced with an energy shortage.[53]

"Provision of modern energy services can improve general health by enabling access to potable water, cleaner cooking facilities, lighting and refrigeration"

Luckily, the provision of modern energy services can improve general health by enabling access to potable water (solar water pumping), cleaner cooking facilities (biogas, solar electricity, or hydroelectricity), lighting (all renewable energy sources) and refrigeration (all sources).[54] Renewable electricity can also enable modern preventative, diagnostic and medical treatment care, including the electrification of healthcare facilities and energy for medical equipment, sterilization, security and information and communication technology. Educational awareness raising programs about epidemics and hygiene tend to be enhanced through the modern tools of mass media, such as radios and televisions, which require electricity. The lack of clean water and proper sanitation, a significant cause of disease, furthermore, is linked with lack of access to energy, which can lift subsoil water and sterilize water before use.[55]

3. Gender and education

Energy poverty affects both the gender roles within society and the educational opportunities available to children and adults. Gender impacts center primarily on physical injury collecting fuel and the health impacts of IAP (discussed above); expenditure impacts relate to women having to bear the costs of fuel, stoves and healthcare; and time impacts relate to fuel and water collection, cooking and the care of sick children. Educational impacts relate to time spent out of school as well as increased absenteeism due to illness.

"The educational impacts of energy poverty include absenteeism from school"

For instance, women are by large the most vulnerable to energy scarcity; time spent in fuel collection in scarce areas can range from one to five hours per day, frequently with an infant strapped to their back. As the Asian Development Bank has reported:

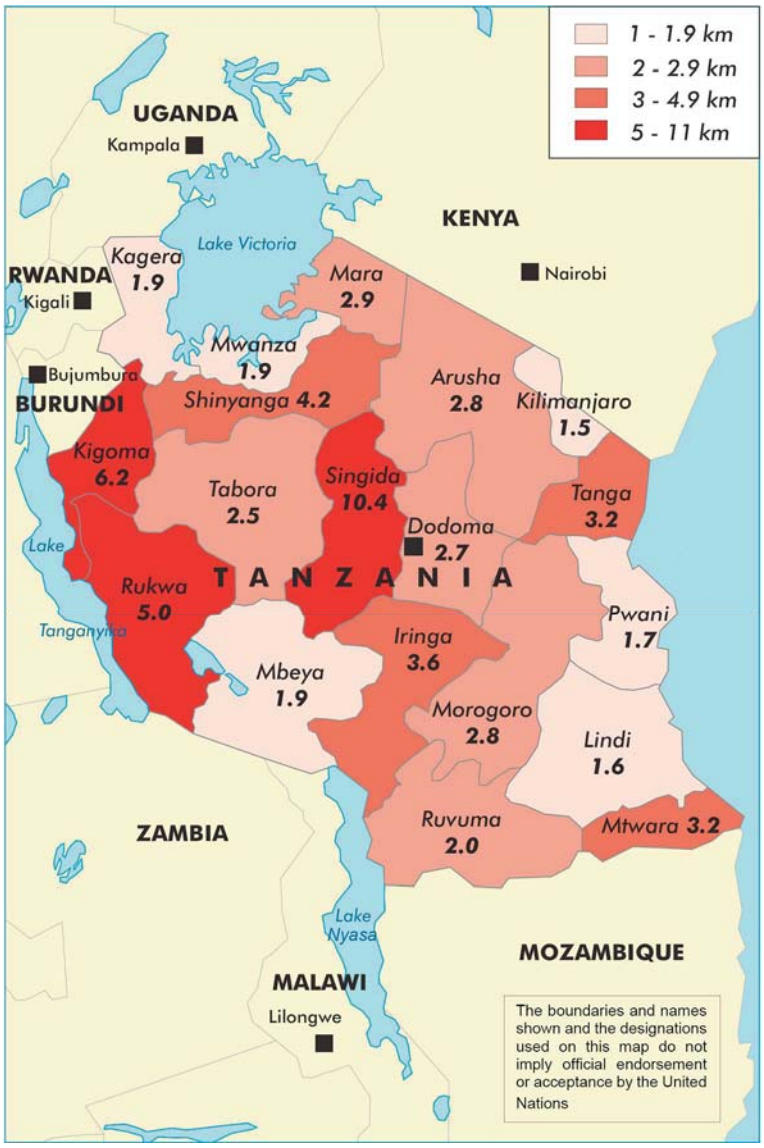
The energy-poverty nexus has a distinct gender bias: of the world's poor, 70 per cent are women. Access to and the forms of energy used by a poor community have significantly different impacts on the men and women in it. Existing social and work patterns, particularly in rural communities, place a disproportionate burden of fuel and water collection and their use in the household for cooking on women and girl children, who consequently have to devote long, exhausting hours to this purpose rather than more productive activities, family welfare, or education. However, women's role in decision-making within the household and community is usually very restricted, reducing their say in issues of spending levels and choices, including with respect to energy. This includes the types of fuels used; amounts of energy purchased, the devices and technology chosen, as well as domestic infrastructure characteristics (e.g., stove design, ventilation and so on). Such decisions are made by the male head of the household, although their burden is borne by the women.[56]

*"Energy-poverty nexus has a **distinct** gender bias: of the world's poor, 70 per cent are **WOMEN**"*

The labour and time intensity of fuel wood collection, one of these burdens, depends on not only the availability of fuel, but also traveling distance, household size and season. In the summer months, when wood must be stockpiled for the winter, some women gather firewood twice a day, each trip taking two hours.[57] In some developing countries, girls spend more than 7 times as many hours collecting wood and water than adult males and 3.5 times as many hours compared to boys the same age. In India, for instance, the typical woman spends 40 hours collecting fuel per month during 15 separate trips, many walking more than 6 kilometres round trip.[58] This amounts to 30 billion hours spent annually (82 million hours per day) collecting fuel wood, with an economic burden (including time invested and illnesses) of $6.7 billion (300 billion rupees) per year.[59]

The average fuel collection times for a variety of African countries; the average women in Africa as a whole has to carry 20 kilograms of fuel wood 5 kilometres per day.[60]

In rural United Republic of Tanzania, most women travel many kilometres to collect wood, with some in Singida region travelling more than 10 kilometres per day.[61]



In addition, current energy production entails occupational hazards that almost uniquely befall women, with estimated 10,000 women fuel wood carriers in Addis Ababa, Ethiopia, supplying one-third of the fuel wood consumed in the city. These women suffer frequent falls, back aches, bone fractures,

eye problems, headaches, rheumatism, anemia and miscarriages from carrying weights often 40 to 50 kilograms, nearly as much as their body weight. The energy needs of rural women can be further marginalized if men control community forests, plantations, or woodlots and if there are other "high value" wood demands on the community that displaces their foraging grounds for fuel.[62]

Physical and psychological violence against women can also be related to energy poverty. When fuel must be collected in areas of contested access or civil disturbances, women may face violence. Hundreds of Somali refugee women have been raped while gathering fuel wood around camps bordering the Somali-Kenyan border and women in Sarajevo, Bosnia, faced sniper fire while gathering fuel.[63] In Darfur, Sudan, women were frequently assaulted and attacked while collecting fuel wood; many trekked hours at dusk and dawn to avoid exposure to the sun, but these were also the times when walking alone was least safe.[64] Bride suicides in India have reportedly been related to women's inability to meet their family's fuel needs.[65]

The educational impacts of energy poverty include absenteeism from school as well as increased incidence of illness. Numerous medical studies have documented a strong connection between the effects of IAP mentioned above and acute respiratory infections in children, which is the principal cause of school absences in many countries. In Uganda, for example, one-third of school absences come from such infections, which commonly last 7 to 9 days each.[66] Moreover, many children, typically girls, are withdrawn from school to complete their chores, including cooking and fuel wood collection. One study in Malawi noted that literacy levels were lower in fuel wood stressed regions of the country and it also found a strong correlation between the time children spend collecting fuel and reduced school attendance.[67]

Conversely, renewable energy technologies can help improve both education and gender equality. Table 7[68] depicts a variety of ways they can enhance the status of women by saving time and improving health. In terms of education, one study of Mali fond that the expansion of energy access improved girl to boy ratios in school, doubling the ratio in some districts. Another study of the Philippines noted that the odds of being illiterate are far greater for individuals that lack electrical lighting.[69] Energy services can also enable schools to recruit and retain better qualified teachers.[70] Lighting from solar and micro hydro

technologies can extend the time children have to study at night and can also lead to better equipped schools with computers and the internet. In Nicaragua, almost three-quarters (72 per cent) of children living in a household with electricity attended school, compared to only 50 per cent of those living without electricity.[71]

Table 7.
Benefits of modern energy services accrued to women

Energy source	Benefits		
	Practical	Productive	Strategic
Electricity	Pumping water, reduced need to haul and carry mills for grinding, improved conditions at home through lighting	Increased possibility of activities during evening hours, refrigeration for food production and sale, power for specialized enterprises and small businesses	Safer streets, participation in evening classes, access to radio, television, and the internet
Biomass (improved cook stoves)	Improved health, less time and effort gathering fuel wood, more time for childcare	More time for productive activities, lower cost of space and process heatings	Improved management of natural forests
Mechanical	Milling and grinding, transport and portering of water and crops	Increased variety of enterprises	Access to commercial, social, and political opportunities

"*Renewable energy technologies* can help improve both education and gender equality"

4. Deforestation, climate change and environmental degradation

The environmental impacts of energy poverty encompass deforestation and changes in land use, as well as greenhouse gas emissions and black carbon. Since billions of individuals rely on biomass for cooking and heating, about 2 million tons of it is combusted every day.[72] Where wood is scarce, or populations are dense, the growth of new trees is not enough to match demand for fuel, resulting in deforestation, desertification and land degradation. Even when entire trees are not felled, the collection of dung, branches, shrubs, roots, twigs, leaves and bark can deplete forest ecosystems and soils of much needed nutrients.[73] It can also damage agricultural production: when wood supplies are scarce, people often switch to burning crops — which threatens food security. Moreover, the deforestation and erosion caused by harvesting reduce the fertility of surrounding fields. One recent assessment attributed 6 per cent of global deforestation to fuel wood collection.[74]

"Since billions of individuals rely on biomass for cooking and heating, about 2 million tons of it is combusted every day"

In Bangladesh, trees and bamboo meet about 48 per cent of all domestic energy requirements followed by agricultural residues that offer 36 per cent and dung that offers 13 per cent.[75] Widespread destruction of forests has occurred to satisfy energy needs, with homestead forest cover reduced to eight per cent of its original area[76] and half of Bangladesh's natural forests being destroyed in a single generation by people collecting fuel wood.[77] Similarly, about 4 per cent of China's standing forests are used as fuel wood and roughly 13 per cent of cultivated land in China is used to grow fuel wood.[78] In sub-Saharan Africa, commercial charcoal production relies on temporary kilns in forested areas that are used until forests are depleted, then moved and rebuilt elsewhere.[79] The link between fuel wood collection and deforestation does not hold for all countries, however. One study noted that many times villagers gather not from forests but "invisible trees" which exist not in dense patches but spread around fields, next to houses and along roads. These trees do not show up on most satellite images of forests or in national forest surveys.[80] Another meta-study of the causes of deforestation in 152 sub-national case studies found that only in Africa did wood collection seriously contribute to tropical deforestation.[81]

Still, the most comprehensive studies suggest that fuel wood collection is clearly an important contributor to land degradation and deforestation. One study of forest stocks around a sample of 34 cities in the developing world noted that even as these urban areas grow, deforestation occurs. As the study concluded:

> *The per capita consumption of biomass fuels persist at a relatively high level until the advanced stages of the energy transition and the aggregate consumption of biomass fuels does not necessarily decline with income growth. With total biomass energy consumption continuing at a high level as cities develop, the demand pressures on surrounding forested land will continue even after cities have reached the later stages of the modern fuels transition.*[82]

Also, the Asian Development Bank has noted that:

> *While deforestation may have many causes other than fuel wood collection that are more important contributors, such as logging, commercial charcoal production, conversion of land to agricultural use and so on, studies show that continued fuel wood harvesting can accelerate such depletion while also diverting biomass away from soil conditioning that can aid vegetative re-growth. Although conditions resulting in deforestation and their underlying determinates may be complex and location-specific, there is little doubt that reducing biomass fuel dependence among the poor … can help relieve the pressure on such natural resources and improve their sustainability.*[83]

Apart from its environmental damage, fuel wood-driven deforestation results in two significant social and economic impacts: an increased burden on fuel wood collectors and farmers and increased fuel prices. First, as stockpiles are depleted, women and children need to travel longer distances to collect fuel, requiring more time and energy. Moreover, such collection typically interferes with the viability of farms and other rural livelihoods that rely on trees for their own income.[84] Second, deforestation results in severe price increases of fuel wood. As deforestation in Bangladesh has accelerated, demand for wood has outpaced supply, causing the price of wood to increase from $0.35 in 1980 to $1.27 in 1991 and $1.69 in 2007 per bunch. When put into the context of the typical household budget, about 50 per cent of the annual income of rural households in Bangladesh is now spent on fuel.[85]

"About 50 per cent of the annual income of rural households in Bangladesh is now spent on fuel"

A second environmental impact of energy poverty involves climate change and black carbon. Burning solid fuels in open fires and traditional stoves has significant global warming effects, due to the release of methane and carbon dioxide.[86] Reliance on biomass fuels and coal for cooking and heating is responsible for about 10 to 15 per cent of global energy use, making it a substantial source of greenhouse gas emissions.[87] One study, for example, projected that by 2050 the smoke from wood fires will release about 7 billion tons of greenhouse gases into the atmosphere.[88]

"Environmental impact of energy poverty involves **climate change and *black carbon***"

By contrast, when direct and indirect carbon emissions are included, renewable sources of power are the least greenhouse-gas intensive sources of energy, a benefit shown by figure 8.[89] Furthermore, renewable energy technologies not only mitigate emissions, they can also promote adaptation to climate change and a suit of social and economic benefits displayed in table 8.[90]

"Renewable energy technologies not only mitigate emissions, they can also promote adaptation to climate change and a suit of social and economic benefits"

Figure 8.
Lifecycle greenhouse gas emissions for electricity sources (grams of CO2e/kWh)

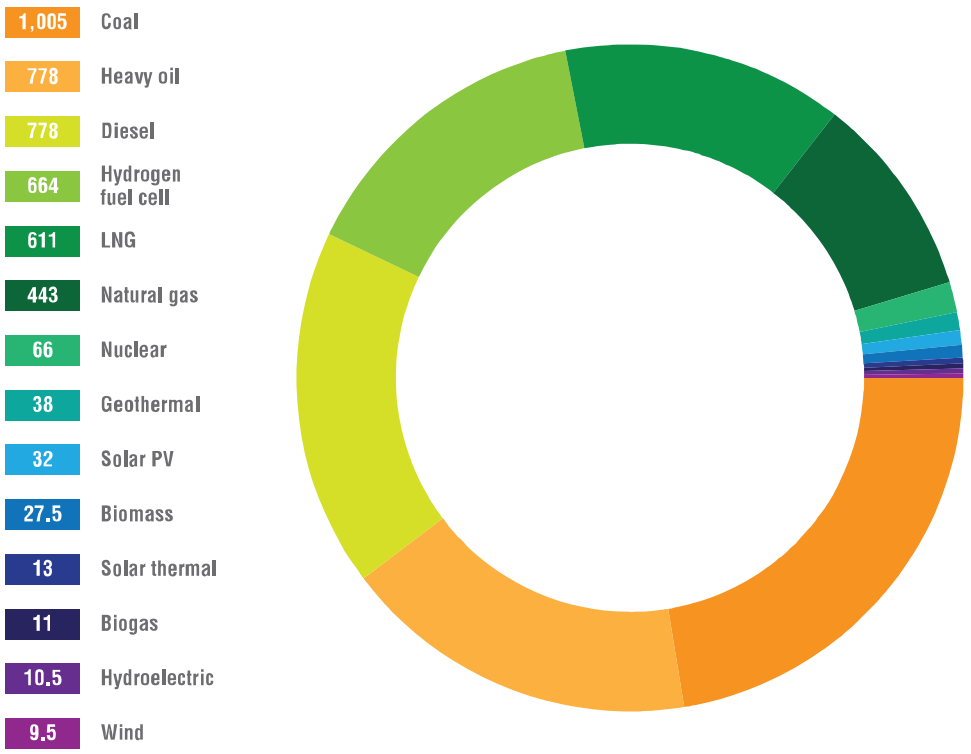


Table 8.
Climate change and development benefits of renewable energy

Type	Application	Migration benefits	Adaptation benefits	Social and economic development benefits
Biomass	Electricity generation and heat	Reduced use of charcoal and fuel wood, less pressure on natural resources	Reduces the likelihood of deforestation and desertification	Creation of jobs and livelihood opportunities, reduced drudgery, reduction of incidents related to indoor air pollution and respiratory infections
Wind	Crop processing, irrigation, and water pumping	Decreased dependence on wood and biomass, avoidance of carbon dioxide emissions	Greater resilience through reduced vulnerability to water scarcity, more adaptation choices through irrigated agriculture	Greater prospects for income generation, improved quality of life, reduced risks of vector born diseases, improved water supply and food security, reduced migratory fluxes, improved school attendance (especially for girls)
Biogas plants	Production of sludge for fertilizer	Reduced use of pesticides and fertilizers	Adapting to soil erosion, aridity, and environmental degradation	Better prospectus for agricultural productivity and income generation
Solar home systems	Cooking, lighting, and water heating	Reduced consumption of fuel wood, kerosene, and batteries, improved local air quality	Improved education through illuminated studying and access to information and communication technology	Improved quality of life as well as better health and sanitation through streetlights and boiled water
Micro hydro	Lighting, agricultural processing	Reduced greenhouse gases, protection of land cover	Improved social resilience	Improved health, greater school attendance

In addition, cooking and heating fires are a major source of black carbon and carbonaceous aerosols (commonly referred to as "soot"), extremely potent contributors to climate change that result from the incomplete combustion of coal or wood. While the precise global warming potential of aerosols can vary, in general black carbon absorbs roughly 1 million times more solar energy than a unit of carbon dioxide per mass. This makes black carbon the second-largest cause of global radiative forcing after carbon dioxide. As one study noted:

> *When deposited on bright ice and snow surfaces such as glaciers or in polar regions, black carbon particles may cause several more months of warming by reducing the reflection of light — this latter effect helps make black carbon an especially effective warming agent that is responsible for approximately 15 per cent of global excess radiative forcing.*[91]

Global warming caused specifically by black carbon has already been connected with the accelerated melting of glaciers on the Tibetan plateau, where glaciers have receded 20 per cent since the 1960s.[92]

C. COST ESTIMATES OF ACHIEVING UNIVERSAL ENERGY ACCESS

This section summarizes cost estimates — of existing financial flows and needed future flows — to achieve universal energy access by 2030. More specifically, it presents data from the International Energy Agency, the recently completed Global Energy Assessment, the World Bank and the Electricity Journal.

1. International Energy Agency (IEA)

In assessing the costs involved with universal energy access, the IEA estimated that $9.1 billion was invested in extending access to energy services globally and that under the absence of any new policies or direction, the amount will rise to about $14 billion per year each year from 2010 to 2030. Most of this will be extensions of the national grid to urban areas. This level of investment — $280 billion over

20 years — may sound significant, but will still leave about 1 billion people without electricity by 2030. With this investment the number of those without clean cooking stays the same at 2.7 billion due to population growth.

In the 'energy for all' scenario by 2030, the amount of investment needs to rise by at least $34 billion to $48 billion per year, or close to $1 trillion by 2030 ($960 billion). That means that total investments must increase, rapidly, by a factor of five. Even then, the amount of $48 billion per year represents only 3 per cent of global energy investments.

"For universal access to modern energy services by 2030, an investment of $48billion per year is required"

Table 9[93] summarizes the additional financing requirements (and potential source of funds) for the 'energy for all' scenario i.e. universal access to electricity and universal access to clean cooking fuels.

Furthermore, the IEA noted that there is a role for numerous technologies and for both renewable and fossil fuels. Grid extension is the most suitable option for all urban areas and for around 30 per cent of rural areas, but not a cost effective option in more remote rural areas. Therefore, 70 per cent of rural areas are assumed to be connected either with mini-grids (65 per cent of this share) or with small, stand-alone off-grid solutions (the remaining 35 per cent).

"Additional investment required to achieve universal access to electricity is estimated to be around $640 billion between 2010 and 2030"

To achieve universal energy access to clean cooking, $74 billion of additional investment is required by 2030. While the largest share of additional investment in the region is for biogas systems, a significant proportion (around 24 per cent) is needed to provide advanced biomass cook-stoves to 395 million people in rural areas. Developing Asia accounts for almost two-thirds of the total additional investment required for clean cooking facilities, the largest element ($26 billion) being for biogas systems, principally in China and India.

"To achieve universal energy access to clean cooking facilities, $74 billion of additional investment is required by 2030"

Table 9.
Energy for All: Additional financing requirements and potential source of funds

	Additional annual investment	People gaining access annually	Household energy expenditure	Main source of financing	Other sources of financing
Additional financing for electricity access in the energy for all case, 2010-2030					
On-grid	$11 billion	20 million	Higher	Private sector	Developing country utilities
			Lower	Government budget	Developing country utilities
Mini-grid	$12.2 billion	19 million	Higher	Government budget, private sector	Multilateral and bilateral guarantees
			Lower	Government budget	Multilateral and bilateral concessional loans
Off-grid	$7.4 billion	10 million	Higher	Multilateral and bilateral guarantees and concessional loans	Private sector, government budget
			Lower	Multilateral and bilateral concessional loans and grants	Government budget
Additional financing for clean cooking facilities in the energy for all case, 2010-2030					
LPG	$0.9 billion	55 million	Higher	Government budget, private sector	Multilateral and bilateral development banks, microfinance
			Lower	Government budget, multilateral and bilateral development banks	Private sector
Biogas systems	$1.8 billion	15 million	Higher	Private sector	Microfinance, government budget multilateral and bilateral development banks
			Lower	Government budget, multilateral and bilateral development banks	Private sector, microfinance
Advanced biomass cook-stoves	$0.8 billion	59 million	Higher	Private sector	Government budget, multilateral and bilateral development banks
			Lower	Government budget, multilateral and bilateral development banks	Private sector

2. IIASA GEA findings

Using different timeframes and methodologies, the International Institute for Applied Systems Analysis (IIASA) Global Energy Assessment (GEA) projects the need for $36-41 billion per year to achieve universal access to electricity and clean cooking; $259 to $406 billion to promote renewables and a further $258 to $365 billion per year to achieve energy efficiency improvements.[94]

3. World Bank

The World Bank estimates that poor households around the world spend about $20 billion per year on traditional fuels for cooking and lighting[95] and that "to make the leap to universal access to modern energy services by 2030, new capital investment of about $35-$40 billion will be needed every year. This is in addition to worldwide annual investments of about $450 billion just to sustain energy services at current levels."[96]

4. Electricity Journal 2011

Indicating that the IEA, IIASA and World Bank's numbers may be conservative, another paper estimated that the total cost of "universal access to electricity for household uses and modern energy services for cooking" could be greater than $70 billion per year, each year, until 2030.[97]

PART III: PARTNERSHIPS FOR ENERGY ACCESS

Collaborations and programs involving Governments as well as businesses, non-profit organizations, banks and community based cooperatives have blossomed in recent years as one way to raise this needed investment to achieve universal energy access. The provision of energy services through renewable energy is capital intensive and requires significant upfront costs compared to conventional energy technology. In most of cases, Government investments and public budgets have proved insufficient to meet the needs of improving energy services in rural areas in a sustainable manner. There is a great need for mobilizing financial resources to expand local energy services delivery.

Public-private partnerships are one of the best mechanisms to supplement and overcome Government budgetary constraints for widening access to energy services, especially to the poor, as they can allocate project-risks between the public and private sector.

"Public-private partnerships are **one of the best mechanisms** *to supplement and overcome Government budgetary constraints for widening access to energy services"*

A. Public Private Partnerships

The specific phrase "public-private partnership" denotes a broad assortment of different relationships among public and private organizations in the context of infrastructure generally and energy technology specifically. Other terms loosely used to describe PPPs are "private sector participation," "liberalization," and "privatization."[98] Table 10[99] offers a sample of some recent definitions from prominent studies. The basic idea is to have national Governments and other public sector entities (such as state Governments, city councils, municipalities and independent legal bodies) partner with actors outside the public sphere to implement projects together.

basic idea is to have national Governments and other public sector entities (such as state Governments, city councils, municipalities and independent legal bodies) partner with actors outside the public sphere to implement projects together.

> *"The specific phrase 'public-private partnership' denotes a broad assortment of different relationships among public and private organizations"*

The most common division of responsibility in a PPP is to have the public partner set service standards (including determining who receives that service and at what level or price) and monitor performance, whereas the private partner raises capital and assumes responsibility for building and operating the project.[100] Consider the example of a PPP for a geothermal power plant. A private company would assume responsibility for financing and building it, including risks related to interest rates rising, delays in construction and increases in labour costs and also for operating it, which includes risks related to selling its electricity at a profitable tariff and maintaining plant equipment. The public partner, say a local Government, would give the company the right to develop the plant on public land and also ensure it meets local environmental and labour standards. The private partner thus gains access to a relatively stable, long-term investment opportunity, collecting revenues from electricity sales; the public partner gets a facility built which will contribute energy and jobs to their local economy.[101]

The roles and responsibilities of the partners may vary from project to project. For example, in some projects, the private sector partner will have significant involvement in all aspects of service delivery, in others, only a minor role. While the roles and responsibilities of the private and public sector partners may differ on individual initiatives, the overall role and responsibilities of Government do not change.

Table 10.
Varying definitions of Public-Private Partnerships (PPPs)

Definition	Source
In a PPP, a private individual or company (large or small, formal or informal) supplies a service (e.g. waste collection, providing water). In return they are paid by the local government, or can collect money from the users of the service.	United Nations Development Programme
Joint venture companies (or special purpose vehicles) with equity contributed by the private and public sectors.	International Monetary Fund
Contracts or union of contracts by which a private entity is bound before a public partner to ensure the development of an activity aimed at satisfying a collective need, and where the funding and responsibility for investment and operating obligations belong, in whole or in part, to the private partner.	Technical University of Lisbon
A spectrum of possible relationships between local government, business, civil society organizations including non-governmental organizations and local communities, for the co-operative provision of basic services.	Public-Private Partnerships for Service Delivery Programme
A partnership that relies on the authority and credibility of the public sector, and the financial and entrepreneurial skills of the private sector.	United Nations Economic and Social Commission for Asia and the Pacific
A cooperative venture between the public and private sectors, built on the expertise of each partner that best meets clearly defined public needs through the appropriate allocations of resources, risks and rewards.	Pranesh C. Saha
A legally-binding contract between government and business for the provision of assets and the delivery of services that allocates responsibilities and business risks among the various partners. In a PPP arrangement, government remains actively involved throughout the project's life cycle. The private sector is responsible for the more commercial functions such as project design, construction, finance and operations.	Government of British Columbia

Public private partnership is not a substitute for strong and effective governance and decision making by Government. In all cases, Government remains responsible and accountable for delivering services and projects in a manner that protects and furthers the public interest. Typically, a Government agency will specify the outputs or services required. The job of producing detailed designs, finding the finance, organizing the construction and on-going management of the facility is left to a private consortium by way of a competitive tender. The private consortium is typically organized by a lead contractor who brings together financiers, engineering firms, construction companies and facilities management companies and so on, to provide individual services.

"Public private partnership is not a substitute for strong and effective governance and decision making by Government"

Because table 10 shows that there is no commonly accepted definition of a PPP, "narrow" and "broad" conceptions exist. In its narrowest form, a PPP refers only to contractual agreement that defines the roles and responsibilities of parties, establishes a sensible risk sharing scheme among them and offers financial rewards to the private party commensurate with its performance and outputs. Or, as Energy Policy 2011 notes, "traditional procurement models take the form of public work contracts: the private sector delivers a pre-designed service, ordered by the contracting agency (public entity) and its unique responsibility is related to the quality standards (established for the service itself)."[102] This contrasts with a "broader" definition that describes a PPP more loosely as any type of project that involves a Government as well as private company, bank, multilateral development bank, or nonprofit organization (including NGOs) at any level of involvement. This definition has been embraced by the Asian Development Bank, who writes that:

> *A PPP allocates the tasks, obligations and risks among the public and private partners in an optimal way. The public partners in a PPP are Government entities, including ministries, departments, municipalities, or state-owned enterprises. The private partners can be local or international and may include businesses or investors with technical or financial expertise relevant to the project. Increasingly, PPPs may also include non-governmental organizations (NGOs) and/or community-based organizations (CBOs) who represent stakeholders directly affected by the project.*[103]

Under this broad definition, Government contribution can be capital for investment through tax revenue, a transfer of assets, or any other type of commitment that forms a partnership. The private sector's role can include finance, management, operations, monitoring, enforcement, evaluation and even consultation. This report considers both "narrow" and "broad" types of PPPs related to renewable energy and expanding energy access. PPPs in narrow and broad types have now come to dominate virtually every form of infrastructure development, with more common partnerships including:

a. Electricity generation, transmission and/or distribution;

b. Water and sanitation; refuse disposal; pipeline construction and management;

c. Hospitals and health clinics; school buildings and teaching facilities;

d. Housing; stadiums; prisons;

e. Air traffic control and airports; railways; roads, tunnels and bridges;

f. Billing and other information technology systems.[104]

1. Global survey on PPPs for sustainable energy

To explore the outlook for PPPs in the renewable energy sector, this section presents the results of an important project carried out in 2010 by the e8[105](Global Sustainable Electricity Partnership) and the UN-Energy group, which involved implementing and analyzing a worldwide survey on the obstacles, impacts, benefits and outlook of public-private partnerships in the implementation of sustainable energy initiatives and projects (renewable energy sources, energy efficiency and cleaner technologies).[106]

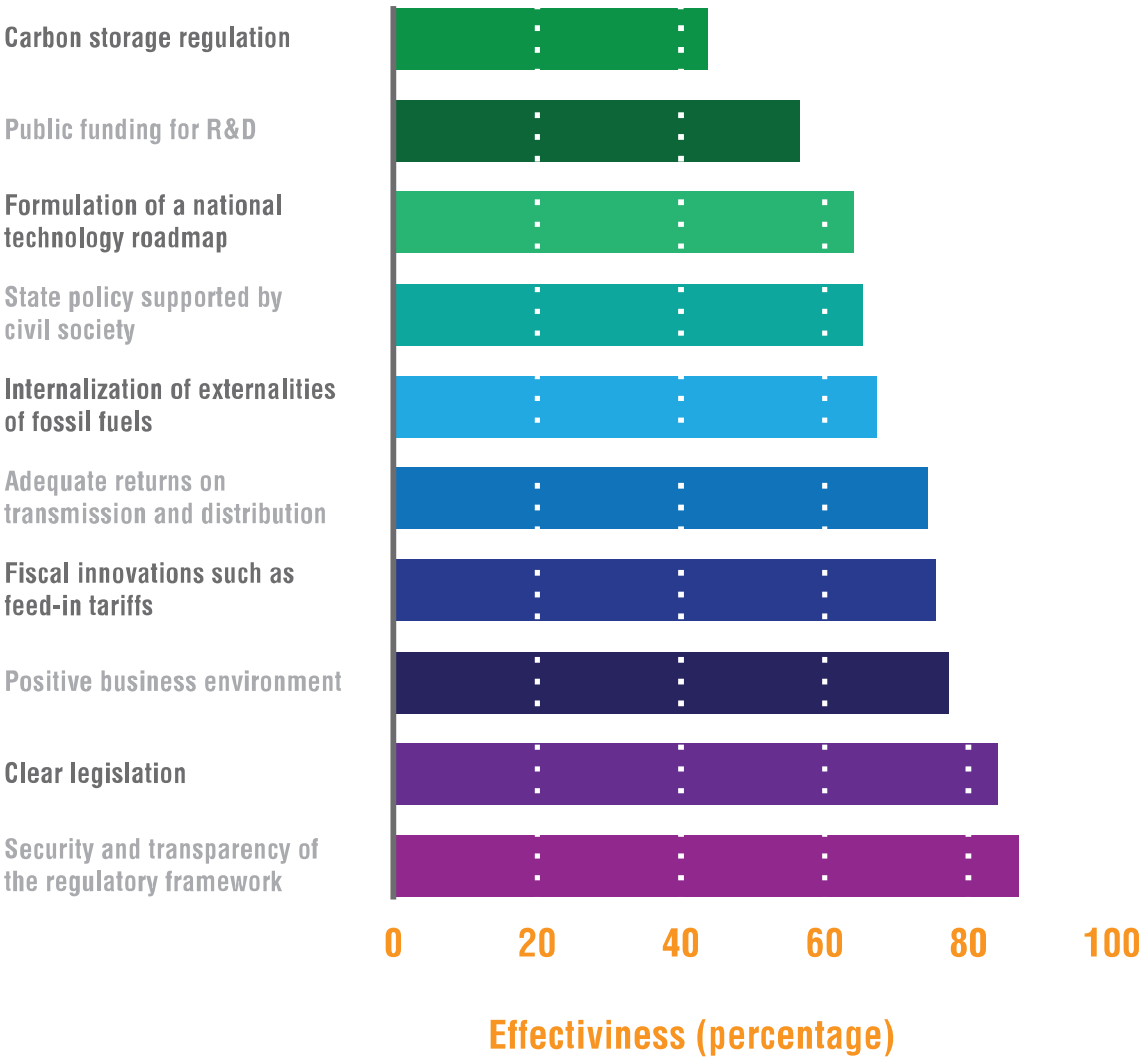
The objective of the survey was to identify best practices in the areas of public policies and public-private initiatives, in order to promote the development of long-term sustainable energy projects.

In the summer of 2010, the e8 asked a large number of firms, associations, multilateral organizations and business groups to share their experiences with PPPs in sustainable energy. The survey received responses from 78 entities, including 38 electric companies, eight non-governmental organizations (NGOs), six technology promoters, five financial institutions and five energy associations. Some of the international/multilateral organizations that participated in the survey included EPRI, GEF, GVEP, IDB, ADB, AfDB, REEEP, TERI, the World Bank, the UN Foundation, WEC, WBCSD and the World Energy Forum. Among the international companies were AES, Duke Energy, EDF, EDP, Kansai, Pacific Hydro, Tractebel, Tepco and the Enel group. The survey also covered important firms and agencies tied to the Latin American energy sector, such as Isagen (Colombia), the Eletrobras group (Brazil), the National Secretariat of Energy (Panamá), the Ministry of Energy and Mines (Peru) and BNDES (Brazil).

The following figures provide a graphic illustration of the results of the e8/UN-Energy study, published in 2011. Figure 9 shows that a strong legislative framework is considered necessary for eliminating barriers, stimulating investment through appropriate incentives, establishing stable regulations, deploying an environmental policy on clean energy sources and supplying special incentives for financing new technologies. This focus on good governance, together with strong community participation, helps improve the probability of project success. In figure 10, the survey results further indicate that national energy development plans or strategies are essential for ensuring and later directing the distribution of financial resources for zero-emissions technology projects, in particular renewable energy.

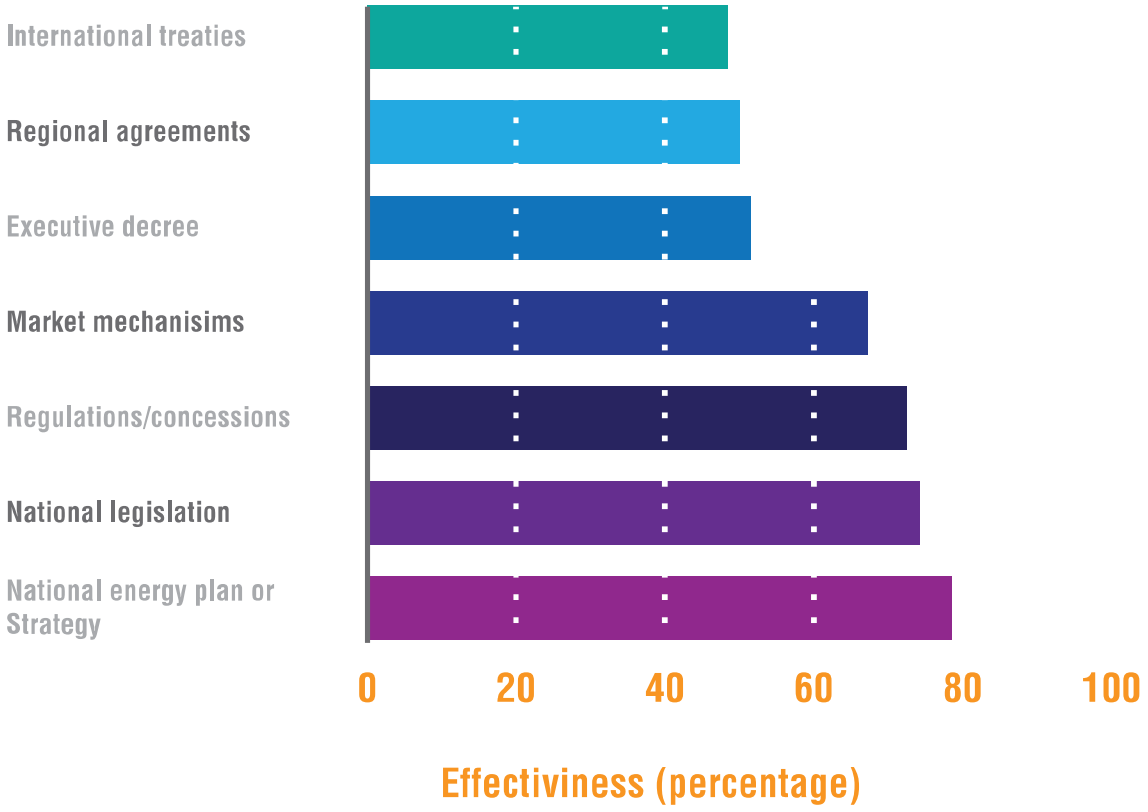
With regard to how PPPs can support the deployment of sustainable energy projects (figure 11), the survey results indicate that the best way for public-private partnerships to support research, development, demonstration and deployment (RDD&D) of clean energy projects is through stable, efficient financing (both public and private) for these types of activities. Further, figure 12 shows that the majority of the survey respondents believe that the biggest benefits of PPPs are improving access to electricity and stimulating local economic and social development. Increased access to electricity allows new businesses to enter areas that were previously considered unsuitable or unprofitable. As new businesses expand into these areas, they bring more jobs, while the newly electrified communities gain access to additional medical care, clean water and education, which fosters their economic and social development.

Figure 9.
Political factors that reduce the risk of promoting sustainable energy



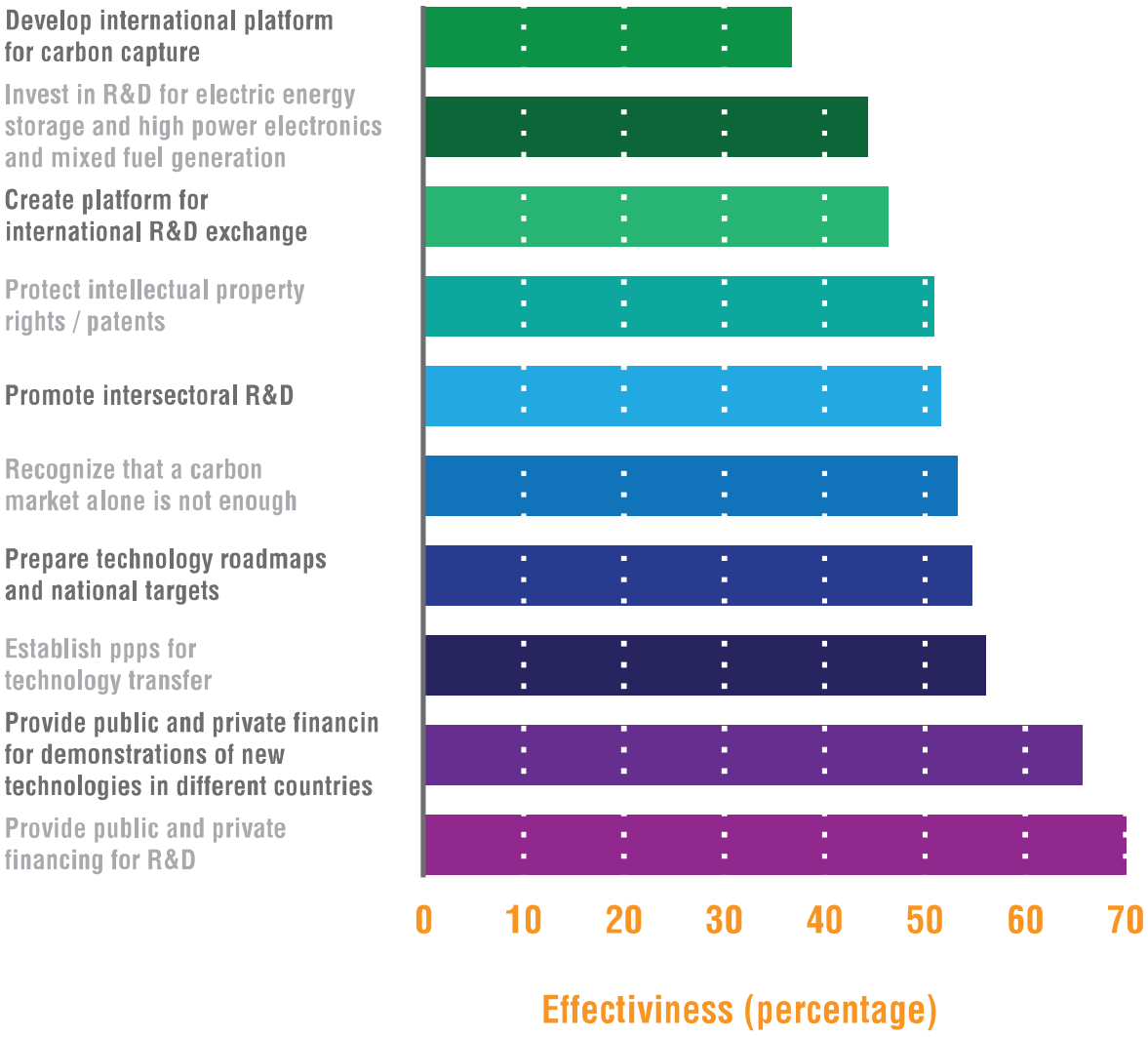
"Strong legislative framework *is necessary for eliminating barriers for financing new technologies*"

Figure 10.
Instruments for implementing effective sustainable energy policies



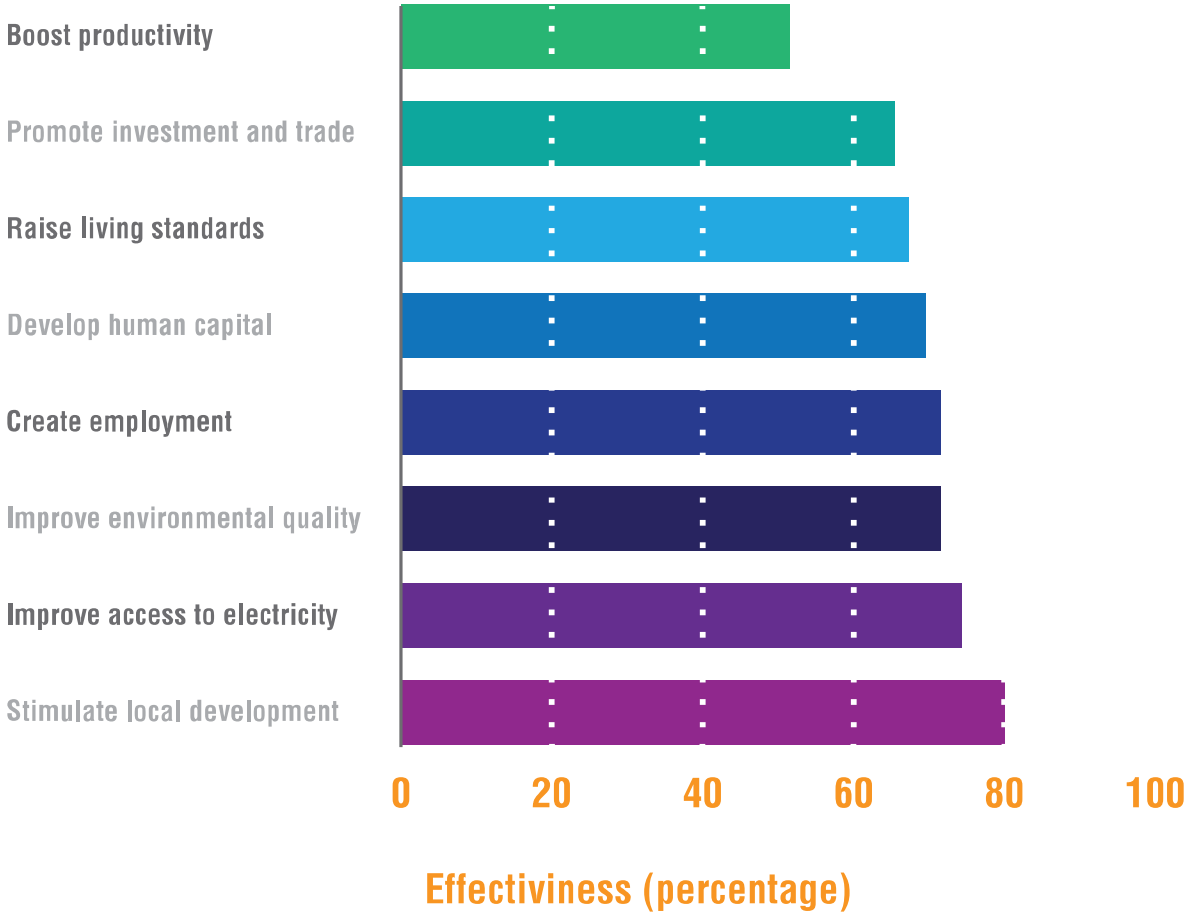
"National energy development plans or strategies are essential for ensuring and later directing the distribution of financial resources for zero-emissions technology projects, in particular renewable energy"

Figure 11.
How can PPPs support the deployment of renewable energy projects?



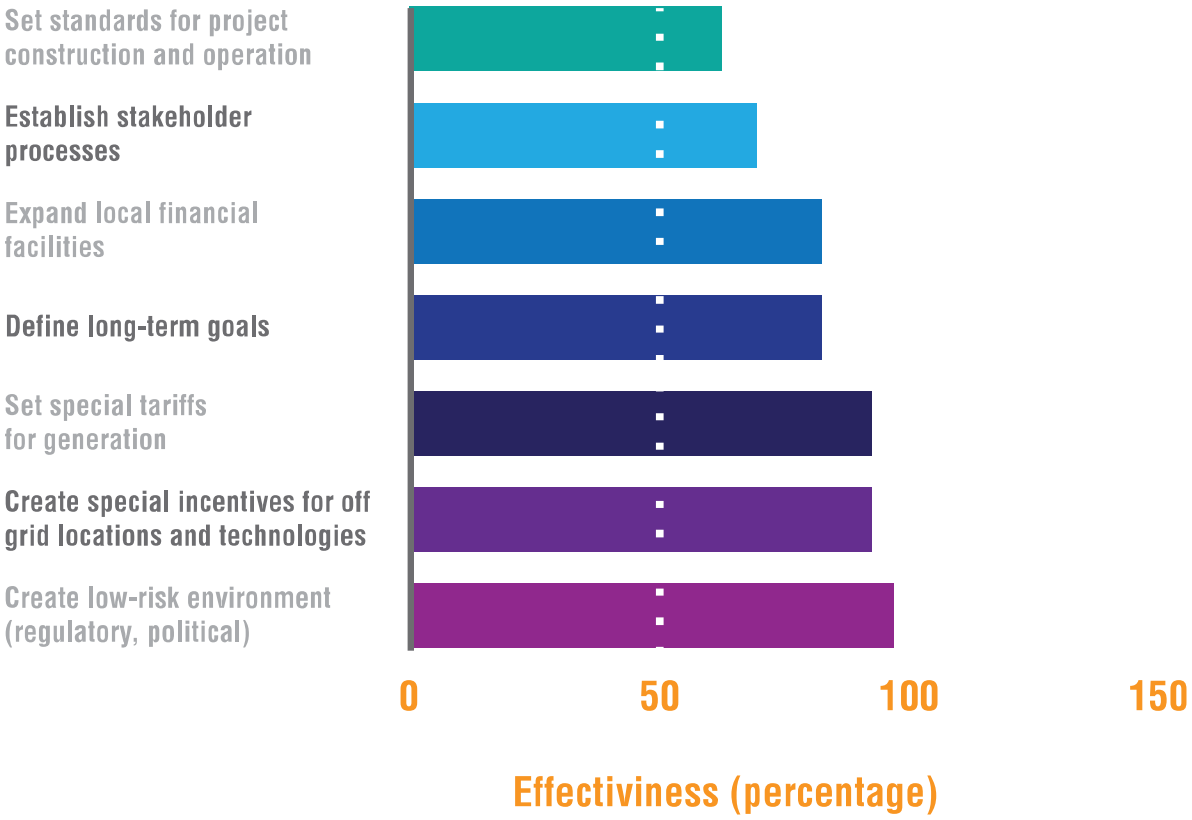
"Best way for public-private partnerships to support research, development, demonstration and deployment (RDD&D) of clean energy projects is through stable, efficient financing"

Figure 12.
Benefits of PPPs for sustainable energy



*"Biggest benefits of PPPs are **improving access to electricity** and stimulating local economic and social development"*

Figure 13.
Effective ways for the public sector to promote and strengthen PPPs



> *"The public sector's strongest contribution is to reduce the risks in the political, legal and regulatory environment"*

Finally, figure 13 reveals a solid consensus among survey respondents that the public sector's strongest contribution is to reduce the risks in the political, legal and regulatory environment. This then allows the relevant authorities to define electricity development goals and to establish long-term plans and programs for the deployment of clean energy technology.

As could be expected, a large share of the respondents indicated that guaranteed long-term income streams are the most effective way to promote sustainable energy projects and that power purchase agreements (PPAs) are the most secure and preferred instrument for that purpose. With these mechanisms, the public sector must act as an intermediary with multilateral development banks and other financial institutions, to ensure that timely payments are made as negotiated under these agreements.

2. Benefits and constraints of PPPs

PPPs have ability to produce higher quality services at a lower cost than either public or private partners can do in isolation"

Generally, PPPs have received support because of their ability to produce higher quality services at a lower cost than either public or private partners can do in isolation. Advantages include attracting private capital investment, increasing efficiency and effective use of resources and improving budget certainty and the maximization of assets.[107]

"

PPPs, however, are not without shortcomings. Sometimes private sector investors are not willing to finance public projects without extensive feasibility studies, which can add to project cost. Private sector players often want projects implemented quickly, meaning they may not seek the participation of civil society and community groups which could slow projects down. Political risks include the changing of public officials who would oversee or enforce the partnership, with some projects being cancelled after major shifts in political structure.[108] The need by Governments to develop projects at least cost, or without significant expenditure, has led to some poorly designed PPPs or, in some cases, projects that operate at a substantial loss. Longer contracts in PPPs spanning more than a decade are often renegotiated, which can take a significant amount of time due to their complexity. Lastly, sometimes firms may strategically manipulate the PPP process to hurt competitors. One study, for instance, found that firms often lowball PPP offers in infrastructure projects to prevent new entrants from competing with them, in essence making PPPs a predatory instrument rather than one of enhanced competition.[109]

The risks involved in a PPP are mainly related to a country's macroeconomic stability and the general and specific legal frameworks for this type of relationship. An important factor in the negotiations for a PPP contract is the degree to which risks are transferred from the public sector to the private sector and at what price. Some of the risks associated with PPPs are described in table 11.

"Risks involved in a PPP are mainly related to a country's macroeconomic stability and the general and specific legal frameworks for this type of relationship"

Table 11.
Typical risks in PPPs

Risk	Description	Risk bearer	Instruments for allocating risk
Construction	Risk of cost overruns or construction delays	Private sector	Project contract
Force majeure	Risk of natural disasters	Private sector	Project contract
Commercial	Risk of insufficient demand and/or unfulfilled supply contracts	Private sector (sometimes the host country, in part)	Project contract (sometimes with minimum income guarantees)
Financial	Risk of interest rate fluctuations or financing	Private sector	Project contract or structured finance facilities
Political	Risk of expropriation, license revocation, confiscation of goods, currency inconvertibility or transfer restrictions, war or disturbances	Host country or guarantor	Insurance against political risk
Regulatory	Risk of changes in laws or regulations, tariff-setting rules, taxes, or unfulfilled public purchase contracts	Host country or guarantor	Project contract and partial risk insurance
Foreign exchange risk	Risk of currency devaluation or depreciation	Host country (somtimes the private sector)	Project contract, foreign exchange guarantees or structured financing

3. Governance and risk

Given the scale and duration of many PPP projects the requirement for robust governance and management is critical to success. With this in mind, this sub-section discusses the common governance problems encountered and approach to managing these risks.

"Robust governance and management of PPPs is critical to success"

Drawing on a number of failed or poorly performing PPP projects from across the globe, the following have been identified as the common governance risks.

a. A part-time project manager (that is, someone who has another full-time job inside the public authority) and limited resourcing of the project team;

b. Loss of continuity and knowledge through badly managed or frequent changes in the project team;

c. Lack of resources, including advisers, or, conversely, excessive reliance on advisers for decision making;

d. Insufficient delegation of powers to the project management group so that even the smallest decision needs to be referred upward;

e. Interference from other bodies outside the governance structure so that no one knows who is actually running the day-to-day operations;

f. Poor management of the day-to-day resources, including the external advisers

g. A project board that is too large and unable to meet as required to make key decisions.

With these in mind interested stakeholders need to develop, align and implement a comprehensive risk management plan. To do this so, four broad stages are required; risk identification, risk allocation & mitigation, monitoring & review and project governance. In effect these four stages are collectively referred to as a risk management plan.

Risk identification is a comprehensive exercise concerning matters and contingent events that are both internal and external to the project

itself; it involves analyzing all phases of a project, notably project preparation, setting up of the project vehicle, funding, design, construction, commissioning and operation, together with risks associated with legacy assets and services that may be transferred into the project following signature of the contract. Checklists of risks that typically apply to infrastructure projects can be used together with risk workshops in which the authority and relevant stakeholders can brainstorm the expected risks. A "risk register" (an example is provided within the appendix) can be used to record all risks and to serve as a checklist throughout the life of the project. This will usually list the nature of the risk, its probability of occurring and its expected impact on the project, as well as the measures Selecting Projects taken to mitigate those risks and how they have worked in practice.

This involves allocating or sharing the responsibility for dealing with the consequences of each risk between the parties. The principle is to allocate the risk to the party best able to control its occurrence or manage its consequences as well as to the party in the best position to assess the likelihood of the risk arising within a context commercially acceptable to the private sector. There are only two parties to whom the risks can be allocated: the PPP contractor (that is, the private sector including its investors, lenders, subcontractors, insurers and so forth) and the public body entering the PPP contract (ultimately, this risk rests with the users or taxpayers of the host country). Therefore, risks can be allocated to the private sector or to the public sector, but they also can be shared on an agreed basis by both sectors. The PPP contract will reflect the agreed allocation of risks and will include risk mitigation measures when deemed appropriate. Risk does not disappear through contractual structuring; it is simply reallocated among the parties. This exercise of risk allocation is one of the most important steps in assessing and developing the bankability of the project. This process also helps to identify the issues that the public authority should resolve at the project preparation stage.

During this stage, a "risk matrix" can be employed, in conjunction with the "risk register," to record the proposed assignments of risk that will be reflected in the PPP contract. Again, advisers can play an important role in this process.

Risk management is an on-going process that continues throughout the life of the project and Governments need to monitor all risks, even those allocated to third parties, because they are ultimately responsible for the adequate delivery of services to the public. Existing risks need to be monitored and new risks identified as the project develops and the environment changes. The contract management team will normally update the risk management plan, which is linked to the risk register, regularly throughout the life of the project.

Managing the preparation, procurement and operation of a PPP project involves dealing with multiple issues with stakeholders all at the same time. Later in the procurement phase, it involves approving complex decisions, often with quite short timelines, while negotiating with private sector bidders who are likely to be highly organized and purposeful. During the construction and operation phases, it involves dealing with changes in the project, users, unforeseen events and termination. Good project governance lies at the heart of successful delivery of the project and management of the interaction with the private sector.

In the early stage of project selection, governance structures may be quite fluid and simple. However, at the end of this phase or when a decision is made to devote more resources to the project, it is important to develop a more comprehensive structure of project governance.

"It is important to develop a more comprehensive structure of project governance"

A common way of implementing effective project governance is through a system of boards. A project board normally comprises the main public sector stakeholders and often, as a matter of good practice, independent members capable of providing neutral challenge, informed by technically sound experience; this is the regular forum for resolving key issues and for making decisions above the powers delegated to the project management team. It sets the project requirements, constraints and boundaries, monitors the project management activities and provides a forum for challenging and supporting the project team. Key project advisers are usually not project board members, but they may be called to attend meetings of the project board when expert advice needs to be examined firsthand.

A full-time project director or manager is responsible for managing the project management team and reporting to the project board. The project team comprises functional managers drawn from across the public authority and deals with day-to-day management of the project within the delegated responsibility and authority. This also includes managing the project advisers. For complex projects, separate boards covering specific issues, such as wider stakeholder management, may be set up and report to the main board.

"Risk allocation is one of the most important steps in assessing and developing the bankability of the project"

For significant projects, it is helpful to identify a senior officer within the public authority, sometimes called the "project owner," who has ultimate responsibility for delivering the project and is capable, available and willing to show leadership and commitment. This person may chair the project board. The project board may, in turn, report to a programme-level board within the procuring authority if a significant programme of projects is involved.

4. Varying types and models of PPPs

Generally, PPPs fall into the following five categories:

a. Service Contracts;

b. Management contracts;

c. Lease Contracts;

d. Concessions; and

e. Build-Operate-Transfer.

Table 12[110] provides a summary of these PPP types and this section reviews each in turn. Many different models of PPPs exist, including those where a private party receives a management fee, generally indexed to a performance target, for running a service on behalf of the public agent; those where the business risk is assumed by the private entity who manages and runs the service, using public infrastructures according to a lease fee; or those where the private agent not only assumes the total (or partial) business risk, but also engages in investments to upgrade or increase the infrastructure capacity that is then operated by public entity.[111] PPPs can be implemented for various purposes and the list in table 12 is not exhaustive. For example, they might be used for technology research and development, large-scale projects, the creation of firms (such as energy service companies, or ESCOs) and the promotion of small producers.

Under a service contract, a Government or public authority hires a private company or organization to carry out one or more specified tasks for a period of usually one to three years. The public authority remains the main service provider and contracts only part of its operation to a private partner — such as maintenance for a wind farm, or laboratory tests on solar home system equipment, or in areas outside of renewable energy street sweeping, water treatment, revenue collection, or meter reading. The private partner has to perform their specified service at the agreed cost and meet performance standards set by the public partner. The most common way of structuring a service contract is to first use a competitive bidding process to select a contractor and to then rely on a cost-plus-fee formula where costs and labour prices are fixed and the private partner shares profits with the public entity. Such contracts are most appropriate when services can be clearly defined, the demand for them is certain and performance can be monitored easily.

Table 12.
Models of private participation in infrastructure and their main characteristics

Type	Description	Level of risk to the private sector	Contract duration (years)	Capital investment	Property ownership	Most commonly financed sectors in developing countries
Service contract	Contracts out services that support the operation of the infrastructure	Low	1-3	Public	Public	Water services Railway service
Management contract	Contracts out all or part of operations management	Low/Medium	2-5	Public	Public	Water services
Lease contract	Contracts out the management of specific renovations and operations	Medium	10-15	Public	Public	Water services
Build operate transfer (BOT)	Contracts out the investment and operation of a specific component of the service or infrastructure	High	Varies	Private	Public/ Private	Energy sector highways Water purification/ desalination plants
Concession	Contracts out the financing, operation and execution of specific investments	High	25-30	Private	Public/ Private	Airports, sea ports and railways Electricity transmission network
Privatization	Contracts out or transfers ownership of the public infrastructure to the private sector	Total	Indefinate	Private	Private	Telecommunications

Under a management contract, more responsibilities are devolved to private actors, including the management of an entire electric utility, hospital, or port authority. The infrastructure is owned by the Government, who is also responsible for upgrades and further investment, but the private actor manages service operations. An example here would be a Government paying to build and install village scale biogas systems that are then managed and maintained by a private company, or a private company managing a fleet of biomass-fired electricity power plants still owned by the state. The obligation of service remains in the public domain, but daily control and authority is assigned to the private sector. In most cases, the private partner covers working capital and labour and must deal with customers, but not financing, investment, or construction. The most common way of structuring management contracts is through performance based payments, or shares of profits.

Under a lease contract or affermage, infrastructure is rented from its public owners to private partners who operate and maintain it. A private entity typically assumes responsibility for service in its entirety, with the public sector responsible only for new and replacement investments. The duration of these contracts is usually for 10 to 20 years and the private operator assumes risks related to losses and unpaid consumer debts. Usually, the initial constructions of a system — say, a hydroelectric dam — is financed by the public authority and then contracted to a company for operations and maintenance. A common example outside the area of energy would be a company leasing an airport or bus terminal from a municipality for 10 years, paying the municipality a fee each year; in return the company can collect passenger fees and also rent out commercial space within the facility. An affermage, similarly, allows the private entity to collect tariffs, pay the public partner an affermage fee and retain any existing revenue. Such fees are usually an agreed rate per every unit sold.

A concession contract has the private sector operator assume full responsibility for the delivery of services previously owned by the public in a specified area, including construction, operations, maintenance, fee collection, management and rehabilitation or decommissioning. Concessions are commonly longer than lease options to enable the private partner to recover their substantial investment costs. The assets — such as wind rights on Government land, or tipping fees for trash at a waste incineration facility — technically belong to the public, but the private concessionaire is given the right to utilize them. The public sector operator retains control over performance standards and ensuring that the private partner meets them, basically shifting the public sector's role from service provider to determining the quality of service. Concessions are usually valid for 25 to 30 years.

Under a Build-Operate-Transfer (BOT), a private firm or consortium of private firms build and construct an infrastructure project and then turn it over to the public sector to manage and operate. The private partners are responsible for financing and raising the capital needed to build the project, paid back either through a flat fee or based on unit charges for the first few years of the facility's operation. At the end of the contract, the public sector assumes ownership but can then rely on other types of contracts (such as service or management contracts) to delegate authority when needed.

5. PPP implementation checklist

A joint initiative between the European Investment Bank (EIB), the European Commission, Member stages of the European Union and Candidate states pooled resources to create the 'European PPP Expertise Centre' (EPEC). This centre promotes best practice in PPP design, development and implantation. Therefore, based on a detailed analysis the EPEC developed the following four-stage guide to implementing a successful PPP initiative, as depicted in table 13.[112]

6. Indicators of successful PPPs

Because of their potential benefits, PPPs have been promoted widely in the electricity and energy sectors around the world. Pressure to alter the accepted model of public procurement for energy infrastructure arose with growing levels of public debt, which expanded significantly after the economic recessions of the late 1970s and early 1980s. Since then, electric utilities in countries across the world have experimented with new ownership models and abandoned the convention that infrastructure services should be the exclusive domain of the state.

> *"PPPs have been promoted widely in the electricity and energy sectors around the world"*

Before entering the PPP process, the Government needs to assess the status quo of the energy sector, identify the gaps and evaluate the constraints. Once the "diagnostic" of the sector is developed, it enables the Government to decide how conducive the environment is for the PPP and what more needs to be done to create a better environment. Based on the assessment, the Government then proceeds to devise a strategy for the sector's reform which is basically an action plan that dictates the activities required according to a timetable and set milestones and key performance indicators. The PPP should be implemented as part of an overall reform strategy whereby the objectives of the PPP constitute a subset of the objectives of the overall energy sector reform. The Government also needs to make sure that its objectives are met by the PPP and that the private sector is willing to partner under the specified conditions. It is advisable, before the start of the procurement process to invite potential bidders to have

a say in the chosen structure. Such opportunities for dialogue between the public and private sectors engender trust in the public entity and may well invite a bigger number of bidders. The pre-requisites that need to be in place before the Government starts the PPP process can be summarized as follows:37

a. The legal, regulatory and policy frameworks. The laws, regulations and policies, Government institutions and entities related to the energy sector, tariff and subsidy policies, availability of quality performance standards, environmental and health regulations and labour laws, foreign exchange laws, foreign investments laws and so on. need to be in place. The more conducive the legal framework is for private investment the less risky and unpredictable it is perceived by the private investors;

a. Institutional structures and frameworks. The capacity of the existing institutions and the skills of their employees to perform their potential roles in the PPP need to be checked; for instance the capacity to perform the bidding process, to enter into the negotiations with the private companies and monitor their performance. In case such measures are not in place, the Government needs to fill the gap by establishing a PPP unit within the energy ministry for instance in order to provide better and specialized management of the PPP;

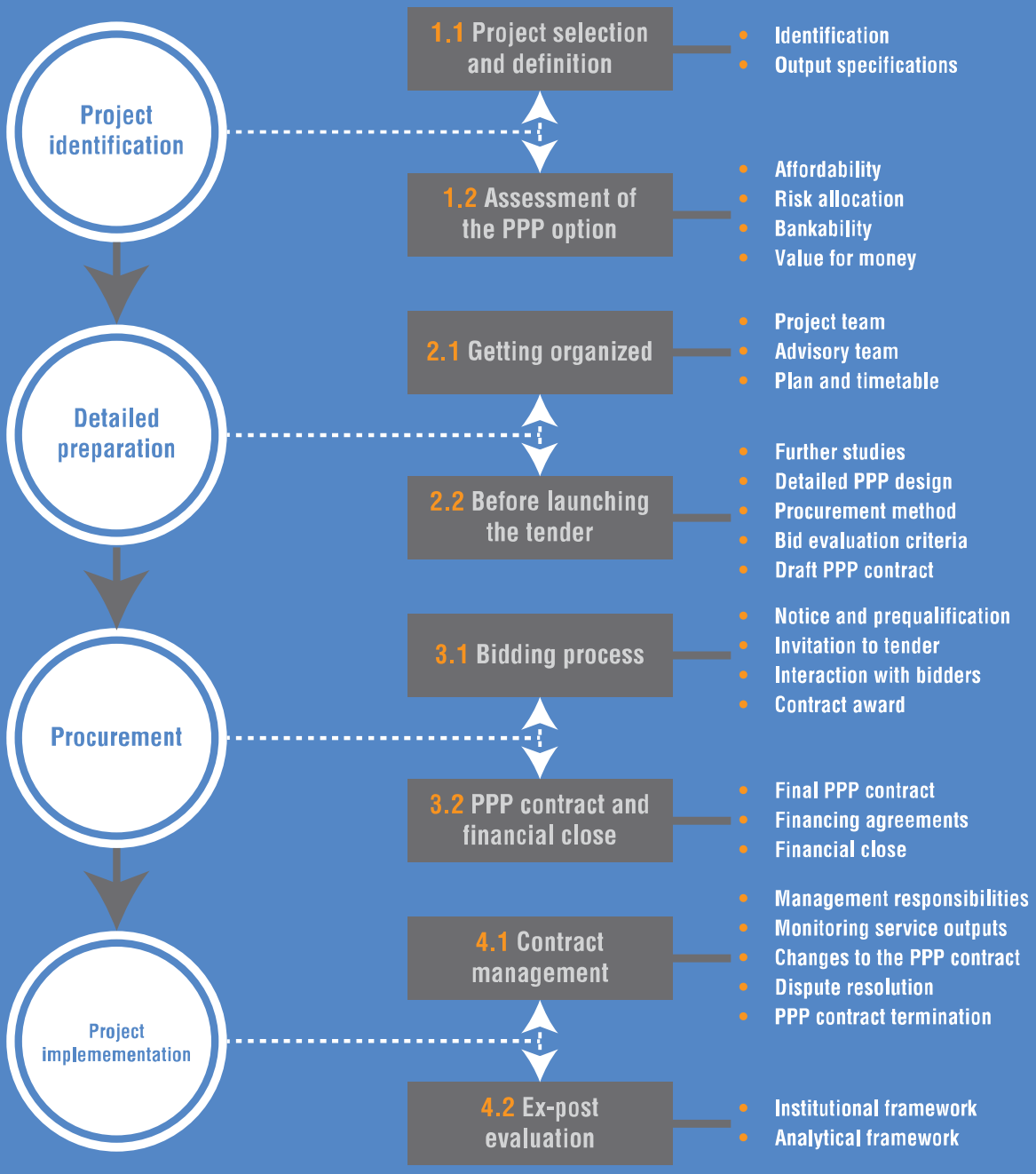
b. Technical issues. Any technical constraints in the current system provision are to be identified in terms of maintenance, ineffective management, operational expertise, technical standards and so on. Gaps can be filled by hiring sector specialists, lawyers, economists, sociologists and anthropologists;

c. Commercial, financial and economic issues. It is important to perform financial analyses by collecting audited financial statements, financial reports, tariff schedules, any planned or ongoing investment programs and construct financial models. Once these assessments are done, the structure of payments, revenues and the cost of service should be set and a market and social research should be performed. When the PPP is designed to serve the low-income segments in a population, special care needs to be given to the pricing structure. For this, before the design of the PPP, data needs to be collected on the low-income groups in terms of demographic characteristics, economic conditions, willingness to pay, access and service preference and the existence of small entrepreneurs in the local community who are willing to provide the services needed at least for the short and medium terms. It is also important to consider mechanisms which facilitate payments, such as pre-paid meters, increased pay points and so on. It is also crucial to employ qualified specialists to model the tariff structure for the PPP;

d. Labour consideration and the inclusion of local partners. It is important to disseminate information regarding the PPP within the Government institutions before the start of the process because certain amendments need to take place in the public structure as a result of the PPP and these amendments may possibly affect the public sector workers, in terms of increase of pay and opportunities for training and capacity building. In addition, for the boosting of the local economy local private companies should be encouraged to bid and all bidding companies should be encouraged to buy the products locally and employ local labour power. For instance, if the ESCWA region is to become a major hub for RE technologies and an exporter of energy to the EU then it would be beneficial for the countries to enhance their capacities in manufacturing equipment, installation, operation, maintenance and all the associated services;

e. Stakeholder consultation and involvement at all stages in the process. Although some Governments avoid public consultation for fear of raising expectations or engendering opposition to the project, avoiding stakeholder dialogue risks stimulating opposition at a later stage. Securing public support of a PPP is important early on as the end-users can provide valuable input beneficial to decision-making. Allowing people to voice out their concerns also makes them feel included and provides credibility to the project. Public awareness and education are also crucial particularly on the importance of RE and this can be done through newspapers, television, radio programs, focus group sessions and pamphlets and flyers on notice boards of the local municipalities or religious establishment.

Table 13.
Four stage guide to implementing a successful PPP initiative



The following critical factors have been signalled out to be considered during the PPP process. The success factors below were drawn from several case studies reviewed in the region and abroad as well as the guidebooks of the UN agencies which have had experience with PPPs.

a. If the country is new to the experience of a PPP, it is suggested that the model be flexible so that it could be amended over time as per the results of monitoring and ongoing evaluations;

b. Though led by the central Government, the project would better be implemented and followed up by the municipalities to keep a close eye on the process;

c. The private sector firms provide, install, maintain and operate the power generation equipment and the equipment is owned by the private company rather than the end-users at least for the first 10-15 years to allow the company to recover its investment and accumulate profit;

d. The financing needs especially in the beginning need to come from several sources: state budgets, the private investor as well as international loans or donations. The international donors usually offer technical advice along with the loan or the grant so countries can benefit from training and capacity building. Particularly at the start of the project, there needs to be cross-subsidies from the Government so the end-users who cannot afford to pay for the service do not pay large bills, especially given that the population in the region has been accustomed to huge Government subsidies on conventional fuels;

e. The involvement of several ministries in the process is important. For instance involve the Ministry of Education with the schools in the area and the Ministry of Health with the health centres;

f. The maintenance costs of the equipment can be covered through a minimum user fee or tariff but again should be subsidized by the Government, particularly if the end-users cannot afford to pay;

g. The service performance should be overseen and monitored at all stages and surveys and public hearings conducted to record community satisfaction or dissatisfaction with the service provided;

h. Official monitoring and evaluation is important to ensure the project is running smoothly and efficiently. Usually, if an international agency has contributed to the budget of the project, it has its own monitoring mechanism which involves progress reports and sometimes visits from consultants to the project area for progress evaluation first-hand.

The Government's past experience and reputation from previous involvement in PPPs and PPPs give the private sector the possibility to predict how a potential PPP can turn out to be. Therefore, as previously mentioned, Governments need to build on previous national and regional experiences and improve their performance in managing and leading the PPP to build credibility. Since the study of PPPs is relatively new in some countries, it is recommended to benefit from the successful models elsewhere through South-South and North-South cooperation and tailor them to local conditions. With time, it is essential to study and analyze best modalities for the implemented PPPs and benefit from lessons learnt in order to maximize the odds of success for future projects.

B. PRO-POOR PUBLIC PRIVATE PARTNERSHIPS (5PS)

Another variant of PPP involves Governments, private companies and, community organizations (and NGOs) in expanding access to energy services.

1. Definition and concept

A pro-poor public-private partnership model, usually abbreviated as "5P," has evolved to explicitly target the provision of services to poor communities, which are often ignored by traditional PPPs since supplying the poor can involve substantial business risk.

The 5P model views the poor not only as consumers that receive benefits, but also as partners in business ventures. It expands beyond the private sector to include partners from development banks, equipment manufacturers, rural energy service companies, philanthropic organizations, CBOs, cooperatives and households themselves.

"The 5P model views the poor not only as consumers that receive benefits, but also as partners in business ventures"

Each of these groups play a different role in the 5P: private sector participants can meet their corporate social responsibility obligations, utilities and energy companies can fulfill their obligation to deliver basic services, communities and members of civil society can expand access to basic services. Or, as UNDP defines it, a 5P is one that "increases access of the poor to basic services by promoting inclusive partnerships between local Government, business, community groups, NGOs, Faith Based Organizations and others."[113] In other words, three things make 5Ps unique from traditional PPPs:

a. They are participatory, involving a broad number of institutions, contrary to having only one or two (Government or Government plus donor);

b. Their priority is helping the poor, not only profits but social and economic development, contrary to how most corporations and electric utilities operate;

c.They are inherently cooperative rather than competitive, attempting to get partners to work together rather than at the advantage or at the expense of others.

Figure 14[114] is one representation of the 5P structure and, as depicted figure 15[115]; the model segments the market towards fulfillment of both — economic and social goals. While the traditional PPPs may operate in the top 'commercial' segment of the market, the bottom segment is purely grants-based.

As a hybrid model, 5P targets the mid-segment. The 5P mid-segment niche recognizes the existence of: 1) entrepreneurship skills in communities and, 2) locally available resources to provision basic infrastructure services. This market-segmentation puts a holistic approach towards community-development and allows the Government budget (with competing priorities) to be targeted specifically towards the bottom segment (figure 14) that relies solely on grants or charity (disbursed as subsidy).

Figure 14.
One representation of a 5P stucture

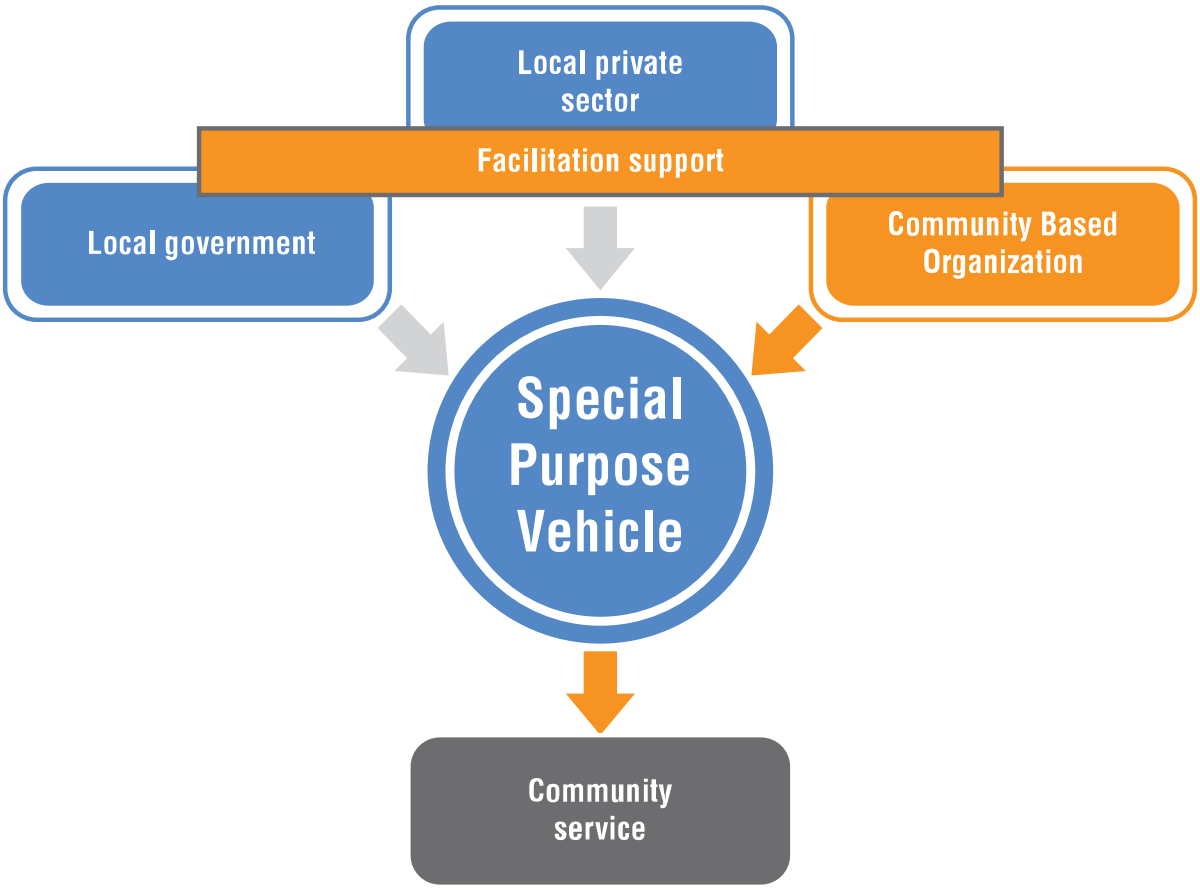
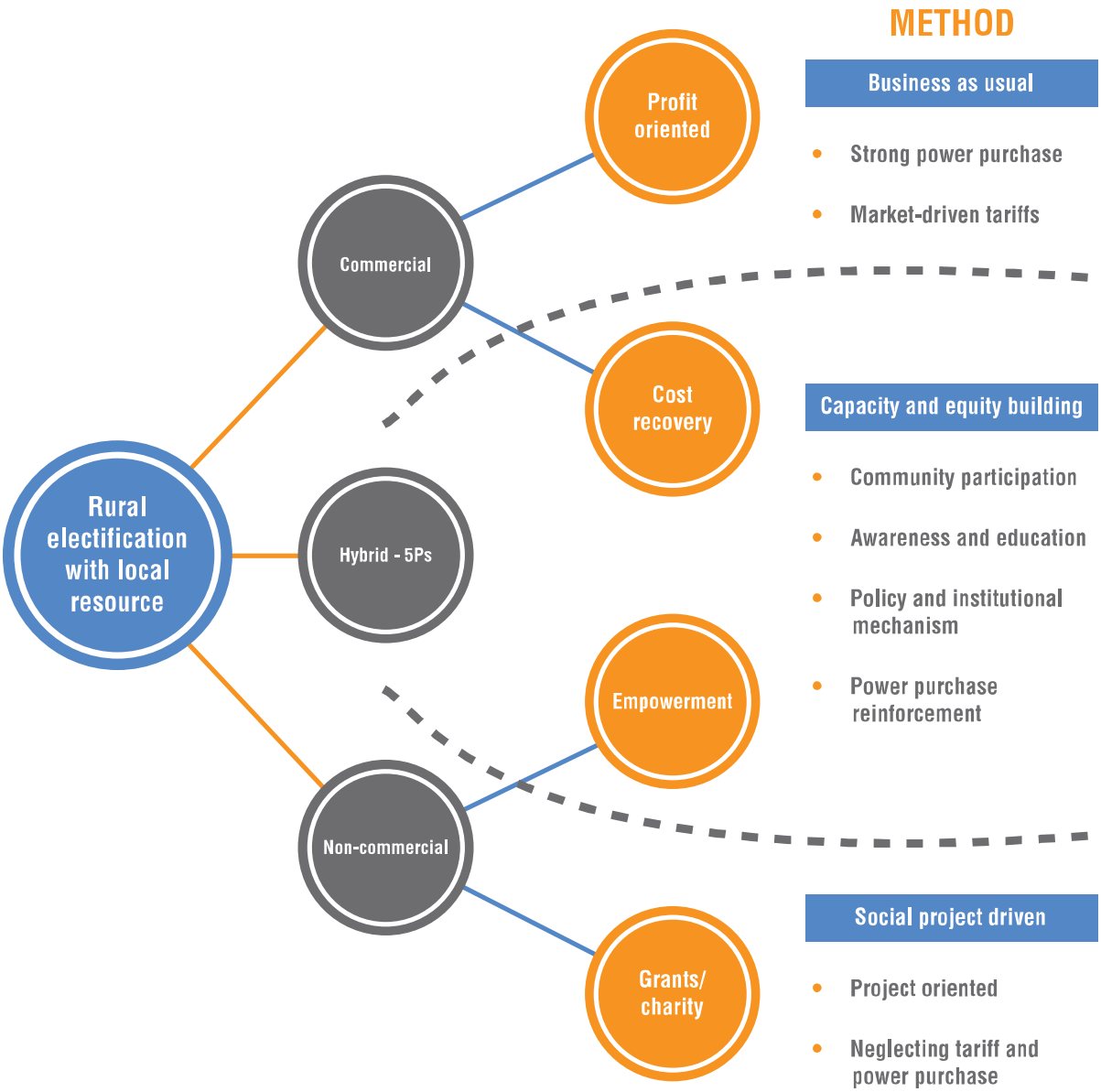


Figure 15.
5Ps for economic and social goals



2. 5P best practices

Though relatively new, 5Ps have been used widely in many fields. Table 14[116] showcases 21 such projects, though this review is cursory and not exhaustive.

Table 14.
Summary of selected 5P projects

Name/sector	Location	Description
Cinta Mekar hydroelectricity	Indonesia	Community-based micro hydro plant is owned jointly by an energy company and a community cooperative to provide electricity to poor households
Sourcing ginger	Sierra Leone	Partnership connected local ginger farmers with business partners for Unifine Sauces and Spices.
Supporting sustainable tuna fishing	Ghana	Formed a 5P for tuna fishes between Ghanaian companies and villagers
Organic cocoa	Dominican Republic	Formed a 5P for cocoa farmers and factories
Processing biodiesel from Jatropha with smallholders	Mali	Connected small-scale farmers with Mali Biocarburant, a transnational company
Yiriwa S.A.	Mali	Partnered local cotton, sesame, and soybean growers with companies
Elephant Pepper	Mozambique and Zambia	Partnership supplies chili peppers to the Tabasco brand and spice companies, with 75 per cent of revenues going to farmers
Agritrade	Bolivia (Plurinational State of)	Specialty coffee business that purchases beans from small-holder farmers and exports them to Europe
Water distribution in Colombo	Sri Lanka	Partnership between NGOs and international donors to distribute water to the squatter settlement of Halgahakumbura
Community sanitation centres in Tangerang	Indonesia	Partnership between an NGO and government to construct water and sanitation centres used by families
Kalimati fruit and vegetable market	Nepal	Partnership composts green waste from the market and disposes it at a landfill site for revenue near Kathmandu
Solid waste management	Nepal	The Forum for Social Improvement and Environmental Development operates cleaning, collection, and transfer station for waste in Biratnagar
Dhalko bottled drinking water	Nepal	Podland Youth Club partnered with the Kathmandu Upatyaka Khanepani Limited to operate almost 100 drinking water stations throughout Kathmandu
Public toilets at Helauda Bus park and city service centre	Nepal	Adarsha Tole Bikash Sanstha, a community based organization, partnered with residents to create local toilets; a second scheme involves Arati & Company and City Service Centres throughout Kathmandu
Manila East concessions	Philippines	Manila Water Company's Tubig Para sa Barangay programme services 64,000 households and 400,000 customers through concessions from the government
Water in Maputo	Mozambique	Partnership provided water standpipes and organized water supply through community water committees
Water in Moreno	Argentina	Partnership created an autonomous water committee to improve management of water pumps and increased awareness of sanitation
Various Pro-Poor business	Namibia	Various partnerships from micro-entrepreneurs cover refuse collection and waste, street cleaning, and the maintenance of public parks
Solid waste management	Bangladesh	Local NGO called Waste Concern organized with communities in Dhaka to set up a system of door-to-door waste collection
Community toilets	Indonesia	NGO has constructed community toilets near factories for migrant workers throughout Jakarta
Community contracts system	Sri Lanka	Communities act as promoters, engineers, and contractors for various partnerships dealing with toilets, water distribution, and community centres

The performance of these partnerships suggests the following six "central lessons."

(a) They are partnerships between different institutions

Central and local Governments are increasingly realizing their shortcomings in providing services and infrastructure that the growing population demands. Without diminishing their responsibilities, partnerships between the Government and the private sector or civil society are increasingly popular. These partnerships have the advantage of bringing the strengths and capacities of different institutions and of allocating rewards and risks in an efficient way. The examples presented in this volume are partnerships between Governments and private companies that also include communities, NGOs and/or the informal sector.

(b) Poor people are part of the partnership

Community organizations have been involved in the design and implementation of the practices. In some cases, the practice relied on existing community organizations; in others, such organizations had to be established before starting the operations. Participation by people who benefit from the intervention improves efficiency and sustainability. If slum dwellers feel ownership of the water distribution system, they will more likely pay their fees. Equally important, such interventions will act as empowering mechanisms for the community.

(c) The practice used external assistance, but relies on internal resources for sustainability

Many fruitful partnerships benefit from some form of external aid, but this was typically provided as an initial grant to help start the operations. In the Community Toilets practice in Indonesia or the Solid Waste Management practice in Dhaka, foreign donor assistance was necessary to acquire land or built infrastructure. In the Water Distribution practice in Colombo, foreign assistance was provided directly as an initial subsidy to the private investor. In any case, the practices are designed in a way that their sustainability relies exclusively on local resources, mostly on the fees paid by the users.

(d) The poor pay for the services

All the practices rest on the assumption that the poor can pay for services and that they are willing to do so, if the services are provided in ways that fit their needs. The conditions can be very different across locations and the interventions need to be designed specifically. Some slum dwellers are not poor in income terms, despite having no access to basic services. They can easily pay the full cost of the service; such is the case in the community toilets example. In other cases, users are not able or willing to pay for the full service and other sources of income need to be explored; this was successfully done in Dhaka.

It is also true that the poorest of the poor may be completely unable to pay for services. For these cases, a well-thought system of subsidies needs to be designed. In the Water Distribution project in Colombo, a minority of the households in the community was considered too poor to pay for the connections and fees. Therefore, arrangements were made that allowed them to use public stand posts. All the practices created a market for basic services to the poor where none existed, or improved an existing one. In the slums of Manila, some people were buying water from private vendors at a rate several times that of the piped water that the better-off households were paying. The residents of the Colombo slum were not paying for the water, but the time wasted in fetching it from the public stand post precluded the women in the community from undertaking more productive activities. The market mechanism that help the poor, may sometimes be only indirectly connected to the service being delivered, as when the demand for organic fertilizer in rural Bangladesh provides a source of income for the solid waste management system in Dhaka.

(e) Polluter pays

Water, sanitation and garbage collection are services that improve the lives of the direct users and protect the environment for everyone else. In the first four cases presented people have to pay for the water they consume and the waste they produce. This makes the users fully responsible for the environmental impact of consuming water and producing waste, contributing to the environmental sustainability of the cities.

(f) NGOs acted as facilitators

Bringing together international organizations, Governments, private companies and communities requires a credible institution with sufficient expertise to understand the issues and sufficiently closed to the people to be trusted by them. NGOs played this role in most of the cases presented here.

Part IV: RENEWABLE ENERGY PPP CASE STUDIES

There are different good practices in many countries in the implementation and sustainable financing of local energy services. It is important to analyze and understand the major factors, criteria and processes to develop PPP models and institutional capacities both at the local and national level to scale up, replicate and mainstream such models. This chapter will discuss 14 separate case studies which employ a variety of models, technologies, investment strategies. These are:

a. Solar energy in China and the "technological improvement" model;

b. Small-scale, off-grid renewable energy in Bangladesh and the "microfinance" model;

c. Micro hydro electricity in Cinta Mekar, Indonesia and the "5P" model;

d. Micro hydro electricity in Nepal and the "community mobilization" model;

e. Solar energy in Zambia and the energy services company (ESCO) model;

f. Electrification efforts in Lao People's Democratic Republic and the "cross subsidization" model;

g. India's Lighting a Billion Lives Programme and the "microfinance" model;

h. Geothermal energy in Chile and the "concession tenders" model;

i. Wind energy in Ecuador and the "business trust" model;

j. Solar energy in Brazil and the "service and management contract" model;

k. Small hydropower in Nicaragua and the "public exemptions" model;

l. Hybrid solar-thermal energy in Egypt and the "build, operate, transfer" model;

m. Solar energy in Jordan and the "power purchase agreement" model;

n. Solar energy in the United Arab Emirates and the "consortium" model.

A. The renewable energy development programme in China

From 2002-2007 more than 400,000 SHS were sold in northwestern China under a $316 million World Bank/Global Environment Facility-supported Renewable Energy Development Project (REDP). REDP has been hailed as a best practice example in SHS deployment for its unprecedented scale and the combination of technology improvement and market development components to strengthen the country's renewable energy industry.[117]

"Renewable Energy Development Project (China) is best known for its unprecedented scale and combination of technology improvement"

In line with the "New and Renewable Energy Development Programme, 1996-2010," developed by the Ministry of Science and Technology and the erstwhile State Development Planning Commission and a series of sequential five-year plans developed by the same, the World Bank/GEF designed the REDP to address prevailing concerns over the country's rural energy sector. Of paramount importance at the time were inadequate electricity access among rural households, barriers to private investment in renewable energy manufacturing and excessive reliance on coal-based power generation. With initial targets of installing 10 MW of solar home systems (approximately 350,000 units), REDP would address those concerns and provide environmental benefits through avoided emissions of SOx, NOx and total suspended particulates.

The State Economic and Trade Commission established a Project Management Office (PMO) to coordinate the REDP, which as a result of Government restructuring was transferred to the National Development and Reform Commission (NDRC) in 2003. Consisting of ten full-time employees assigned to the Technology Improvement or Photovoltaic components, as well as Financial and Contracts Management, the PMO was responsible for making all management decisions at the central Government level. This included tasks like selecting participating companies, authorizing grant payments and designating certification procedures for sub-components.

Over the course of the programme they engaged in promotion efforts, like the production

of television and movie content to expand awareness about renewable energy, as well as initiated training capacity-building courses and conferences for PV companies. While the PMO was an independent body, their decisions still required approval from the NDRC and the World Bank, with whom they had regular contact.

The initial target areas for the SHS component were Inner Mongolia, Gansu, Qinghai, Western Sichuan, Tibet and Xinjiang, later extended to Shanxi, Ningxia and Yunnan provinces. As of 1995, more than 9 million people were without electricity across these 10 provinces and autonomous regions. The central priorities under REDP were to improve product quality, reduce production costs and install a total SHS-capacity of 10 MWp. In reality, the 28 participating companies surpassed the capacity target in 2007 and sold 11.1 MWp. The PMO verified a sales volume of at least 400,000, while companies claimed an even higher unofficial figure of some 500,000 SHS sold during REDP's implementation.

Improving the quality of SHS products on the market was a core objective of REDP. To qualify for REDP support, PV companies were required to demonstrate that all system components complied with prevailing standards. With support from an international expert, the PMO created a PV Technical Standards Committee which outlined all technical specifications for sub-components, including modules, inverters, controllers, batteries and DC lights. The PMO then acted as an intermediary to connect qualified suppliers with PV companies and circulated technical guidelines. Along with a laboratory based at Arizona State University, four centers – Tianjin Institute of Power Sources, Post and Telecommunications Industry Products Quality Surveillance and Inspection Center, National Center for Quality Supervision and Testing of Electric Light Sources and Shanghai Institute of Space Power Sources – were selected to conduct product testing, with funding available through TI grants for manufacturing companies to have their products tested. Other institutes were later added, such as the Photovoltaic and Wind Power Systems Quality Test Center of the Chinese Academy of Sciences. In addition to testing random product samples in the laboratory, engineers travelled to western provinces to obtain products for quality inspection and stage spot checks at manufacturers.

As part of the REDP's evaluation process, local consultants conducted face-to-face interviews with 1,203 households in the Tibetan

Autonomous Region and Gansu Province. Of this sample, 69 per cent were PV system users and 31 per cent were without electricity access. The evaluation team concluded that SHS use had a positive effect on household income for more than 53 per cent of respondents. Among other benefits, they also estimated improvements in family communication levels, increased workable hours and improved access to information through radio and television. Use of alternative lighting sources, such as kerosene lamps, declined as a result of SHS penetration. With the same survey data, the World Bank concluded that "there are strong indications that poverty impacts have been achieved among a considerable number of people."[118]

B. Grameen Shakti in Bangladesh

Inspired by the success of the Grameen Bank, GS was established in June 1996 to distribute renewable energy systems to the rural population. Prior to GS's involvement, renewable energy was not considered viable in Bangladesh. GS was created to explicitly improve access of Bangladesh's rural population to renewable energy technologies both through overcoming the high upfront cost of installing solar and biogas systems as well as promoting knowledge and awareness about renewable energy. Derived from the Sanskrit word for "energy" or "empowerment," GS (which literally means "village energy" or "village empowerment") was kicked off with a $750,000 loan from the International Finance Corporation as well as a number of small grants.

As of September 2010, the nonprofit company Grameen Shakti (GS) operated 1,134 offices throughout every district of Bangladesh and had installed almost half a million SHS, 13,300 biogas plants and 132,000 improved cook stoves (ICS) among 3.1 million beneficiaries. They plan to ramp up their expansion so that by 2015; more than 1.5 million SHS are in place along with 100,000 biogas plants and 5 million ICS. These numbers are all the more impressive when one considers that Bangladesh is one of the poorest countries in the world and also home to an environment perpetually disturbed by natural disasters.[119]

Though it receives no direct funding from the Grameen Bank, GS is part of a family of Grameen Bank companies because it adheres to the same principles of empowerment and microfinance and also since its founding director Dipal Barua was close friends and co-founder of the Grameen Bank, together with Nobel Laureate Muhammad Yunus. Its positive ties with the Grameen Bank even persuaded U.S. President Bill Clinton and other world leaders to convince USAID, GTZ and other development assistance donors to support the organization with about $6 million in extra grants and loans. Despite this early assistance, however, GS has been operating as a self sustainable nonprofit company since 2003 and today it receives more than 90 per cent of its revenue directly from sales. Three of their programs – SHS, biogas and ICS – have been the most significant.

"As of September 2010, Grameen Shakti (GS) had installed almost half a million SHS, 13,300 biogas plants and 132,000 improved cook stoves (ICS) among 3.1 million beneficiaries"

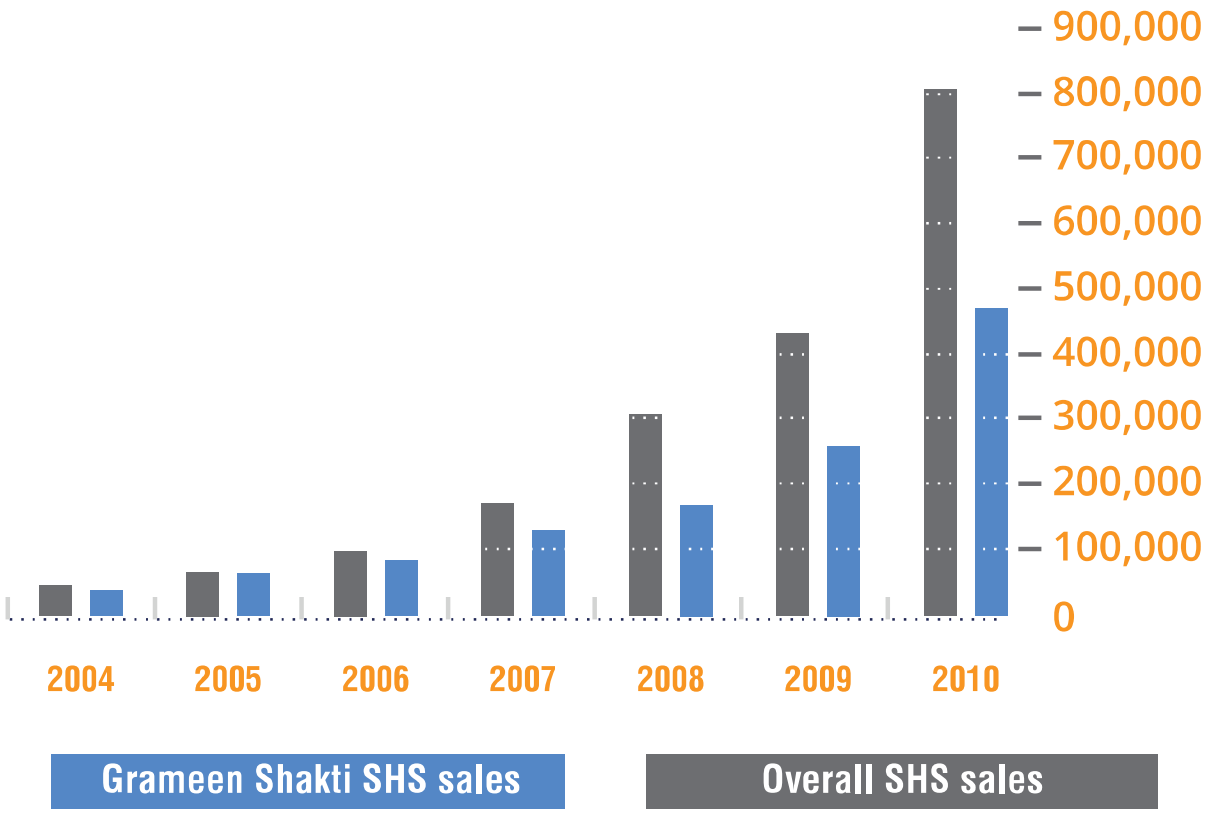
The SHS programme targets those areas that have little to no access to electricity and limited opportunities to become connected to centralized electricity supply within the next 5 to 10 years. The ease of operating solar panels, their long lifespan, avoidance of combustible fuel and lack of pollution make them an ideal choice for remote areas and the programme offers microcredit schemes to enable homeowners and businesses to acquire the necessary capital they need to finance installation. Under the SHS programme, interested parties make a down payment to cover 15 to 25 per cent of the system cost and then repay GS through a low-interest loan. Given the expense of kerosene and diesel in rural parts of Bangladesh, solar systems typically pay for themselves in 3 to 4 years, meaning people that purchase them then own a system that lasts 20 years without fuel costs. Customers can also elect to share in the cost of larger systems under a solar micro-utility scheme that allows shopkeepers or villages to share a 10 per cent down payment spread across 42 months of repayment. GS offers free maintenance while their loans are being repaid and trains interested clients in maintenance and operation at no additional cost. As of September 2010, GS has installed more than 464,000 SHS, or 23.23 MWp of installed capacity, with a production capacity of 93 MWh-p to more than two million people. About 10,000 clients have availed themselves of the micro-utility financing option and the entire programme is growing at a rate of 20,000 new clients per month.

The programme's success rests in part to "active marketing" as well as its emphasis on training and maintenance. Also, to keep on top of maintenance and the expansion of the SHS programme, GS has established 45 Grameen Technology Centers (GTCs) that have trained more than 176,000 heads of households (mostly women) in the proper use and maintenance of solar panels. GS engineers pay monthly visits to households during their financing period and, they offer their services for a small fee of a few dollars per month afterwards, if a client signs an annual maintenance agreement with GS. The GTCs have trained more than 6,700 women in advanced solar maintenance, enabling them to become full-time specialists who travel around the country to service GS clients for this small fee. Many GTCs actually pay for women to get a four-year technical degree at national universities before they move to rural areas. Apart from providing repair and maintenance services, GTC trained technicians also assemble solar accessories such as lamp shades, charge controllers and inverters and GTCs run exposure programs for rural school children to increase their awareness about renewable energy.

"Grameen Shakti's success rests in part to 'active marketing' as well as its emphasis on training and maintenance, mostly for women"

To further lower costs, GS funnels money back into research on solar devices and their engineers design and patent original low-cost ballasts and charge-regulators that are more efficient and less expensive (often by more than 50 per cent) than the ones previously available on the local market. GS furthermore offers an inclusive warranty that includes a buyback component under which a buyer can return his or her system to the organization if their area becomes connected to the national grid. The programme has an extremely high satisfaction rate. GS reports that 97 per cent of SHS customers payback their loans on time. Such high payback and participation rates may explain why GS dominates the market, accounting for three-quarters of all SHS sales in 2005 and 2006 and about 60 per cent in 2010, dwarfing the second most successful distributor which had only a 6 per cent share, numbers depicted in figure 16.

Figure 16.
Sales of total SHS and GS SHS in Bangladesh, 2004 to 2010



The GS biogas programme promotes small-scale, two to three cubic metre biogas plants to be used in homes and communities, suitable for providing gas and heat for cooking three meals a day for an average sized family. The biogas programme can be subscribed to at the commercial scale as well, with larger systems offering enough gas to meet the energy needs of neighborhoods, restaurants, tea stalls and bakeries. These larger systems, installed near large farms, poultry farms and livestock ranches, can supply enough gas for up to 1,000 families. By relying on biogas, these units minimize reliance on traditional forms of biomass, animal dung and charcoal (with their negative environmental and social impacts) and also protect communities from disease by enhancing sanitation. The plants harness gas obtained from livestock and human excrement. Bangladesh has more than 30 billion cubic metres of potential annual biogas from livestock and another 10 billion cubic metres from human beings. The biogas programme quite literally has people using their own waste to meet their energy needs.

> *"The biogas programme can be subscribed to at the commercial scale as well, with larger systems offering enough gas to meet the energy needs of neighborhoods, restaurants, tea stalls and bakeries"*

In 2004, GS started promoting fiberglass biogas units as opposed to traditional brick, sand, clay and concrete systems. According to GS "fib erglass units cost the same as the traditional ones, but can be constructed quicker and work more efficiently. It takes 15 to 20 days to install a brick biogas system and is completely impossible during the rainy season. Brick systems also sometimes leak methane from pipes. But fiberglass units can be installed in two to three hours, anytime in the year and almost never leak."

The financing scheme behind the biogas programme is similar to the SHS programme. Purchasers pay 25 per cent of the total cost of each system as a down payment and then repay the rest in 24 monthly installments with a 6 per cent service charge. Buyers are also encouraged to construct their own plant under the supervision of GS engineers. Biogas plants at the community scale have proven to be quite effective, as many people in rural Bangladesh live as joint families or in joined households with dozens of people close to each other, meaning they can easily share a biogas system. GS manages a special programme in Chilmari (the northern part of the country) that provides farmers and communities with the livestock in addition to biogas plants so that they have adequate "fuel." More than 13,000 biogas units were installed by September 2010 and follow up evaluations have found that 90 per cent of the plants installed under the project are still in operation and more than 90 per cent of the households that use them meet their fuel demand exclusively from these plants.

The ICS programme, started in 2006, distributes one, two and three-mouthed clay cook stoves which have chimneys that create a smoke-free cooking environment, improving air quality within the home. Almost all of these stoves are made locally by GS employees. These efficient cook stoves not only result in less fuel consumption (typically reducing fuel needs by 40 to 50 per cent), they also facilitate shorter cooking times, generate more heat and reduce indoor air pollution by 20 per cent. GS has so far installed 132,000 ICS and has recently started an ambitious programme to install 5 million of these systems by

2015. It has also trained more than 4,000 local youths and women to manufacture, sell and repair ICS. A special effort has been made to promote ICS among restaurants, soap manufacturers and other food providers. Though their claim could not be independently verified, respondents told us that 90 to 95 per cent of cook stoves installed under the programme are still in use.

The technical benefits of these improved stoves, moreover, are manifold. They can be installed quickly, often taking only one to two days. They last longer, with lifetimes of ten years compared to five for traditional stoves. They can be constructed quicker, with prefabricated models taking only 7 to 15 days to mold and they are affordable, costing only $12 for a complete three-mouthed model with a chimney. The ICS is the fastest growing programme, with 200 new GS branches established in 2010 exclusively for ICS as well as the hiring of 500 extra staff.

C. Cinta Mekar Micro hydro project in Indonesia

The 120 kW hydroelectric facility was built through a partnership between public, private and community organizations where energy has been used to electrify village homes and produce revenue through exports to the national grid. Profits from the project are split equally between a private company, Hidropiranti Inti Bakti Swadaya (HIBS) and the community itself, represented by a village cooperative. Each month the hydro scheme generates about $3,300 of gross income that is then channeled back to its investors.

With funding support from the Dutch Government, this was a flagship project by ESCAP to demonstrate the key roles of different stakeholders on 5P approach after the Rio+10 meeting. The project covered the basic services to the poor from energy, water/sanitation, environmental protection/biodiversity and health. ESCAP supported the initiative in three aspects: (a) raise awareness and visibility for the 5P efforts through international cooperation; (b) support the Government with advisory services to develop framework and mechanism on policy and finance for 5P and finally (c) demonstrate the effectiveness of 5Ps approach by establishing a pilot project. In addition, under South-South Cooperation, ESCAP facilitated exchange visits on policy, technology and financial mechanism on energy access as well as organized activities at national and regional level to facilitate policy dialogues.

Motivations for the Cinta Mekar project started with the rural electrification priorities established by the Indonesian Government, which recognized in the early 2000s that about 100 million people in the country lacked access to electricity and that it had 75,000 MW of untapped hydroelectricity potential. The Government also sought to promote private sector participation in electricity projects through its Electricity Law No. 20 of 2002.[120] The Cinta Mekar community is situated in a valley about 150 kilometres from the capital city of Jakarta and it is home to 640 households with a population of 2,050 in 2003, when the project began. More than 90 per cent of these households depend on agriculture for their livelihood, with most farming rice or working as wage laborers on commercial farms. A strong majority of farmers have land holdings less than 0.1 hectares, meaning most agricultural activity is non-mechanized and small-scale.

One of the most important factors for success was the selection of right partner – IBEKA - as a champion for converting the concept to reality. IBEKA championed the project in early 2003 near Cinta Mekar because of its proximity to the Ciasem River and because 122 out of the village's 640 households still lacked access to electricity. These homes could neither afford the initial cost for an electricity connection to the grid nor the cost of monthly payments and instead relied on kerosene. IBEKA identified key stakeholders and established effective partnerships to complete the project on April 17, 2004.[121]

"One of the most important factors for a successful 5P project is the selection of right partners and empowerment of community"

Public sector involvement came from the Directorate General of Energy Electricity Utilization, Government of Indonesia and PLN, the national electric utility, which agreed to purchase all excess power generated by the Cinta Mekar micro hydro plant. These actors set a power purchase agreement and also provided overall policy support and guidance.

Private sector involvement revolved around HIBS, a company in West Java with experience developing small-scale micro- and mini-hydro projects. HIBs provided one-third of the initial capital outlay for the

project and agreed to underwrite any cost overruns, in exchange for 50 per cent of the project revenues and profits. HIBs thus provided technical assistance and contracted to build the infrastructure for the micro hydro plant.

Lastly, community involvement took the form of a grassroots village organization called the Cinta Mekar Cooperative (termed "Mekar Sari" by the locals) which offered community assets on top of the ESCAP-funded grant as equity contribution to set up the joint venture, in exchange for subsuming a 50 per cent share of ownership and revenues. The Cooperative also assumed the responsibility for helping HIBS construct the facility through contributions of labour and for assisting with maintenance and operations, once the project was built.

While HIBS has used their revenue to build micro hydro plants in other areas and extend their business operations, the Mekar Sari cooperative has largely utilized its revenues to achieve universal village access to electricity and make investments in education, health care and local enterprises.

Because of its innovative 5P structure and its focus on community empowerment, the benefits of the Cinta Mekar project have been manifold. The most direct benefit has been the complete electrification of the village, with all homes now receiving affordable electricity that they use for lighting, cooking and other productive uses. Such electrification has occurred with no disruption of water needed for irrigation and no recorded pollution of the local river. A secondary benefit has been the extra revenue from the electricity sold to the grid. About 72,000 kWh are sold every month creating about $3,780 of extra income per month. Based on a democratic voting process and survey with the villagers themselves, the cooperative disbursed their share of this income according to the following priorities:

a. Power connections to the poorest households;

b. Microcredit loans for income generating activities;

c. Sponsorship for children's education and adult skills training;

d. Healthcare;

e. Infrastructural improvement to roads, buildings and telecommunications.

After the cooperative met all of these targets during the first 17 months of operation, table 15[122] shows they slightly shifted expenditures to focus more on education and healthcare. As of 2008, the cooperative had paid the connection installation fees for all poor households in the village, granted scholarships to 156 children, generated seed capital for local enterprises, rehabilitated irrigation canals and built a health clinic, community radio station and village telephone network.

Table 15.
Community improvement from the Cinta Mekar micro hydro project, 2004-2008

Category	Percentage of revenue (2004-2005)	Percentage of revenue (2005-2008)	Target beneficiaries
Electrification	62.5	0	122 households
Community co-operative costs	10	5	All members of the cooperative
Education	8	65	Training for 4 groups of villagers, scholarship for 30 children (first 17 months) and then 156 children (as of 2008)
Seed Capital for Income generating activies	8	7.5	15 local enterprises
Infrastructure	5	4	Improved roads, rehabilitated irrigation canals, a community radio station, and a village telephone network
Health	4	16	Health cards for 142 households, a new village health center, treatment of 5 villagers for chronic illnesses
Administration costs	2.5	2.5	

D. Micro hydro village electrification scheme in the Federal Democratic Republic of Nepal

A consortium of multilateral donors, including the World Bank and UNDP, initiated the Nepal Power Development Project in 2003. The most effective component was a Micro Hydro Village Electrification (MHVE) scheme which distributed more than 250 units — small-scale off-grid hydroelectric dams in capacities ranging from 5 kW to 100 kW — to 50,000 households in less than ten years.[123]

The World Bank and UNDP, in conjunction with local banks and the Government of the Federal Democratic Republic of Nepal, started the Nepal Power Development Project with three primary objectives: (1) to develop Nepal's hydropower potential in a responsible manner to meet domestic electricity demand (a grid connected element); (2) to improve access to rural electricity services (a non-grid connected element); and (3) to promote private participation in the power sector overall, improve efficiency and mobilize financing. Planners deemed the "traditional" strategy of promoting large-scale hydroelectricity "infeasible" because of the difficulty with raising large amounts of capital for the upfront costs of big dams and the prohibitive difficulty of reaching remote communities by extending the national grid.

The MHVE component relied on off-grid micro hydro schemes and cost about $5.5 million. It was designed to scale up community-level projects with a total capacity of 2.5 MW to 3.0 MW, serving about 30,000 new customers and ten new districts, building on an earlier United Nations Development Programme (UNDP) scheme called the Rural Energy Development Programme (REDP). The component supported hydroelectric facilities ranging from 10 kW to 100 kW, with an average plant size of 25 kW to 30 kW. Programme implementation was decentralized to local Governments, with District Development Communities (DCCs) and Village Development Communities (VDCs) required forming Micro hydro Functional Groups in each community. The Alternative Energy Promotion Center (AEPC), an autonomous body established in 1996 under the Ministry of Science, Technology and Environment, was tasked with assuming overall management of the component.

The intended benefit was to provide customers currently dependent on kerosene and other fuels for lighting with reliable electricity. A secondary benefit came from the promotion of end use activities such as cereal milling, rice husking and mustard seed processing as well as the replacement of manual implements for carpentry by electrical machines and tools, though to prevent deforestation project financing could not be used for sawmills. The MHVE required that communities wishing to build micro hydro facilities donate land for the construction of canals, penstocks, power houses and distribution lines voluntarily. Furthermore, villagers were required to contribute labour for civil works related to

micro hydro units. Tariffs for micro hydro units were set by each Micro hydro Functional Group and were based on considerations of loan repayments, operation and maintenance costs, depreciation and provision of a reserve fund for maintenance. Only schemes expected to yield average economic return of 10.9 per cent for the programme as a whole, or individual returns ranging from 10 per cent to more than 12 per cent, were supported.

One unique element of the MHVE was its emphasis on maintenance. The programme provided extensive training in operations and maintenance for local operators and managers from each local community doing a micro hydro project, assigned to each system, so that they would understand technical aspects of operation, bill collection, disconnecting for non-payment, record keeping and accounting. Turbines and generators were manufactured in the Federal Democratic Republic of Nepal and maintenance support facilities and service centers within districts were established and strengthened to provide repayable financial support.

"The Micro Hydro Village Electrification scheme provided extensive training in operations and maintenance for local operators and managers from each local community"

Another unique element was that part of MHVE project funds was given to promote women's empowerment, skills enhancement, better management of technology and income generation in a "Community Mobilization Fund" (CMF). This fund focused on coupling hydropower with income generation schemes and it offered $400,000 in total for the promotion of non-lighting uses of electricity such as the agro-processing, poultry farming, carpentry workshops, bakeries, ice making, lift irrigation and water supply. To support these activities, Rs 10,000 per kW of installed capacity was given (though capped at Rs 250,000) and local "Community Energy Funds" were established to cover the financing of local projects. The CMF also gave grants for power connections from micro hydro schemes to schools, health posts, clinics and hospitals and promoted afforestation to offset any trees felled for the construction of distribution poles. CMF funds were lastly utilized for community training and to educate the operators of micro hydro plants and other end-use machinery.

"Part of the Micro Hydro Village Electrification project fund was given to promote women's empowerment, skills enhancement, better management of technology and income generation"

Micro hydro system coverage grew under the MHVE from only a few thousand homes in 25 districts in 2003 to 40 out of 51 targeted districts and 40,000 households in 2007 and more than 50,000 homes as of November 2010. The number of micro hydro projects also jumped from 29 in 2003 to 280 in mid-2010. As of December 2007, a total of more than 90 projects with 1.5 MW of capacity had been completed, providing access to 16,914 households, meaning original project deadlines had been completed almost 18 months ahead of schedule. By 2012, project managers told us they expect to be operating in all 75 districts with 6 MW of capacity installed reaching more than one million people.

E. The PV-ESCO project in Zambia

In Zambia, three companies for solar energy services operate with 400 clients paying for the daily or weekly use of 50 Wp solar panels, with four lights and a socket for radios or other direct current appliances. Clients do not own the systems, but pay a fee to have their batteries charged and the panels and components maintained. Fees cover the full operational costs of the companies as well as eventual battery replacement. Children now have the possibility to study in the evening; homes have access to radio and video entertainment; and the poorest members in communities benefit from access to SHS present in shops and communal buildings.[124]

The Zambia photovoltaic-energy service company (PV-ESCO) project began in 1996 by the Ministry of Energy, in cooperation with the Stockholm Environmental Institute and the Swedish International Development Authority. The ESCO concept allowed people to pay for the use of solar electricity rather than the technology itself. The delivery approach is commonly referred to as a "fee-for-service" or "utility model." Three companies — a farmers' cooperative, a company dealing with farm products and one involved in waste management — were selected in 1998 to serve communities in the eastern towns of Nyimba, Chipata and Lundazi with 50 Wp solar panels under an ESCO approach. They were chosen on the grounds that they had existing well-established rural networks even though they had never

distributed solar technology before. The first company bought 100 solar systems with a low-interest loan from a local bank; the second and third companies purchased 150 systems each with similar loans and installed them throughout 1999.

The PV-ESCO project promotes learning and training through constant interactions between ESCO technicians, households and universities. Awareness campaigns and regular spot checks by technicians built trust with customers and penalties for overuse resulted in more sustainable battery charging. The Energy Regulation Board, in a partnership with the Zambia Bureau of Standards, developed rules for solar systems in 1999. ESCO technicians have also been trained at the University of Zambia in advanced system design and maintenance.[125]

"The PV-ESCO project promotes learning and training through constant interactions between ESCO technicians, households and universities as well as awareness campaigns and regular spot checks"

Experiences from PV-ESCO have so far shown that people are willing to pay for solar lighting. The current service fee of $7 per month has resulted not only in satisfied customers, but also a waitlist of several hundred prospective clients per company. The service fee covers not only company operation and maintenance, but also goes into a savings account to fund purchases of new batteries when needed. Households using the programme have commented how the quality of light is much better than fossil-fueled lamps and also that they feel more connected to the modern world with access to telephony, radio and television. Units have been disbursed to shops, bars, restaurants and motels which have reported an increase in business.

Moreover, a 2009 follow-up study noted that systems continue to run efficiently and customers report being satisfied with the quality of service being provided. Each ESCO still has a waiting list of several hundred customers and the companies have expanded the choice of technologies available, incorporating 70 Wp, 120 Wp and 150 Wp systems into their portfolio. Some of these newer systems can power the recharging of mobile phones through an inverter or provide electricity to refrigerators.[126]

F. Rural electrification project in Lao People's Democratic Republic

In tandem with the Rural Electrification Project (REP) and other national efforts, the Government of Lao People's Democratic Republic was able to quadruple its electrification rate from 16 per cent in 1995 to 63 per cent in 2009. The REP specifically brought grid-connected hydroelectricity and off-grid SHS electricity to more than 45,000 households in four years.[127]

The first phase of the REP, which we discuss here, was based on a World Bank grant of $10 million and an additional GEF grant of $ 3.75 million to the Government from 2006-2009. The objectives of REP Programme were twofold: to increase access to electricity of rural households in villages of seven southern provinces and to achieve sustainability of power sector development. Broader objectives also consisted of poverty reduction and environmental sustainability.

"Government of Lao People's Democratic Republic was able to quadruple its electrification rate from 16 per cent in 1995 to 63 per cent in 2009 through the Rural Electrification Project"

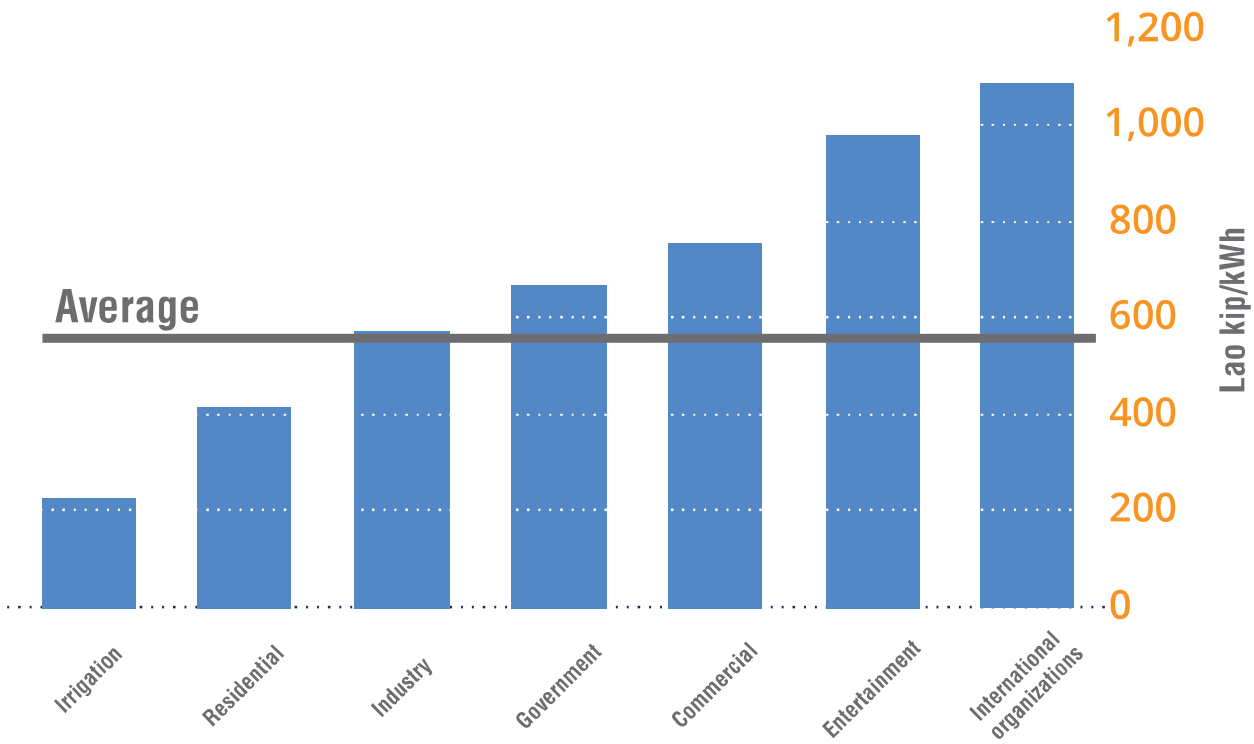
The key stakeholders in the REP were the World Bank, which provided the main funding through an International Development Assistance grant; Electricité du Laos (EdL), the state-owned utility, which implemented grid expansion; the Ministry of Energy and Mines of Lao People's Democratic Republic; and the various bodies it consulted in implementing off-grid electrification such as the French consultancy IED (Innovation Energie Developpement), Provincial Electrification Service Companies and village electricity managers.

Grid extension was carried out by EdL. The goal was to connect 29,400 households and it was achieved in 2010. The network comprised 22 kV, 12.7 kV and 0.4 kV lines, transformers and single wire earth return systems. Villages for electrification were chosen with preference given to those closer to existing roads, larger in size and already engaged in economic and social activities. Efforts were also put into

transmission and distribution loss reduction through better systemic planning and preparation, reducing losses from more than 21 per cent in 2005 to 13 per cent in 2009.

Grid electrification efforts worked on a cross subsidization model. The EdL was tasked with expanding the grid to meet nearly 30,000 new households and at the same time keeping tariff rates affordable. Tariffs for residential consumers were cross-subsidized against other consumer cohorts (see figure 17). The 2008 average tariffs in the chart below show that the residential sector tariff was one of the lowest and below the overall average tariff of 542 kip/kWh (a little more than 6 United States cents/kWh). This low tariff was designed with the social objective of connecting as many households as possible to electricity. Overall, the REP I project was successful in achieving high electrification rates in rural areas. In all, 36,700 households were electrified by mid-2009.

Figure 17.
Average electricity sector tariffs in the Lao People's Democratic Republic, 2008



"Grid electrification efforts worked on a cross subsidization model"

For off-grid electrification, SHS were installed in over 9,000 households. The project followed an ESCO model, for example, they leased the equipment to households for a monthly fee through ESCOs. But neither the Government department nor EdL had the institutional capacity to support installation and implementation of off-grid electrification. Hence it was decided that an external contractor should be hired to support this work, at least for the first phase of RE which lasted for 3 years, during which time the Government could build its capacity. IED was awarded the implementation contract and set up a management structure. The programme office established VOPS at the upper level to manage the PESCOs which would run operations at the provincial levels. PESCOs are local private companies responsible for planning, installation, operations and maintenance of the off-grid systems. They are mini electricity franchises who act as the key implementers of the off-grid systems. They are paid $2 for each household that signs up, $1 for installation and 20 per cent to 35 per cent of the monthly payments collected from the off-grid systems. PESCO managers are recruited by VOPS. PESCOs work with the village electricity manager (VEM), who is in effect the head of the village and makes decisions for the village and its residents. VEMs also keep 20 per cent to 35 per cent of the monthly payments as fees for their services. The remainder of the monthly payments is put into a rural electrification fund. This fund is supervised by VOPs and used to pay additional incentives to PESCOs, VEMs and for maintenance.

In addition to PESCOs and VEMs, the other key actors are the Provincial Department of Energy and Mines who play the role of regulator for PESCOs and inspect the quality of installations and the Village Electricity Advisory Committee which oversees the programme at the village level. Procurement of the solar panels was mainly through Sunlabob, a private entrepreneur who coordinated the purchases of all SHS components (panels, wires, controllers, battery, switches, inverters and so on) from various suppliers across Asia and then assembled them.

G. Lighting a Billion Lives in India

The Energy and Resources Institute (TERI) in India has undertaken this initiative to address the challenge of providing clean lighting to populations without access to electricity, majority of them are in India alone. It has so far covered 1,500 villages in India, benefitting 370,400 people and has taken its

footprints to some countries in Africa and South East Asia. Local entrepreneurs are trained to operate and manage the solar charging station and rent out certified, bright and quality solar lanterns to the community every evening for an affordable fee. The required training support to both the LaBL Partner Organizations and the entrepreneurs is provided as a part of this initiative to ensure sustainability of the stations.

The fee-for-service model of the initiative ensures clean energy is supplied at an affordable price. Funds have been generated through a range of financial instruments which largely include grants but also equity investments, micro-loans, payment for services, research grants and so on. Institutionally, the programme identified the local level platforms for micro-implementation of project deliverables, carrying out training and capacity building and ensuring after-sales services, as the missing link in implementation of grassroots projects. A network of Partner Organizations (POs) that consist of NGOs and other grassroots level developmental agencies has been created to bridge this gap.

This project started with a pure grant-based model for testing the entrepreneurial fee-for service delivery model which otherwise had not been tried on a larger scale in India and gradually moved to a more flexible equity and investment based model for scaling up. The equity contribution from communities is a flexible amount that varies within a range depending upon the communities' socio-economic conditions and actual paying capacities. Similarly, the daily rental is decided by the operator and community jointly so that it is comparable to the average expenditure incurred on the current fuel for lighting. While the affordable rental fee ensures that everyone gets an equal opportunity to use the lanterns, the local partners help in implementing the initiative with sensitivity towards the specific local issues and customs, since they understand the community composition, user expectation and behaviour.

"This project started with a pure grant-based model for testing the entrepreneurial fee-for service delivery model and gradually moved to a more flexible equity and investment based model for scaling up."

The initiative developed a partnership base at three different levels. While strategic partners like Government bodies and international, bilateral and multilateral agencies form the 'macro' level partnership network, the local NGOs and other implementing agencies form the next or the 'meso' level of the web. At the 'micro' level, the initiative has created the institution of TRCs to enable post-implementation maintenance support to ensure sustainability.

Efficient functioning of these local level institutions requires continuous mobilization, training and capacity building. Interestingly, having such a large stakeholder or partner base could also lead to dilution of the programmatic objective and vision since every partner or stakeholder also has a unique mandate of its own. To overcome this risk, LaBL has ensured (a) clarity in the roles of every stakeholder by clearly spelling them out and (b) the incorporation of sensitization and training of every stakeholder at different stages of project implementation. This includes community sensitization and engagement prior to the inception of the project at any site to assess the need and ensure acceptability of the project by the community. It is followed by training of the entrepreneur before and after installations, focusing on the technical and entrepreneurial aspects, apart from upkeep and maintenance of the charging station. Second level user training is conducted immediately after installation to ensure that the users are not only made aware about proper usage but are also trained on the institutional pattern to enable them to seek proper after-sales, as and when required. Every partner, particularly those involved in direct implementation is given exhaustive and advanced training on the vision of the programme, technology, implementation model and their role in sustaining the initiative.

Working towards continuous improvements in solar lantern designs in line with communities' feedback, TERI in collaboration with leading solar lamps manufacturers, lighting companies and PV manufacturers has developed cost-effective products with improved efficiency and quality. The shift to LED lanterns from CFL lanterns, without compromising on the illumination level, made LaBL achieve almost 30 per cent cost reduction in terms of lumen-hour for solar lanterns.

By developing cost-effective, modular, easy-deployable solar charging station configuration with different solar PV technologies and institutionalizing standard operating and monitoring procedures, for quality controls and product approval have also gone a long way in addressing the technological barriers to implementing this programme smoothly.

It is interesting to note that the initiative doesn't only focus on making access to modern sources of energy affordable to the targets users; it also tries to enhance their income and affordability by extending additional income generating opportunities like mobile phone charging, to bridge the gap from both ends. LaBL also provides an option to the operators to start solar enterprises by facilitating loans and subsidizing partial cost of the enterprise. In some areas, training and initiation on income generating activities for women like tailoring, selling mobile telecom services have been undertaken. Institutions created under state level Rural Livelihood Projects and Poverty Reduction Programs have also been utilized for taking the initiative forward in some areas.

"Initiative focuses not only on making access to modern sources of energy affordable to the targets users, but also on enhancing their income and affordability by extending additional income generating opportunities like mobile phone charging"

One of the key strengths of the programme lies in the fact that it has been able to develop convergence with other developmental programs in providing co-benefits to rural community. For example, the programme model was customized to provide lighting in tribal residential schools in remote parts of Koraput district or Odisha, where grid infrastructure is finding it extremely difficult to reach owing to the tough terrain and left-wing extremism related disturbances. This was undertaken in partnership with the Integrated Tribal Development Agency, established by the Government of India. The programme has been linked with micro-finance institutions in certain areas to promote innovative financing models and with Forest Departments to link conservation activities with it.

H. National Geothermal Company in Chile

Chile's Geothermal Energy Concessions Law No. 19657, which went into effect on 7 January 2000, allows the state-owned national oil company, ENAP, to participate in this industry through corporations operating in the sector, where ENAP owns a share of less than 50 per cent.

Under this legal mechanism, in April 2005 ENAP forged a strategic alliance with the Italian company Ente Nazionale per l'Energia Elettrica (ENEL) to develop geothermal exploration and production projects in Chile. This partnership was formed when ENEL acquired a 51 per cent share of the National Geothermal Company (Empresa Nacional de Geotermia S.A., ENG), a corporation in which ENAP holds the remaining 49 per cent.

In March 2006, this strategic alliance was extended when ENEL acquired 51 per cent of the corporation Geotérmica del Norte S.A. (GDN); the remaining shares are controlled by ENAP (44 per cent) and CODELCO (5 per cent).

Between 2006 and 2009, ENG and GDN mainly focused on participating in concession tenders for geothermal exploration and exploitation, carrying out research and pre-feasibility studies in the areas of interest. The activities involved in obtaining concessions and conducting these studies required a substantial investment by the companies, in terms of both human and financial resources (estimated at tens of millions of dollars). The results of the field studies underscored, in particular, the high geothermal potential of the El Tatio Geyser Field in the northern Atacama Desert. More detailed technical and scientific studies began in the area, both on the surface and at depth.

In September 2009, GDN came under fire for a leak in one of the exploration wells near the El Tatio Geysers National Park, which produced fumaroles more than 60 metres high. The exploration project was subsequently rejected by the community and local authorities, who accused GDN of environmental damage and the destruction of natural heritage and tourism potential. These events caused GDN to cease exploration activities in the region and to search out areas with a lower environment/tourism impact.

In May 2011, the General Manager of ENAP announced the decision to sell the company's shares of 49 per cent of the National Geothermal Company (ENG) and 44 per cent of Geotérmica del Norte (GDN), thereby pulling out of the geothermal business. The announcement further stated that the sale would be handled by the investment bank BNP Paribas and estimated that the process would take six months to complete. Despite these announcements, that same month the directors of Geotérmica del Norte reported the initiation of environmental procedures for installing a geothermal plant about 200 kilometres north of the disputed El Tatio region.

The project, called Cerro Pabellón, is located in the Pampa Apacheta area, in the community of Ollagüe (II Region). Project investment is estimated at $180 million, according to the environmental impact report filed by GDN. The project involves a production capacity of 50 MW of power, which will be injected into the Norte Grande Interconnected System (SING) via a 220 kV transmission system. In addition to the generation facilities, the plan includes 11 drilling rigs for production wells and reinjection wells, a pipeline network, an internal road network and auxiliary works.

The geothermal plant, in addition to contributing to energy diversification in the country and particularly in the Antofagasta Region, would be the first 50 MW plant in South America, turning the region into a model for the development of this clean, constant, renewable energy.

The next stages of the project (in 2012) include analyzing the fluid composition and reservoir data from the geothermal fields and drilling additional wells for both production and reinjection of geothermal fluids, followed by plant construction (in 2013), operation and commercialization of the energy produced. The plant is expected to enter into operation in the first quarter of 2014.

Based on these concrete developments, ENAP is re-evaluating its decision to pull out of GDN and, hence, the geothermal business. If the company decides to keep its share, the Chilean Government would retain its strategic presence in the development of an important energy resource for the country, at the same time that it could effectively recover the investments made — with fiscal resources — in risk activities associated with geothermal exploration.

"The geothermal plant, in addition to contributing to energy diversification in the country and particularly in the Antofagasta Region, promises a public-private model for the development of this clean, constant, renewable energy"

I. San Cristóbal Wind Project in Ecuador

With financing from the e8 (an organization comprising the largest electric companies in the world), the United Nations Fund (UNF) and the Government of Ecuador, a wind farm was built on San Cristóbal Island, the most populated island in the Galapagos archipelago, Ecuador.

The project aims to reduce the use of diesel fuel, which is the current source for electricity generation on the island and to promote the introduction of renewable energy in the Galapagos. This will not only reduce the environmental risks associated with transporting diesel fuel, but also lower the cost of electricity generation, which is strongly subsidized by the national Government.

Implementation of the project began in 2005 with the creation of the San Cristóbal Wind Corporation (EOLICSA), through a business trust set up by the e8 companies and the Galapagos Provincial Electric Company (Elecgalápagos S.A.), a Government subsidiary that provides electric service to the islands.

Fondos Pichincha, an Ecuadorian company specialized in managing businesses and investment funds, acts as the business trust administrator, while Industry and Energy Associates, a United States of America company, serves as the project director.

The tariff set for electricity produced by the San Cristóbal wind farm is $0.1282/kWh. This tariff is guaranteed for a period of 12 years through a contract signed by Elecgalápagos S.A. and EOLICSA, in accordance with Regulation 004/04 ("Prices of Energy Produced with Unconventional Renewable

Energy Resources") issued by the National Electricity Council (CONELEC). This rate is lower than the rate paid for diesel fuel generation ($0.16/kWh), which receives a Government subsidy to bring the cost of diesel to $0.91/gallon.

"The tariff set for electricity produced by the San Cristóbal wind farm is lower than the rate paid for diesel fuel generation in the region"

Table 16.
Approximate financing of the San Cristóbal wind project in Galapagos, Ecuador

Source of financing	Amount (thosands of United States dollars)
Donations from e8 members	6,800
Dontations from the United Nations Fund (UNF)	1,000
Capital subsidy from the Ecuadorian government	3,200
2004 income tax through the San Cristóbal municipal government	250
Total	11,250

Project financing was mixed and included public and private capital, as detailed in table 16. The estimated cost of the project was $11.25 million.

The unit cost was approximately $4,100/kW, which is relatively high compared with larger projects developed on the continent. This reflects the small scale of the project and the logistical difficulties stemming from the geographic location. This was anticipated, however, so it did not cause unforeseen complications in the implementation phase.

J. Salvador City Solar PV Project in Brazil

This project plans to install a 400 kW solar photovoltaic generator on the roof of the Salvador city football stadium in the state of Bahía and connect it to the state's electricity network.

This project not only offers significant scientific and technological benefits for Brazil's energy sector, but also has strong economic and social impacts. The use of photovoltaic systems that are directly connected to the network has not yet been developed in Brazil, so the project opens the possibility for being replicated in other regions.

The PPP structure of the project is as follows: the public sector is represented by Eletrobras, the State Government of Bahía and Federal University of Santa Catarina (UFSC), while the private sector participants are the Bahia State Electric Company (Coelba), Neoenergia (one of the largest companies in the Brazilian electricity sector, which operates all along the electric energy production chain), GIZ/Germany and the Instituto Ideal.

Coelba, the State of Bahía and GIZ are responsible for financing the total investment of R$5,557,510.70, as follows: Coelba (66 per cent), State of Bahía (32 per cent) and GIZ (2 per cent). Coelba will invest fresh capital through the ANEEL regulation on energy efficiency projects, providing funds for project development, system acquisition and installation. The Government of Bahía will invest in reinforcing the stadium infrastructure, while GIZ will pay for consultants and travel expenses.

The PPP set up for this project represents an interesting pilot case, as it shows how to maximize the advantages of distributed generation from solar photovoltaic systems integrated in buildings, located in urban areas and close to the consumer. Given the stadium's high public profile, the project will help raise local public awareness of the need to expand the energy supply using renewable sources.

More generally, this type of PPP can have a positive influence on the long-term development of policies and regulations that support the effective integration of renewable energy into the network, not only in Brazil, but in other countries in the region.

"PPP projects with a public-awareness component can have a positive influence on the long-term development of policies and regulations"

K. Wiwili Mini Hydropower Project in Nicaragua

This project plans to install a 1.48 MW hydroelectric plant in the Municipality of Wiwili, with an expansion of the distribution network in north Nicaragua.

The PPP structure of this project is as follows: the public sector is represented by the EMEEAW Municipal Company and the Ministry of Energy and Mines, while the private sector participant is the e8 (Global Sustainable Electricity Partnership).

The country's energy policy supports the development of renewable energy projects and small hydroelectric plants through various incentives, such as tax exemptions during construction and the first years of operation and subsidies for rural electrification. The Wiwili project was thus financed through a combination of public funds (loans and grants), which were provided under the framework of the national rural electrification programme financed by the World Bank, private sector funds and a grant from the Inter-American Development Bank (IDB). The participation of an internationally respected group of firms (the e8) in the PPP was crucial for getting development financing organizations like the World Bank and the IDB on board.

"The Wiwili project illustrates the importance of the division of roles and responsibilities among the PPP partners"

This project illustrates the importance of the division of roles and responsibilities among the PPP partners: the private partners contribute know-how and financial facilities, while the public partner can facilitate the process by liaising with different segments of society (communities, local authorities and so on) and offering incentives (tax exemptions and subsidies) to support the local development of the population. It also shows that a more precise definition of roles and responsibilities and the long-term commitment of all the PPP partners should be established and agreed before the project is launched.

L. Al Kuraymat hybrid solar-thermal power plant in Egypt

Al Kuraymat is located at about 90km south of Cairo. The project site is uninhabited and characterized by a flat desert landscape, high intensity direct solar radiation that reaches 2,400 kWh/m2/year, an extended unified power grid and extended natural gas pipeline and is near a source of water. The international call for tenders for the plant was issued by NREA and the project

went into commercial operation in June 2011. The project is a grid-connected hybrid power plant which uses natural gas and solar power and has an overall capacity of 140 MW (out of which, share of the solar component is 20 MW). The technology is a conventional combined-cycle plant including: two gas turbines of about 41.5 MW each firing natural gas as fuel to generate electricity; two heat recovery steam generators to use the exhaust gases from the gas turbine to produce superheated steam; one steam turbine of about 68 MW; a cooling system in which the steam turbine exhaust will be condensed and pumped to the heat recovery steam generators; and a solar thermal power collector comprised of parallel rows of solar collector arrays, sets of typical mirrors forming parabolic troughs that focus the sun's energy on an absorber pipe located along its focal line. The total area of the solar collectors is about 220,000m^2 and the solar field technology was developed by Solar Millennium Group and designed by Flagsol GmbH, a subsidiary of Solar Millennium AG. The solar field was installed and commissioned in cooperation with an Egyptian company Orascom Construction Industries (OCI). An assembly hall has been built specifically for the project and houses a hundred Egyptian workers who construct the collector units. Flagsol advises OCI on Operation and Maintenance (O&M). Flagsol and OCI are to operate the solar section of the plant for two years after which they hand over to NREA.[128]

The project is financed as follows: $49.9 million from the GEF as a grant; $92.3 million from the Japanese International Bank of Japan (JBIC); and the remaining $57.1 million equivalent from NREA (excluding interest during construction). The total project cost was estimated[129] at €250 million, 30 per cent of which are attributable to the realization of the solar field. An integral part of this project is to train NREA and other public sector workers in solar thermal power plant operations particularly with regards to integration into the grid. NREA is planning to survey local equipment suppliers/ contractors to establish a data base of what needs to be developed locally for future projects. NREA is also monitoring the project and evaluating it as it progresses so that the results are disseminated and provide lessons for future projects. The NREA plans to benefit from this project and other RE projects for the creation of the RE fund. The natural gas saved due to the RE projects could be exported at a premium price with a margin of profit which would go into the fund. The fund can be used to establish the solar thermal industry and develop local know-how.

M. Shams Ma'an Solar PV project in Jordan

Ma'an is located in the South of Jordan, 110km away from Aqaba and 200km away from Amman, 125km away from Saudi Arabia and 400km away from Iraq. It is home for 28,000 people and has direct access to a specialised cargo highway that directly connects Jordan to both Saudi Arabia and Iraq. The Ma'an Development Area (MDA) extends over 8.75km^2 in the vicinity of the city of Ma'an and is planned to comprise four clusters: a Residential Community, a Skill Development Centre, a Hajj Oasis and an Industrial Park of 750,000m^2. MDA was set up to further establish Jordan as a premium investment destination and to serve as a regional hub for industrial activity. MDA is managed and promoted by the Ma'an Development Company (MDC), a partnership between Al-Hussein Bin Talal University, the South Company for Construction and Development (SCCD) and the Jordan Industrial Estate Corporation (JIEC). The SCCD was created to develop the South of Jordan in line with the King of Jordan's vision for developing all regions of Jordan and is totally owned by the King Abdullah II Fund for Development. The JIEC was established in 1980 in accordance with Law No. 59 of 985 with participation between the public and the private sectors. It is responsible for land use and zoning within industrial estates, constructing buildings and infrastructure networks suitable for industrial projects, establishing policies and regulations and concluding agreements with investors for rental or sale of land within JIEC.

In May 2009, Shams Ma'an Power Generation PSC, a consortium of Jordanian and global organizations announced the $400 million Shams Ma'an project, the first PV site on a large scale in Jordan and in October of the same year they formalized the agreement to secure a plot of land for the project. Under the agreement, MDC contributed a 2km^2 plot of land within MDA's Industrial Park for the duration of 30 years for the project's commencement. MDC would avail an additional adjacent land if necessary under similar terms and conditions for the future project's expansion. The plant has an initial 100 MW capacity expandable to 200 MW and is expected to produce 168GWh-200GWh/year, enough to electrify around 1.2 per cent of Jordan's total needs. The consortium established to build the solar PV plant is composed of Kawar Energy, a Jordanian utility firm, Solar Ventures Srl, an Italy-based developer and operator of PV power plants and first International for Investment and Trade Company,

which has a strong business presence in Jordan and ties to electricity distribution in Jordan since the 1930s.

The project is expected to be carried out in four phases: evaluation, pilot, feasibility study and finally implementation upon reaching an agreement with the Government so the plant goes into its production phase by the end of 2012. A milestone of the agreement is a Power Purchase Agreement (PPA) between the consortium and the Jordanian Government. Given the huge supply of energy to be provided by the plant, the aim is to ensure the future sale of the produced electricity which in turn will have a determinant impact on the project's financing channels. The negotiations for the PPA would incorporate details to realise a fair price per kW to all concerned parties and the duration and terms of agreements, in addition to access to the MSP — mentioned under Section III. As part of the agreement, the consortium would deliver a feasibility plan. The feasibility study would include an assessment for the optimal plant size and technology; several scenarios to compute the potential energy output levels; an evaluation of interconnectivity options to the national and other grids; an analysis of electricity tariffs; a complete financial model that incorporates all acquired data to assess the long-term feasibility of all proposed scenarios; and a scoping of international markets to identify potential technology suppliers, contractors, financiers, donor programs and environmental protection agencies with which to enter into agreements for Shams Ma'an.[132]

In addition to supporting the EDAMA initiative, the aims of the project, as stated in the press and by the private companies involved in the project are to:

a. Help Jordan meet its renewable energy targets of 7 per cent by 2015 and 10 per cent by 2020 based on the national energy strategy and reduce its overall CO2 emissions output by as much as 160,000 tons/year;

b. Enhance Jordan's RE industry and forge partnerships to optimize the capability of Jordan to attract and increase foreign investments;

c. Generate jobs during the construction phase and consequent operations and foster technology-transfer of green energy competencies and skills in the MDA;

d. Become a regional leading centre of excellence for RE R&D in collaboration with local universities and stakeholders.

In March 2011, it was reported in the online media that Kawar Energy and the feasibility specialist CH2M HILL started the survey due for completion by the end of 2011 or early 2012. The group was also reported to be supporting the establishment of a professional learning center to create the training capacity required for installers and technicians. In May 2011 it was reported that MDC and Shams Ma'an Power Generation PSC, in collaboration with the National Centre for Research and Development/ Energy Research Programme (NERC), began the Solar Technology Qualification, a technology evaluation project to allow for the harnessing of the best solar technology. It entails the installation and evaluation of solar electric power generation systems in proximity to the location of the planned Plant. The electrical performance measurements, meteorological and irradiance data are expected to provide inputs for the optimization of the future plant. The consortium reported that it was awaiting further direction from the Government of Jordan about how they intended to price and use the energy produced by Shams Ma'an.

N. Shams 1 CSP project in the United Arab Emirates

The agreement for the financing of the CSP plant named Shams 1 in the UAE was signed in March 2011. The plant will be located in Madinat Zayed, approximately 120km southwest of Abu Dhabi and is planned to have a capacity of 100 MW. In addition to the strong solar irradiation in the area, the location was chosen to supplement ongoing efforts to develop the western region of Abu Dhabi by providing renewable power, as well as new jobs and a strengthened economy. The Shams 1 is planned to be one of the largest CSP plants in the world, extending over an area of 2.5km^2 and a solar field consisting of 768 parabolic trough collectors. It is expected that the plant would displace approximately 175,000 tons of CO2 per year, equivalent to planting 1.5 million trees or removing 15,000 cars from Abu Dhabi's roads.

The Shams consortium accessed a 22-year bank loan of $600 million from eight foreign and two local banks led by French bank BNP Paribas which also acted as the financial advisor, to build Shams 1. The consortium also received a $153 million equity subscription from its sponsors; Masdar holding a 60 per cent stake, alongside France's Total and Spain's Abengoa each holding 20 per cent.

"The plant in would displace approximately 175,000 tons of CO2 per year, equivalent to planting 1.5 million trees or removing 15,000 cars from Abu Dhabi's roads"

Shams 1 is considered one of Masdar's flagship projects and is expected to contribute towards Abu Dhabi's target of achieving 7 per cent RE power generation capacity by the year 2020 and a core contributor to Abu Dhabi's long-term RE objectives. The project qualifies for carbon credits under the CDM and the plant is being built under the independent water and power producer (IWPP) model already used by Abu Dhabi for conventional power and water desalination. Under the model agreed upon, the project company will sell power to the state utility Abu Dhabi Water and Electricity Co. (ADWEC) under a power purchase agreement. An important feature of the Shams 1 solar project is the introduction of a "green payment" under which the Abu Dhabi Ministry of Finance will compensate ADWEC for the difference between average domestic power generation cost and the generation cost for Shams 1. A major aspect of the green payment is the provision of political support which enhances the long-term viability of renewable transactions.

Part V: Multiplying and replicating partnerships

Globally, it is estimated that to ensure universal electricity access by 2030, out of a total generation requirement of 952 TWh, a staggering 60 per cent (or 572 TWh) will be provisioned via mini-grid and isolated off-grid technology.[133]

Table 17.
Generation requirements for universal electricity access, 2030(TWh)

	On-grid	Mini-grid	Isolated off-grid	Total
Africa	196	187	80	463
Sub-Saharan Africa	195	187	80	462
Developing Asia	173	206	88	468
China	1	1	0	2
India	85	112	48	245
Other Asia	87	94	40	221
Latin America	6	3	1	10
Developing countries*	379	3,993	171	949
World**	380	400	172	952

*** Includes Middle East countries; ** Includes OECD and transition economies**

Based on the data under table 17[134] and the cases presented earlier in this document, it is evident that bulk of the effort to ensure universal access to modern energy services will need to be focused in rural areas of the African and the Asia-Pacific regions.

"The effort to ensure universal access to modern energy services will need to be focused in rural areas of the African and the Asia-Pacific regions via mini-grid and off-grid technology"

Understandably the pro-poor partnership models, to support such a transformation, need a boost. The multitude of stakeholders involved in traditionally diverse areas such as rural development, agriculture, energy, finance, corporate affairs, make the task challenging. At the same time, it presents an unparalleled opportunity to strike collaborative working arrangements.

"Pro-poor partnership models need a boost to move towards the scenario for universal access to modern energy services"

This section analyzes multipliers, or how the pro-poor public private partnership (5P) approach can be scaled up and "made bigger." Furthermore, it explores replicators, a term denoting best practices that other communities and countries can use to replicate it within their respective jurisdictions.

A. Multipliers

This section explores how public private partnerships, particularly the 5P approach, can be quickly scaled-up to produce greater results. It analyzes new and innovative possibilities for 5P multiplication involving carbon financing, community interest companies, low-profit limited liability companies and B corporations. This section of the report discusses potential policy- and legal- methods to multiply the 5P approach: (1) Project Bundling, (2) Universal Service Obligations and, (3) Legal Provisions.

1. Project bundling

One way to address the mismatch between interests of a large-scale investor and a relatively small rural community is to bundle smaller projects together such that economies of scale and scope helps minimize transaction costs. An appropriate Government policy on pro-poor public-private-partnerships (5Ps) that grants a private corporation the right to provision modern energy services to (say) 500 villages could potentially invite the required investment-interest. The duration of awarding such a license could be appropriately adjusted to allow for cost recovery and a normal profit. This is represented in figure 18.[135]

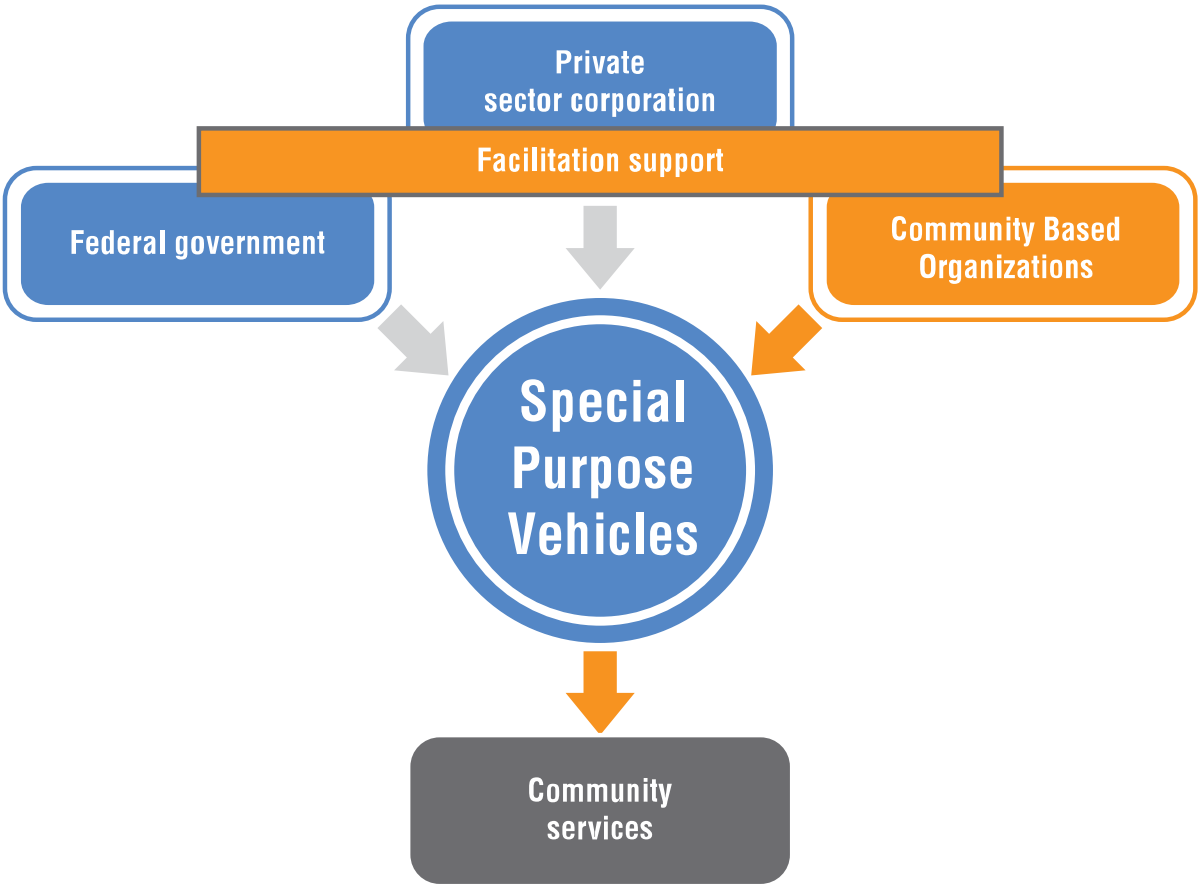
"One way to address the mismatch between interests of a large-scale investor and a relatively small rural community is to bundle smaller projects together"

In such a scenario, the private sector company assumes the role of a partnership aggregator – partnering with many community based organizations across the country. Instead of a single Special Purpose Vehicle (SPVs), the result is a number of such entities and each for a unique community. A national level non-governmental-organization (NGO) can play a crucial role to facilitate the formation of and, operations of these SPVs by helping to develop capacities of local entrepreneurs and communities.[136]

The amount of financing from the sphere of climate change is undeniably substantial. During the 2010 Cancun Conference of the Parties, industrialized countries pledged to mobilize $100 billion per year by 2020 to address the needs of emerging economies in responding to climate change. At the centre of this pledge is the Green Climate Fund (GCF), which has already raised $30 billion in "fast-track" financing as of 2012. If it reaches the $100 billion amount, the GCF will be equivalent to the cost of the entire four-year Marshall Plan to rebuild Europe after World War II.[137]

A bundling approach is helpful for to tap in to carbon funds. While using locally available renewable energy resources, the volume of generated carbon credits as Certified Emission Reduction (CER) or Voluntary Emission Reductions (VERs) units from a single village is relatively low. Moreover the administrative process of procuring these credits from international carbon markets makes it unviable for small scale community projects. However, a bundling approach allows for aggregation of smaller projects to justify the administrative costs and strengthen the financial closure for the benefit of the stakeholders.

Figure 18.
5P multiplier: A project bundling approach



2. Universal Service Obligations

The divergent motives of profit and social development means Universal Service Obligation (USO) clauses in many public-private-partnerships can mandate the private sector corporation to provision an agreed percentage of the overall production of the SPV to people, who are unable to pay for it. USO is also perceived as a mechanism of partial payment by the private sector to the Government to gain access to new markets and scarce resources. Though made popular by its adoption in the telecom industry, the usage of the term USO is now increasingly recognized in other areas including the energy sector.[138] This compliments the growing recognition of the importance of access to modern energy services for national economic and social development.

3. Legal provisions

One of the limitations to small, community-based, socio-economic projects could be the inadequate legal provisions to help contain risk of liabilities. Lately, some options are emerging, that might support the adoption of similar projects at a relatively larger-scale in the future.

(a) Community Interest Companies (CICs)

A new type of institution that might express a great interest in 5Ps is a Community Interest Company, or CIC. "The Community Interest Company does what it says on the tin," explains one study. "The concept is straightforward. It has the interests of the community at heart and proves this by agreeing to regulatory oversight of the use of its assets and social purpose and by providing transparency in the way it operates."[139]

> *" Community Interest Companies have the interests of the community at heart and proves this by agreeing to regulatory oversight of the use of its assets and social purpose and by providing transparency in the way it operates"*

The legal form of a CIC is quite new, being established in the United Kingdom of Great Britain and Northern Ireland under the Companies Audit Investigations and Community Enterprise Act of 2004, which permitted CICs to start forming in July of 2005.[140] The CIC is a hybrid between a non-profit organization and a company. It gets away from the restrictions on income generating companies that not for profit companies are allowed to undertake and its central purpose is to "enable organizations with philanthropic purposes to generate their own resources by conducting business."[141] One recent article summarized the CIC concept this way:

> *The CIC Law establishes a new corporate form that allows a firm engaging in charitable activities (and indeed any firm that the Government deems is operating for the "benefit of the community") to issue stock and grant dividends," but the implementing regulations cap those dividends at 35 per cent of total profits. Moreover, the charitable CIC is not permitted to sell its assets to a for-profit firm unless the firm receives full consideration. Importantly, the charitable CIC does not receive the tax breaks that traditional British charities receive, that is, the equivalent of the tax breaks for non-profit firms in the United States of America. In short, the CIC form allows community-benefit firms to raise limited capital from equity markets but discourages profit-driven shirking by limiting the extent of dividends.*[142]

Legal and financial analysts have thus described the CIC as a "limited liability company but with entrenched public interest purposes and restrictions on the distribution of profits and assets"[143] and a "vehicle which will protect investment made for a clearly community based purpose."[144]

A CIC can be created to take one of three forms: a private company limited by shares, a private company limited by guarantee or a public limited company. They must use their assets for the "benefit of the community" and a Community Interest Company Regulator, whose office is attached to the Registrar of Companies in the United Kingdom of Great Britain and Northern Ireland, must oversee their operation. CICs must demonstrate to the Regulator that they do indeed fulfil a social purpose and that they will not unduly restrict their group of beneficiaries. CICs operate under an "asset lock" which places restrictions on how assets and profits are distributed. Political parties and campaigning organizations are prevented from becoming CICs. As one of the creators behind the concept put it, "the key thing with shares in a CIC is that the capital growth inures to the social purpose; it does not go to the shareholders, so shareholders in a CIC are really a bit like bondholders. They don't get the capital growth; they get an income."[146]

"Community Interest Corporations don't get the capital growth; they get an income due to its charitable feature for benefit of the community"

The CIC legal form has a multitude of benefits. It is extremely cheap to create, costing only £20 to register and CICs can be anywhere in the world, even though they must be registered in the UK (and a few other countries that have since adopted the concept, such as Italy). It is externally audited, which in theory makes it more accountable; the CIC Regulator can order a forensic audit at the CIC's expense, can start civil proceedings to interfere in the company's operation and can remove the Company's directors. It has substantial tax benefits. Put simply, "the current legal framework in the US does not encourage, or even allow, many forms of entrepreneurship or profitable activities."[147] For-profit charities must forfeit all state and federal tax benefits available to non-profit organizations and one recent study estimated that the non-profit sector therefore wastes $100 billion of value annually — as a whole socially responsible investment (those which engage in self-described "socially worthy" activities) represent 7 to 11 per cent of all total economic assets under management in the United States of America, or more $2.14 trillion in value.[148] The CIC fixes this dilemma and enables for-profit entities to receive tax breaks.

The CIC does have some particular drawbacks. It is limited by the shares it can sell, by the profits it can distribute (no more than 35 per cent of revenues) and the amount of debt it can accrue. It can pay directors competitive salaries, but the level of remuneration must be "reasonable."[150] Furthermore, CIC legislation does not directly prohibit the distribution of surpluses to individuals by permitting, for instance, staff bonuses and employee share schemes.

Despite these limitations, however, CICs have clearly become useful, with the 1000th CIC created less than two years after the UK created it[151] and 4,280 CICs are in existence as of 2011.[152] These CICs operate in a variety of sectors including agriculture, fishing and manufacturing, though the top four categories are social and personal services (35 per cent), education (19 per cent), real estate (17 per cent) and health and social work (15 per cent).[153]

"More than 1000 Community Interest Corporations have been created within two years after established in UK"

At least one, the Yansa CIC, already deals with community-based wind energy systems. That company, registered in May 2008, has a stated commitment to (1) developing wind turbine designs for rural communities, (2) working with community based organizations at resource assessments and training and (3) raising awareness and doing research and publications. They have developed a wind platform that is cheap (they say it costs "a fraction" of commercial designs) and locally produced, drawing from local materials and local communities for operations and maintenance. Commercial wind companies, for example, often refuse to share data produced from wind sensors in their machines with buyers; Yansa shares the data freely. Some designers plan their machines for obsolescence or discontinue manufacturing lines; Yansa CIC pledges not to do so. The company also has pledged to share all profits with communities on a 50-50 basis. The company is currently building manufacturing facilities in Spain and the US, with deployment targeted to start in Mexico.[154]

(b) Low-Profit Limited Liability Companies (L3Cs)

Low-Profit Limited Liability Companies (L3Cs) are similar to CICs. They are a new legal form established in the United States of America that "combines the financial advantages of the Limited Liability Company with the social advantages of a non-profit entity."[155] An L3C is an LLC that must

"significantly further the accomplishment of one or more charitable or educational purposes."[156] The Charter for an L3C must specify that "no significant purpose of the company is the production of income or the appreciation of property." Profit making, in other words, comes second to the organization's goals; it is entirely "organized for a business purpose and operated to significantly further charitable purposes."[157] Like CICs, L3Cs enable "greater access capital (a critical issue for social enterprise) that may have been restricted for nonprofits and cooperatives in the past."[158] But they differ from CICs in that they limit liability and protect members of the L3C from being personally liable for the debts of the company.[159]

"Low-Profit Limited Liability Companies is a new legal form that combines the financial advantages of the Limited Liability Company with the social advantages of a non-profit entity with one or more charitable or educational purposes"

L3Cs have the advantage of being able to promote a "socially and environmentally embedded mission" in the ways for-profit companies cannot. Even for-profit companies with a social purpose can dedicate only a meagre portion of their assets to it. Ben & Jerry's Ice Cream, one of the best known for-profit companies with a "social mission," was limited to committing no more than 7.5 per cent of its profits to a charitable foundation.[160] L3Cs can also operate with much longer time horizons with greater autonomy. For example one CEO of an L3C dealing with herbal teas recently argued he could expand the company faster if he were willing to compromise their social objectives — by finding lower cost suppliers, as one example — but that he refused to do so because it would trade-off with their reforestation efforts and prosperity among the company's employees.[161] L3Cs can therefore decide to pay above minimum rates for products, to source more sustainable products and to grow more slowly than ordinary firms, all while maintaining their autonomy. One way they do this is by frequently avoiding standard venture capital firms, which usually come with expectations of both control and rapid growth; surveys have indicated that 60 per cent of social entrepreneurs seek patient or long-term capital below market-rate equity and debt finance.

"L3Cs have the advantage of being able to promote a socially and environmentally embedded mission"

Though the L3C concept has these benefits, it does have its limitations. It must operate in conformity with requirements to "significantly further" charitable or educational purposes. No "significant purpose" of the company can be the production of income or the appreciation of assets. No part of the company can engage in political or legislative spending.[162] So far LC3 regulations exist at the state but not the federal level in the United States of America, creating some confusion and incongruity about whether the concept of an L3C is strictly legal. One recent review worried about the fact that L3Cs were not entitled to special treatment under federal law concerning programme related investments and as such, was "particularly harmful since such foundations may run afoul of various tax provisions and, indeed, may endanger their charitable status."[163] The hybrid nature of L3Cs can also create "clouds of confusion and difficulty for investors, managers, creditors, policy makers and regulators" given their novelty and complexity.[164] Indeed, some have been so against the concept that they have called it "an unnecessary and unwise contrivance," "nonsensical," and "useless."[165]

Notwithstanding these limitations, Vermont enacted the first L3C law in 2008 and since then its adoption has expanded. Though L3Cs are not popular in the energy sector, hundreds of firms have been registered in these states.[166]

(c) B Corporations

A final institution that can become more involved in potential energy access efforts, similar to CICs and L3Cs, is a "B Corporation," with the "B" standing "for-benefit." B Corporations use "the standard state law-defined, for-profit corporation as a model, but tweaks the model to pursue a more blended mission."[167] The non-profit B Lab, for example, offers to license its "B" trademark to companies that meet requirements indicating that they "use the power of business to solve social and environmental problems." To qualify, corporations must define "nonfinancial" goals in their charter and obtain approval of two-thirds of their shareholders.[168] Table 18 summarizes some of distinctions between B Corporations and traditional companies.[169]

"B corporations use the power of business to solve social and environmental problems"

Table 18.
Key distinguishing features between traditional firms and B corporations

	Organizational objectives	Relationships with suppliers, employees, and customers	Interaction with market competitors and industry institutions
Traditional firms	Addresses social and environmental issues only if the organization has the slack (e.g., resources, profit) and a strong business case	Cost factors are primary and relationships with suppliers, employees, and customers is functional and transactional	Activity is premised on creating markets for goods and services, appropriating and protecting competitive benefits, and altering industry standards for self-serving benefit
"Hybrid" firms such as B corporations, CICs, and L3Cs	Addresses explicit social and environmental issues by design, independent of resources and profit	Social and environmental outcomes are primary and relationships with suppliers, employees, and customers is mutually beneficial	Activity is premised on creating markets for social objectives, competing successfully with traditional firms, and altering industry standards to serve the social and environmental contexts where companies operate

B Corporations have tax benefits, giving "organizations greater protection from shareholder lawsuits that demand the prioritization of profits over social and environmental missions."[170] B Corporations must be organized as entities with an "other constituency" statute, meaning corporate directors must consider non-shareholder interests when making business decisions. It offers a slightly weaker structural enforcement of blended missions than CICs and LC3s, as it places requirements to pursue social goals into fiduciary mandates but leaves it up to shareholders to enforce those mandates (rather than, say, the CIC Regulator).[171]

(d) 5P SPVs

In its ongoing work, ESCAP has proposed leveraging existing legal mechanisms to establish a Special Purpose Vehicle (SPV) for small community-based projects. These small-scale investment vehicles may be established under the extant provisions of national laws while focusing on features of traditional Public-Private Partnerships (PPPs) such as risk-sharing, limited liabilities and, using discounted cash-flow methods towards financial closure. At the same time, it considers communities and NGOs as potential partners.

"5P SPVs leverages features of traditional public-private partnerships and the extant legal mechanisms under national context while considering communities and NGOs as potential partners"

The 5P SPV may be initially capitalized through a combination of contributions from private company, community based organization (CBO) and banks. While the equity contribution from a CBO may be a combination of cash, land and labour, the non-cash contribution from the community should be evaluated for its equivalent cash value. In addition, financial institutions may provide debt capital based on projected cash-flow and secured against project assets.

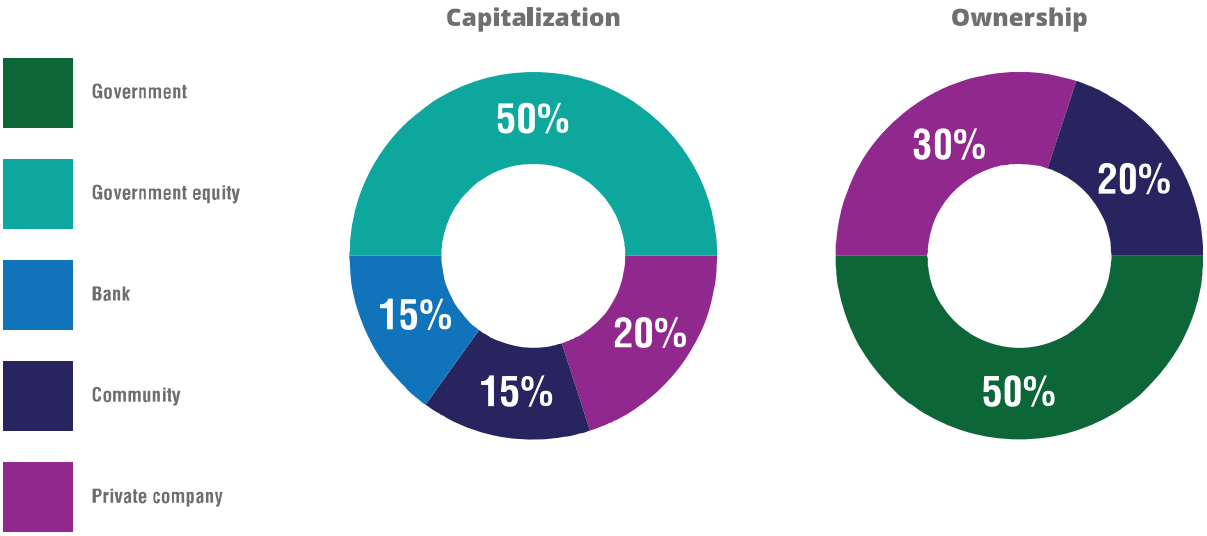
Consider that a biomass-to-energy project. In this case, community's contribution to provide the fuel (biomass) is critical to assume sustainability of project operations. This ongoing contribution by the community should be evaluated in its cash-equivalent to provide a realistic estimate of their equity contribution.

(i) Case of subsidy support

Should the project be partially capitalized through subsidy contributions from government agencies, the corresponding ownership structure should be drawn depending upon appropriate assumption of risks by partners and to support the objectives of the pilot project. Subject to national context, government agency may or may not assume an ownership role in the partnership vehicle.

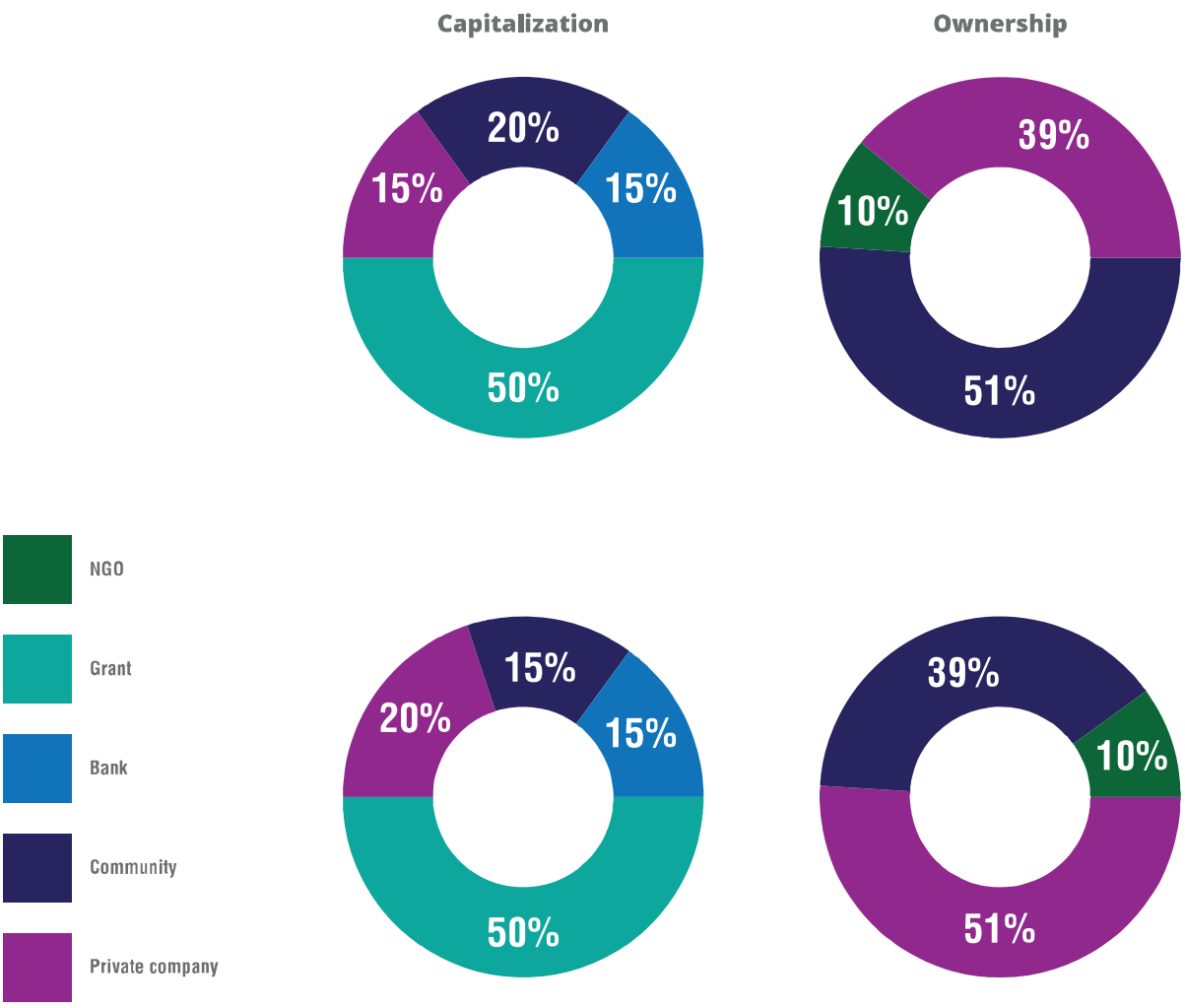
Scenarios of capitalization and ownership help to serve as a basis for consultations and negotiations amongst stakeholders. Figure 19[172] below depicts a few, with government equity or subsidy support.

Figure 19.
5P SPV: Capitalization with government ownership



In a case where the government does not assume an ownership role while providing subsidy support, an NGO's role may be enhanced to play a balancing act between the profit-seeking objectives of the private company and the social needs of a community. This is depicted in figure 20.[173]

Figure 20.
5P SPV: Capitalization without government ownership



B. Replicators

This part of the report presents twelve key design principles or best practices that can be utilized to replicate successful partnerships. This section suggests at least ten, in no particular order (though evidence suggests that all of them are important).

1. Create stable regulatory frameworks

Establishing a clear, stable and transparent legal framework appears to be an essential condition for attracting private capital in renewable energy generation. This, in particular, access to financing were emphasized at the conference, "Financing Low-Carbon Electricity in Latin America," organized by the e8 and ECLAC, held in Santiago, Chile, on 22-23 August 2011.

All the cases studied here feature such a regulatory framework. While each regulatory framework reflects the particular situation of the given country, they also have several points in common. In particular, they are all official governmental policies, which make them more stable in the face of changes in Government.

Because these projects are characterized by high investment costs and substantial risk, Governments need to establish financing mechanisms and agreements through which the purchase of the power generated is guaranteed for a long period and an agreed price. The majority of the programs studied feature contracts for the energy generated (or PPAs). PROINFA is perhaps the most prominent example, given its long history and the magnitude of the investments involved.

Access to financing is another critical point for these types of projects, again due to the high investment costs and risks involved. The programs presented herein provide insights in this area, as well. The loans offered by the Brazilian Development Bank (BNDES) in the context of PROINFA, as one example, were crucial for attracting the participation of the private sector. However, the guarantees required by the bank excluded many small and medium-sized enterprises from participating in the tender process. The rules of the game must thus be crystal clear, with the authorities spelling out the restrictions imposed and the incentives offered and with the private companies demonstrating the project's short- and long-term sustainability.

2. Select appropriate technology

Successful partnerships almost always choose appropriate technologies matched in quality and scale to the energy service desired. They usually do not set rigid requirements concerning eligible technology. They frequently start small with pilot programs or with feasibility studies before initiating full-scale projects and scaling up to greater production or distribution volumes. They lastly tend to promote or harmonize rigorous technical standards to ensure such technologies work as expected.

China's Renewable Energy Development Programme, for example, focused on whole-cycle quality improvement for solar panels and SHS. It executed a "start to finish" quality process by establishing manufacturing standards and practices, facilitating access to product certification and introducing a randomized testing regime which penalized companies at the production-line and retail stages for non-compliance with system performance requirements. These efforts strengthened the quality of SHS at multiple ends of the supply chain. This start to finish aspect is a key contribution of REDP, without which SHS sales may have accelerated anyway (since a growing market already existed and numerous other rural electrification projects were ramping up operations in neighboring areas), but might have stagnated in later years without lasting product quality improvements. It is also likely that participating companies would not have as quickly entered export markets had the quality standards not been imposed, especially those markets where international compliance is a threshold requirement.

Grameen Shakti in Bangladesh did not presume what customers wanted, it asked them and then involved them in its programs. In a way each programme targets those with different energy service needs and eligible technologies vary by price. Those with livestock, straw, dung, corn, agricultural waste and poultry can subscribe to biogas, those in need of light or television a SHS, those using prodigious amounts of fuel wood an ICS. Within each programme, participants can select fiberglass or brick biogas units ranging from smaller household capacities to larger community-scale systems, SHS ranging from 10 Wp to 130 Wp (or even configured as micro-grids) and variously sized cook stoves. Big and expensive technologies, put another way, are not always needed to provide large segments of the population with energy services.

The Cinta Mekar Micro hydro Project in Indonesia chose an appropriately scaled and designed micro hydro system to meet the particular needs of the community.

The MHVE in Nepal focused as well on simple technologies matched in proper scale to energy end-uses. Rather than build new grids, micro hydro units in the range of 10 kW to 100 kW were simple to construct and able to be owned and operated by communities themselves.

Zambia's PV-ESCO Project relied on extensive surveying and feasibility studies to determine which locations were best suited to the partnership. Eastern Zambia was chosen only after a 1998 pilot survey showed that three-quarters of residents there said they were willing to pay to use solar electricity. This made demographic sense, since that part of the country had a wealthier rural population in addition to smaller service areas believed to build more trust and interaction between companies and customers.[174] The Project also started out small; the first company bought 100 solar systems, the second and third companies only 150 systems each during the first round of purchasing before scaling up in later years.

The Rural Electrification Project in Lao People's Democratic Republic relied on World Bank sponsored feasibility assessments well before it was implemented and India's Solar Lantern Project conducted willingness to pay studies of hawkers and other consumers to determine if they would pay more for solar energy than kerosene or dry cell batteries.

The essence of these partnerships is to provide consumers with energy choices and a variety of energy services, rather than presuming what they want, and then providing them with high-quality technology.

3. Promote community participation and ownership

Effective partnerships actively promote community participation and ownership; they do not "give away" renewable energy technologies or over-subsidize technology or research. (This lesson does not apply to the Zambian, Laotian and Indian case studies since these communities do not own renewable energy technology but instead pay a fee to use it).

China's Renewable Energy Development Programme gave market development funds but only if solar energy companies were willing to cover at least half of the costs with their own money. Because it is a company, Grameen Shakti must break even or operate at a profit in Bangladesh or it loses money and goes bankrupt. This is why households must make down payments on technologies and then pay off microfinance loans so that they own them, ensuring that sales of technology are autonomous and self-sustaining. The formula seems to work, with almost every customer paying their installments on time. Most of the participants in the German feed-in tariff are residential customers, municipalities and cooperatives which invest, individually or collectively, in wind turbines, solar panels and other renewable energy equipment. The Cinta Mekar Micro hydro Project in Indonesia relied on an innovative financing scheme which saw the community itself, through a cooperative, own half of the system with their own capital, which they replenish through a power purchase agreement with PLN to sell electricity to the grid.

The MHVE in Nepal necessitated community participation. Only communities expressing an interest and desire for energy participated and they had to know how to build, own, repair and manage a micro hydro unit before they were given one. These communities consequently made in-kind contributions to the scheme as well, including cash, labour and land, ensuring a blending of financial responsibility so that the national government, local banks, micro hydro functional groups, village development committees and communities all had a stake in each project. Communities provided their own cash, offered collateral for loans, dug channels, collected sand and built wooden poles for transmission and distribution of electricity. India's Solar Lantern Project saw cost sharing where 15 per cent of project capital came from entrepreneurs and 85 per cent from a three year low-interest loan by the State Bank of Mysore.

This lesson has been confirmed by one wide ranging survey of renewable energy markets in developing countries.[175] That study noted that donations without cost recovery can actually destroy markets. Many state-financed renewable energy projects following the "give technology away for free" model resulted in damaged technologies, since people tend not to take care of things they don't have to pay for. The study also found that such approaches can inhibit commercial markets as consumers come to expect more donor aid and will wait rather than pay market prices. It lastly found that subsidies are unlikely to

lead to sustainable markets unless they explicitly create conditions whereby they are no longer needed and that they can undermine private investments.

Having local communities pay for renewable energy projects with their own funds means they express interest and responsibility in how they perform; they become not only passive consumers, but active participants. Contributions do not have to be financial, either; communities and households can donate time (such as digging a canal), land (such as free property for the project site), or resources (such as wood for distribution poles). As the World Bank has noted, "participation of local communities, investors and consumers in the design and delivery of energy services is essential."[176]

4. Have robust marketing, demonstration and promotion activities

Successful partnerships do not take consumer awareness or information about renewable energy for granted.

China's REDP utilized a variety of grants to enable companies to improve advertising and marketing efforts related to wind and solar energy. Grameen Shakti in Bangladesh also takes a progressive stance towards community acceptance, promotion and advocacy. Grameen Technology Centers conduct large demonstrations of solar and biogas devices and GS employees sometimes embark on door to door visits to familiarize communities with technology. GS engineers consistently work with village leaders to distribute brochures, hold science fairs at local elementary schools and host workshops for policymakers. The advocates of the Cinta Mekar Micro hydro Project in Indonesia educated the village first about the various types of renewable energy available to them before they decided on a micro hydro dam; the MHVE in Nepaldid "road shows" where experts from the AEPC travelled around the country to inform villager leaders about how micro hydro worked. Solar technicians frequently interact with potential new customers through demonstrations in Zambia, the Rural Electrification Project in Lao People's Democratic Republic and India's Solar Lantern Project also relied on advertisements to ensure knowledge about each programme was disseminated.

5. Emphasize after sales service and maintenance

Successful partnerships strongly emphasize after sales service and maintenance, ensuring that technologies are cared for by rural populations or technicians.

China's Renewable Energy Development Programme improved the quality and availability of after-sales service at the township and provincial level. Once Grameen Shakti technicians in Bangladesh sell and install equipment, they do not leave it up to the consumer to care for it. GS runs a buyback system where clients can return their system at a reduced price to the organization and the organization gives free maintenance and training to all existing clients so that they can care for and maintain their systems by themselves. They teach each user how to properly maintain and conduct minor repairs and also offer a free warranty for the first few years of operation. They view the needs of households and customers as "never ending."

The Cinta Mekar Micro hydro Project in Indonesia trained village members in micro hydro maintenance and operations and the MHVE in Nepal trained village leaders in not only maintenance, but also opportunities for how to put energy services to productive use. The programme actually spent more on developing technical capacity and training than on technology. The ESCO components of Zambia's PV Project, the Rural Electrification Project in Lao People's Democratic Republic and India's Solar Lantern Project ensured that maintenance and battery replacement were formal parts of each programme, with responsibility clearly delegated to private sector participants.

6. Couple energy services with income generation

For rural and off-grid areas, the more effective partnerships couple energy services with income generation and employment, they don't just "wait" for it to occur.

China's Renewable Energy Development Programme offered nomadic herders tips on how they could use solar electricity not only for lighting but also to separate milk and cheese, charge mobile phones and refrigerate yoghurt. Grameen Shakti in Bangladesh recruits marginalized and socially disadvantaged groups, such as women and youths, to train as technicians and offer a scholarship competition for the

children of SHS owners. Also, GS has also done an excellent job linking its products and services to other local businesses and integrating its technologies with other programs. As one example, it connects the use of biogas units in homes and shops with the livestock, poultry, agriculture and fishery industries. Clients wishing to own their own biogas unit can also purchase livestock and clients that do not wish to use the fertilizer created as a byproduct from biogas units can sell it to local farmers, aqua-culturists and poultry ranchers. Similar linkages have been made in the promotion of GS's solar panels, mobile telephones, compact fluorescent light bulbs and light emitting diode devices. GS also set no restrictions on how consumers can use the energy provided by their technologies.

Part of the proceeds from the Cinta Mekar Micro hydro Project in Indonesia provide seed money so local enterprises can grow. Similarly programme managers at the MHVE in Nepal did not mandate what micro hydro electricity was used for and instead empowered communities to adapt systems to meet their own needs. In Dhading, where mustard won't grow, mechanical energy is used to husk rice. In Kavre, more agriculturally oriented, grinding and mustard seed expelling are given priority. In Lukla, a tourist destination home to hotels, tourist facilities consume most of the electricity.

In Zambia and Lao People's Democratic Republic, the services put to use by solar panels have increased the business of restaurants, hotels, teahouses and shops and in India such light has helped preserve food, flowers and other items sold by hawkers undamaged by kerosene fumes.

7. Effectively distribute risks

Effective partnerships distribute responsibilities among different institutional partners, involving a diversity of important stakeholders in each project, especially "non-state actors."[177] This allows for the sharing of risks as well as organizational multiplicity which can create "checks and balances" on other actors involved in the project.

For example, China's REDP involved actors at not only the global scale (World Bank and GEF) but the national scale (NDRC), provincial scale (Governments) and corporate scale (solar and wind manufacturers). Rather than run things from Dhaka, Grameen Shakti in Bangladesh has a network of

more than one thousand offices spread throughout the country. GS enrolls communities into renewable energy projects at the household and villager level but also engages district and national policymakers along with international donors and lending firms.

The Cinta Mekar Micro hydro Project in Indonesia involved members of civil society, a private company, the national utility, the national energy ministry and a community based cooperative. The MHVE in Nepal collaboratively works with various layers of community organizations, including Governments and social networks. To improve accountability and hedge against corruption, the programme was formally institutionalized in Village Development Committees, the lowest level of governance in the Federal Democratic Republic of Nepal and also Micro hydro Functional Groups, working committees that must meet at least once a month to maintain and manage each plant. District Development Committees and District Energy and Environment Sections share experiences as well, institutionalizing bottom up participation in the project. National actors like the AEPC and Ministry of Environment, Science and Technology, as well as global actors like the World Bank and UNDP, play significant roles as well.

Zambia's PV-ESCO Project involved two international donors, the Ministry of Energy and three local companies and the Rural Electrification Project in Lao People's Democratic Republic divided risks so that grid-expansion was carried out by EdL on a cross subsidization model but off-grid SHS were diffused out under an ESCO model. India's Solar Lantern Project analogously relied on a combination of NGOs (S3IDF), a private company (SELCO), a bank (State Bank of Mysore) and two local entrepreneurs.

8. Make energy services affordable

All successful case studies offered financial assistance to overcome the first cost hurdle related to renewable energy technology; in some cases these took the form of financing from microcredit, or self-help groups, or an ESCO model, or even direct tariffs to consumers. The emphasis is ultimately on affordability and service quality rather than technological deployment or installed capacity.

China's REDP investigated numerous mechanisms that would encourage consumer credit access for purchasing SHS. Various intermediaries were to be considered, including consumer banks, rural credit cooperatives and the PV companies themselves. Grameen Shakti's entire mission revolves around providing microcredit to rural homes so they can purchase SHS, biogas and improved cook stoves. Germany's EEG offers consumers and investors tariffs for electricity about the retail market rate so they can make a profit and rapidly pay off any loans related to their systems. The Cinta Mekar Micro hydro Project in Indonesia prioritized making electricity access affordable for low-income households. The MHVE in Nepal overcame the first cost hurdle through grants and Zambia's PV-ESCO project, SHS in Lao People's Democratic Republic and India's solar lantern project all overcome financing issues with their ESCO approach.

"All successful cases ultimately emphasize on affordability and service quality rather than technological deployment or installed capacity"

9. Develop local capacity

Effective partnerships build local capacity so that a self-sustaining renewable energy market can function without external support or dependence on international actors. Variants of this lesson include selecting partners that already have networks into rural areas; outsourcing to international consultants when capacity is lacking; and building the technical or managerial capacity of domestic firms and institutions. This view contrasts with an older view that believed a renewable energy transition would automatically occur as long as prices could be lowered beyond a certain threshold.[178] It can also be helpful to establish within countries a special Unit, usually within the Prime Minister's Office, dedicated to PPPs to enhance recognition of those partnerships and to enable them to be authoritatively implemented.

China's REDP sponsored private sector solar energy research and also enabled companies to build capacity in accounting, marketing, auditing, sales and promotion. Grameen Shakti in Bangladesh trains hundreds of technicians each year in renewable energy maintenance and the manufacturing of selected components. The Cinta Mekar Micro hydro Project in Indonesia saw the creation of an independent

community cooperative which was then trained in handling the daily activities of the dam. The MHVE in Nepal elected village leaders to learn how to manage micro hydro dams and Zambia's PV-ESCO Project targeted companies with existing networks into rural areas instead of urban companies that would have to undertake costly expansion programs. Such proximity to customers was a key element for success, so technicians could reach clients on bicycle or on foot. The Rural Electrification Project in Lao People's Democratic Republic actually outsourced project components to a French company IED. The Indian solar lantern project also witnessed international sponsors training local technicians in solar design, maintenance and battery charging.

10. Dynamically adjust responsibilities and targets

Though not all case studies validate this lesson, recognition that not everything can be planned and that partnerships will need to be altered to account for changing circumstances, has proven to be an important factor in overcoming implementation challenges. So has relying on feedback and monitoring to adjust programs or partnerships as needed, as well as flexibility in how programme goals or targets are met.

China's REDP ended up cancelling their finance component for SHS midway through because targets were being met without it. Grameen Shakti frequently conducts surveys and evaluations to ensure their programme targets are being met. Germany built flexibility into their feed-in tariff scheme through a formal review every three to five years, when new tariffs are adjusted. German regulators constantly monitored and adjusted FIT rules and rates differentiated tariffs by technology and started degression to keep prices low. To minimize uncertainty in the renewable energy market, these changes were implemented slowly and with input and feedback from manufacturers, power companies, environmental groups and other stakeholders.

The Cinta Mekar Micro hydro Project in Indonesia changed how they disbursed revenues from electricity exports after they met all of their initial targets in the first 17 months of operation. The MHVE in Nepal was restructured twice, in 2008 and 2009, due to an ongoing civil war throughout the

country. Zambia's PV-ESCO project has raised its leasing rates for solar panels twice since its inception to ensure that affordability of customers is balanced with the profitability of energy services companies. The Rural Electrification Project in Lao People's Democratic Republic revised their grid-connection targets midway through the programme and the Indian solar lantern project increased solar rates in 2008 to account for the climbing price of system components and of the kerosene lamps they were competing with.

Flexibility in programme design and management can also assist in expanding access and meeting goals. MHVE Sri Lanka's Energy Services Delivery Project in the Federal Democratic Republic of Nepal and the REP-I in Lao People's Democratic Republic all met this criterion, with separate components tailoring grid, micro-grid and off-grid solutions to local circumstances.

Part VI: CONCLUSION

A crucial aspect that has been neglected in traditional rural energy policies is the use of energy not only to meet basic needs (such as lighting and cooking) but also to power income generating activities such as food processing, irrigation and manufacturing. Investing in energy access improves public health, community and household productivity and reduces greenhouse gas emissions.

"Investing in energy access improves public health, community and household productivity and reduces greenhouse gas emissions"

Access to modern energy services produces benefits in improved living standards; livelihood opportunities and climate change mitigation that often far outweigh the costs of the programs themselves. Efforts to improve energy access not only meets basic needs, but also diversifies and expands sources of income, increasing both the scope of local employment and the status of skill development and training. Moreover, expanded access can improve the resilience of poor communities to handle other social and economic setbacks such as natural disasters or the closure of local factories, enabling them to prosper rather than merely survive. The unit cost of energy decreases as one move up the energy ladder. This trend is related largely to improvements in efficiency as well as the reduced effort required for energy access, freeing up time and income for other needs and aspirations. Furthermore, high-speed transportation, telecommunications, information technology and a variety of things that make life better depend on electricity; none of them can function on traditional fuels.

"Access to modern energy services produces benefits in improved living standards; livelihood opportunities and climate change mitigation"

More and more Governments around the world acknowledge the benefits of renewable energy for providing access to energy, particularly in rural areas of the developing world. The welcome forecast is that during the period through 2035, renewable energy deployment is on the rise. It is driven by incentives, falling costs, rising fossil fuel prices and, in some cases, carbon pricing. A main driver propelling renewable energy policies is their potential to create jobs.

"Governments around the world increasingly acknowledge the benefits of renewable energy in rural areas"

However, expanding renewable energy access for rural and increasingly poor communities is a daunting task. Those without electricity or dependent on traditional fuels tend to have income levels, purchasing power and consumption levels far below what private companies and electric utilities typically deem profitable. The reluctance to invest is further attenuated by the inaccessibility of these communities to national electricity grids. Public officials, like their private counterparts, prioritize investments in urban infrastructure and often subsidize grid electricity to existing customers instead of expanding access or incorporating off-grid technologies. Many international donors continue to focus only on pushing particular technologies instead of holistically utilizing energy services to improve standards of living and productivity.

Public-private renewable energy partnerships, however, can overcome many of these difficulties and have shown, through the eight case studies presented in this report, to rapidly expand energy access and meet millennium development goals simultaneously. Ultimately, the public-private partnership model of renewable energy diffusion can be effective at meeting national and programmatic targets for electrification and access, sometimes ahead of schedule and below cost.

"The public-private partnership model of renewable energy diffusion can be effective at meeting national and programmatic targets for electrification and access, sometimes ahead of schedule and below cost"

We know that the inclusion of multiple stakeholders in programme design, implementation and evaluation can enhance the efficacy of renewable energy deployment. The involvement of women's groups, multilateral donors, rural cooperatives, local Government, manufacturers, nongovernmental organizations and other members of civil society and even consumers can increase both the performance and legitimacy of partnerships. They improve performance since input from multiple stakeholders can accelerate feedback; they improve legitimacy since programs with a broader base of support, and community involvement, are less likely to be opposed or protested.

Most successful partnerships appear to follow a set of shared attributes. The box highlights the recommended practices to developing schemes for public-private renewable energy partnerships.

a. Establish a formal national energy development plan protected by a strong legislative framework, with targets for clearly identified and defined PPPs. These policies help stimulate investment, establish stable regulatory and legal frameworks and provide incentives and financing for these technologies;

b. Provide cost recovery guarantees on invested capital through national energy plans backed by legislation and regulation that establish a commitment to the promotion of renewable technologies;

c. Promote the use of Power Purchase Agreements (PPAs) with the private sector to reduce the uncertainty of long-term investments;

d. In PPP policies, include a component for the shared funding of research and development of emerging renewable technologies to complement the production chain;

e. Optimize the private sector's ability to attract financing to design, build, maintain and operate electric works. Expand the private sector's options for financing renewable energy projects;

f. Set long-term goals. One of the key strengths of the public sector is the ability to develop long-term, low-risk policies that can attract investors and developers to renewable energy projects;

g. Maintain strong partnerships between the public and private sectors through effective communication, well-defined roles and responsibilities and a continuous commitment.

We know that the most effective way to expand access to renewable energy through partnerships necessitates a shift in how most development practitioners conceive of energy technology and programme structure.[179] Effective partnerships emphasize markets and energy services for customers, rather than technologies. They go beyond merely equipment supply to assess income generation, applications and user focuses. They consider the economic viability of renewable energy technology as only one piece of the puzzle alongside policy formation, financing, institutional capacity and social needs. They usually require national or local champions, either in the form of institutions or individuals. Successful partnerships share not only the rewards of building sustainable renewable energy markets, but also the risks.

"Successful partnerships share not only the rewards of building sustainable renewable energy markets, but also the risks"

Importantly, we know that investments in renewable energy bring benefits that far exceed their costs. In some cases these include improvements to household income and standards of living, in others productivity and community development. In others they bring technological reliability and quality and reductions in cost. In still others they encompass significantly reduced greenhouse gas emissions and rates of deforestation. Investments in renewable energy technologies and programs represent one of those rare cases where not only households and small enterprises benefit, but also companies, regulators and society at large.

"Investments in renewable energy bring benefits that far exceed their costs"

Public-private renewable energy partnerships continue to play an increasingly important role to overcome investment and business barriers while distributing risks and returns appropriately. In support, there is a need to enhance the awareness on and understanding of innovative models such as the pro-poor PPPs (5Ps) concepts, especially among policy/decision-makers, local communities and private investors. Policies to support formation of relatively smaller-scale investment-vehicles for rural areas need review and, as applicable, reforms. Institutions need capacity development to help improve access to financing for the private sector to invest in rural renewable energy area. And, as with any multi-stakeholder initiative, generating political-support remains a crucial process.

ANNEXES

Annex I: Global institutions involved in facilitating energy access

(Excluding bilateral development agencies such as USAID or GIZ and corporations) Institution Acronym Central Location Primary Function Description

Institution	Acronym	Central Location	Primary Function	Description
United Nations System	UN	New York, USA; Vienna, Austria; Geneva, Switzerland	Building international peace and security as well as promoting social progress, better living standards and human rights	UN Secretariat and many UN agencies are working on various energy issues. The newly formed umbrella UN Energy is intended to coordinate their efforts
Global Environment Facility	GEF	Washington DC, USA	As the world's largest public environment fund, the GEF sponsors environmental projects, through grants to developing countries, for biodiversity, climate change, international waters, deforestation and biodiversity loss. GEF was made independent of the World Bank in 1994	GEF is the entrusted financier for projects br the United Nations Framework Convention on Climate Change as well as several other international conventions relating to energy. It has so far allocated almost $9 billion in funds including $40 million as part of a Least Developed Countries Fund for Climate Change and the Special Climate Change Fund
International Energy Agency	IEA	Paris, France	To establish a reporting system on oil prices and create an emergency oil-sharing system and to serve as a key information source on energy	The IEA has been relatively successful at coordinating national action among oil consuming countries, although membership excludes such key oil consumers as China and India. It is the primary producer of global energy statistics and is moving to address broader energy and climate topics
International Renewable Energy Agency	IRENA	Abu Dhabi, United Arab Emirates	Charged with promoting renewable energy among its 142 member countries	Although only about two years old, IRENA has already begun developing a knowledge base of best practices for renewable energy promotion, providing policy advice, facilitating technology transfer and financing and stimulating research on all aspects of renewable energy
World Council for Renewable Energies	WCRE	Bonn, Germany	Promotes renewable energy through information, agenda setting and networking.	A precursor to IRENA, WCRE still plays a role providing analysis on the international barriers to renewable energy, providing advice on renewable energy targets, evaluating the performance of commercially available technologies and identifying best practices in renewable energy promotion

Institution	Acronym	Central Location	Primary Function	Description
Global Energy Network Institute	GENI	San Diego, California	Dedicated to promoting the interconnection of national electric power networks so that renewable energy resources can be integrated on a regional and global scale	Focuses on raising awareness about the benefits of high voltage interconnected electricity transmission networks through research, including electric power maps, simulations and visualizations developed in partnership with the World Resources Simulation Center
Asian Development Bank	ADB	Manila, Philippines	To facilitate economic development and reduce poverty among its member countries	The ADB has provided billions of dollars of energy infrastructure lending and restructured energy and electricity markets. Historically, ADB has invested in capital-intensive technologies and fossil fuels, but there is some evidence of a shift now in priorities to renewable energy and energy efficiency
European Bank for Reconstruction and Development	EBRD	London, United Kingdom of Great Britain and Northern Ireland	Supports projects in Eastern Europe and Central Asia by investing in private sector clients and encouraging free market mechanisms	Provides loans for conventional infrastructure and electricity networks and also launched the Sustainable Energy Initiative in 2006, with key focus on investing about €6 billion in energy efficiency and cleaner forms of energy supply
African Development Bank	AfDB	Abidjan, Côte d'Ivoire	Invests in poverty reduction and sustainabl development projects in its regional member countries	Focused mostly on energy development and power sector reform, enhancing export opportunities for its members and increasing equitable access to energy services
The Inter-American Development Bank	IDB	Washington DC, United States of America	The multilateral development bank for Latin America and the Caribbean	Aims to promote regional energy integration an investments in energy infrastructure, also launched a Sustainable Energy and Climate Change Initiative in 2008 to offer $1 billion in loans for energy efficiency, renewable electricity and bio fuels
World Bank Group	WBG	Washington DC, United States of America	Umbrella organization, consisting of International Bank for Reconstruction and Development, International Development Association, International Finance Corporation, Multilateral Investment Guarantee Agency and the International Centre for Settlement of Investment Disputes, that funds and provides technical expertise to development projects (wide ranging) in developing countries aimed at fighting poverty and promoting foreign direct investment	Much larger than the other multilatera development organizations, the WBG offers billions of dollars of loans each year for energy development, mostly in conventional (and fossil fueled) infrastructure. In recent decades, the World Bank has been looking into how to improve energy access for developing countries, in a sustainable way

Institution	Acronym	Central Location	Primary Function	Description
Organización Latinoamericana de Energía	OLADE	Quito, Ecuador	Developing energy security and sustainable development for South America, Central America and the Caribbean	Initially conceived as a platform for encouraging energy integration and created by the Lima Agreement, OLADE now manages a number of projects related to renewable energy and energy efficiency planning, capacity building and training, information systems and electricity development
Association of Southeast Asian Nations	ASEAN	Jakarta, Indonesia	Aims to unify the geopolitical region of Southeast Asia and encourage economic growth, social progress, political stability and peace	Manages several energy centres and ministerial meetings including a Council on Petroleum, an Energy Research Centre and often brokers bilateral and multilateral agreements between its members and also between Southeast Asia and major energy exporters and importers
Organization of the Black Sea Economic Cooperation	BESC	Istanbul, Turkey	Encourages economic and political interaction and harmony between its 11 member states around the Black Sea, with observer status given to several other countries including the United States of America	Their plan of action on energy consists of ensuring energy security for each other, integration of an energy market through harmonizing legislation, adopting best practices in environmental standards, research, demonstration and investment in energy efficiency, developing renewable energy and micro-generation and promoting regional energy exports globally
Southern African Development Community	SADC	Gaborone, Botswana	Its 14 member states aim to develop regional economies, reduce poverty and harmonize economy and trade policies and have reduced internal trade barriers and are working towards a single currency	The organization actively promotes larg-scale electricity and transmission projects such as the Southern African Power Plant Western Corridor Transmission Project and other regional electricity interconnections as well as a regional petroleum and gas association between Angola, Botswana and the Democratic Republic of the Congo and coordinated rural energy planning
Asia-Pacific Economic Cooperation	APEC	Singapore	A non-binding intergovernmental group of 21 economies, including all Asian majors, whose primary focus is to reduce trade barriers and improve investments and exports among members	Set up the energy security initiative in 2000, which includes data sharing and the Joint Oil Data Initiative to counter supply disruptions. Their Sydney declaration in 2007 focused on climate change and energy security. Their action agenda includes several goals such as improving energy efficiency, increasing forest cover and strengthening low-carbon energy technology

Institution	Acronym	Central Location	Primary Function	Description
South Asian Association for Regional Cooperation	SAARC	Kathmandu, Nepal	To facilitate trade and regional cooperation between Bangladesh, Afghanistan, Bhutan, the Federal Democratic Republic of Nepal, India, Sri Lanka, Pakistan and the Maldives	Committed to a number of energy related goals including strengthening South Asia's capacity to address energy problems, enhancing energy trade, establishing regional electricity grids and natural gas pipelines and encouraging investments in renewable energy and energy efficiency
Central Asia Regional Economic Cooperation	CAREC	Manila, Philippines	A unique consortium funded by 8 nationa Governments and 6 multilateral organizations (including the ADB and WBG) dedicated to reducing poverty and improving infrastructure development	Mobilizes about $2.4 billion in capital each year to be invested in roads, transport, water and electricity
International Energy Forum	IEF	Riyadh, Saudi Arabia	Although its first summit was held in 1991 hosted by France and Venezuela (Bolivarian Republic of), its formal secretariat was established following the Osaka Announcement in 2002. The IEF is the world's largest recurring gathering of energy ministers	Holds forums designed to focus attention on key global energy issues and also coordinates the Joint Oil Data Initiative along with efforts from other organizations such as APEC, IEA, OPEC and OLADE
Renewable Energy and Energy Efficiency Partnership	REEEP	Vienna, Austria	To reduce greenhouse gas emissions, improve access to reliable and clean forms of energy in developing countries and promote energy efficiency	Has formed partnerships with more than 12 Governments, banks, businesses, nongovernmental organizations and IGOs and invested €16.4 million in more than 145 projects. However, REEEP implements only small-scale projects and lack of permanent funding forces the agency to focus on the short-term
Global Network on Energy for Sustainable Development	GNESD	Roskilde, Denmark	To serve as a knowledge network of developing world Centers of Excellence and network partners whose main objective is reach the UN's Millennium Development Goals	Oriented to address energy access issues and promote renewable energy technologies that reduce poverty. Mainly conducts workshops and publishes reports on energy and poverty Asia, Africa and Latin America
International Network on Gender and Sustainable Energy	ENERGIA	Leusden, Netherlands	Informal international network working on gender and sustainability issues. Modus operandi is regionalization of activities through networks.	Focused entirely on empowering rural and urba women through the use of energy. ENERGIA offers three types of primary assistance around the world: placing gender and energy issues on the international agenda for countries and development institutions (including national gender audits), building capacity on gender integration and energy through training materials and workshops and conducting research and analysis on case studies and the gendered impacts of energy production and use

Institution	Acronym	Central Location	Primary Function	Description
Appropriate Infrastructure Development Group	AIDG	Boston, United States of America	To improve access to electricity, sanitation and drinking water	Provides business incubation loans betwee $10,000 and $100,000 aimed at procuring energy equipment and technology, providing education and training on energy use and serving as seed money for energy startup companies
International Network for Sustainable Energy	INFORSE	Hjortshoj, Denmark	Established as part of the Rio Convention, INFORSE represents a network of 140 NGOs operating in 60 countries and is funded by a mix of national Governments, multilateral institutions and civil society organizations. The organization is dedicated to promoting sustainable energy and social development	Focuses on four areas: raising awareness about sustainable energy use, promoting institutional reform among national Governments, building local and national capacity on energy related issues and supporting research and development
World Business Council on Sustainable Development	WBCSD	Geneva, Switzerland	Also founded at the 1992 Rio Earth Summit, WBCSD is a global association of some 200 companies and 55 partner and regional organizations dealing with business and sustainable development that sees its primary function as advocating for businesses and influencing policy	Aims to create a platform for companies to explore sustainable development best practices, share knowledge and advocate business positions. Also manages a variety of business sponsored projects including energy efficiency in buildings, water, cement, electricity supply, forest products, mining and minerals and tires
Global Village Energy Partnership	GVEP	London, UK	Seeks to reduce poverty through accelerated access to modern energy services through its 2,000-plus members which include a mix of private companies, national Governments, development agencies, multilateral financial institutions and universities	Committed to forming partnerships from the bottom up at the community and municipal level to increase energy access and also build capacity to adapt to climate change
Energy Through Enterprise	E+Co	Bloomfield, New Jersey	Focuses on clean energy innovation by partnering multilateral financial institutions with NGOs and the private sector through eight international offices to implement projects in 20 developing countries	Provides debt and equity to support the expansion of energy services to rural populations around the world through the use of entrepreneurs
Global Energy Efficiency and Renewable Energy Fund	GEEREF	European Investment Bank, Luxembourg	Created by the European Commission to promote public-private partnerships in clean energy through private equity funds to small- and medium-sized enterprises in emerging economies	Has so far leveraged or disbursed about $200 million in more than 20 projects in the developing world

Institution	Acronym	Central Location	Primary Function	Description
Small-Scale Sustainable Infrastructure Development Fund	S^3IDF	Cambridge, Massachusetts	Promotes a Social MerchantBank approach to help local entrepreneurs create micro-enterprises that provide infrastructure services to the poor	Has so far built a portfolio of almost 200 small investments and associated enterprises in India with an additional 100 projects in the pipeline
World Energy Council	WEC	London, United Kingdom of Great Britain and Northern Ireland	Charged with promoting sustainable energy and energy access through research and analysis, energy projections and recommendations in 93 countries	Produces publications, hosts conference and arranges meetings covering all major energy sources, including electrification and off-grid sources, as well as a World Energy Conference once every three years
International Fund for Agricultural Development	IFAD	Rome, Italy	Combats rural hunger and poverty in developing countries through low-interest loans and direct assistance	Works with the rural poor, Governmens, donors and NGOs to improve rural access to biogas and SHS units and to reduce drudgery and "lighten the load" for rural women
Solar Electric Light Fund	SELF	Washington, DC, United States of America	Created to empower people in developing countries to escape poverty harnessing energy from the sun	Has established more than a dozen se-sustaining solar energy projects in eleven countries spread across Asia, Africa and South America
Acumen Fund	AF	New York, United States of America	Formed to reduce poverty by investing in social enterprises and "breakthrough" ideas in the health, water, housing, energy and agriculture sectors	Approves about $6 million per year in social enterprise funds for micro hydro, solar, biogas, biomass and lighting projects in India, Pakistan and East Africa
Global Alliance for Clean Cook stoves	GACC	Washington, DC, United States of America	Committed to saving lives, improving livelihoods and addressing climate change by creating a thriving global market for fuel efficient cook stoves	Backed by the U.S. Department of State, the United Nations Foundation and more than 200 other partners from the public, private and non-profit sectors, the Alliance has set the goal of distributing 100 million cleaner cook stoves by the year 2020
Green Climate Fund	GCF		A fund emerging from the Conference o Parties (COP) climate change discussions at Copenhagen, Denmark and Durban, South Africa to coordinate and consolidate funding on climate change mitigation and adaptation	Attempts to harmonize ongoing global financing efforts related to energy and transport infrastructure (among others) from the World Bank, Global Environment Facility, the Adaptation Fund, the Clean Development Mechanism of the Kyoto Protocol and the G8
Yansa Community Interest Company	YCIC	Mexico City, Mexico	A community interest company focused on "social impact" and "responsible investment" in the environmental sustainability sector	Promotes technology, capacity development, training and management to build and operate community-scale wind farms throughout Central and South America

Institution	Acronym	Central Location	Primary Function	Description
La Via Campesina	LVC	Jakarta, Indonesia	Informally known as the "international peasants movement," the group consists of about 150 organizational members which coordinates migrant workers, farmers, rural women, indigenous communities on rural development issues	Possesses "sustainable agriculture," "water," and "women and human rights" programs that all deal with various aspects of rural energy use, especially the connections between food security and bio fuels
Global Sustainable Energy Islands Initiative	GSEII	Washington, DC, United States of America	Created during the Sixth Meeting of the Conference of Parties at the UNFCCC, GSEII works with NGOs and multilateral institutions to help small island developing states address energy security and climate change issues	Has helped nine small island developing states build capacity, increase awareness and implement energy efficiency and renewable energy projects. It has spent about $1 million on the preparation of national energy plans, biofuel feasibility studies, energy efficiency training and renewable energy projects
Clean Energy Ministerial	CEM	Various	A high-level forum to promote policies and programs that advance clean energy technology, share lessons learned and encourage sustainable energy transitions	Creates and implements action plans on three global climate and energy goals: improving energy efficiency, enhancing clean energy supply and expanding energy access. Currently manages 14 current initiatives including a Global Superior Energy Performance Partnership for commercial buildings, a Clean Energy Education & Empowerment (C3E) women's initiative and a Solar and LED Energy Access Programme (SLED)
Lighting Africa Programme	LAP	Washington, DC, United States of America	A joint World Bank -International Finance Corporation programme launched with the aim of improving access to clean and affordable lighting throughout Africa	Mobilized at meeting the goal of distributing high quality clean lighting to 2.5 million people from 2007 to 2012 and to 250 million people by 2030
Global Lighting and Energy Access Partnership	Global LEAP	Washington, DC	A partnership founded by the U.S. Department of Energy, Italy's Ministry of Land and Sea, the World Bank, the International Finance Corporation, the UN Foundation, the Energy and Resources Institute , the African Development Bank, the Global Environment Facility, the UN Development Programme and Japan's Ministry of Economy, Trade & Industry, as well as more than 100 private sector and civil society organizations, to encourage access to clean lighting	Aims to catalyse the market and product development for off-grid energy products and services. Is currently managing $4.5 million to distribute 500,000 solar LEDs throughout India from 2012 to 2015

Annex II: Global Institutions involved in promoting energy efficiency

Institution	Acronym	Central Location	Primary Function	Description
Renewable Energy and Energy Efficiency Partnership	REEEP	Vienna, Austria	To reduce greenhouse gas emissions, improve access to reliable and clean forms of energy in developing countries and promote energy efficiency	Has formed partnerships with more than 12 Governments, banks, businesses, nongovernmental organizations and IGOs and invested €16.4 million in more than 145 projects. However, REEEP implements only small-scale projects and lack of permanent funding forces the agency to focus on the short-term
Efficient Energy for Sustainable Development Partnership	EESD	Washington DC, United States of America	Launched as part of the world summit on sustainable development by U.S. Department of Energy, the EESD intends to improve the productivity and efficiency of energy systems. Its partners include businesses, NGOs, academia and financial institutions	Focused on increasing overall energy efficiency by 10 per cent or more in 20 countries by 2012
International Institute for Energy Conservation	IIEC	Vienna, Virginia, United States of America	To assist both the public and private sectors in implementing energy efficiency, transportation and environmental policies. Funded by community groups, national Governments and members of civil society	Conducts work on standards and labels, demand side management, climate change mitigation and adaptation, transport planning, energy efficiency and pollution prevention, renewable energy and water
Clinton Climate Initiative	CCI	New York, NY, United States of America	Part of the William J. Clinton Foundation, CCI manages an extensive programme to undertake building retrofits, improve outdoor lighting, reduce waste, measure GHG emissions, encourage non-motorized transport and promote "climate positive" communities in major cities, conducts research on carbon capture and storage and concentrating solar power and works with Cambodia, Guyana, Kenya, Indonesia and the United Republic of Tanzania to prevent deforestation	Brings stakeholders from industry (such as energy service contractors and the manufacturers of energy efficient equipment), the public sector (municipal and city Governments) and finance (banks and lending agencies) to conduct climate-related projects in 40 metropolitan areas; Forestry project has also teamed up with university research institutes and Government agencies
Global Energy Efficiency and Renewable Energy Fund	GEEREF	European Investment Bank, Luxembourg	Created by the European Commission to promote public-private partnerships in clean energy through private equity funds to small- and medium-sized enterprises in emerging economies	Has so far leveraged or disbursed about $200 million in more than 20 projects in the developing world

Institution	Acronym	Central Location	Primary Function	Description
Collaborative Labelling and Appliance Standards Programme	CLASP	Washington DC, United States of America	To foster economic development, stimulate global trade and alleviate poverty through the use of standards and labels	Funded by a variety of organizationsincluding the U.S. Government, World Bank Group and United Nations, CLASP assists with the implementation of various standards and labels relating to energy and energy efficiency technologies and services
Global Sustainable Energy Islands Initiative	GSEII	Washington, DC, United States of America	Created during the Sixth Meeting of the Conference of Parties at the UNFCCC, it works with NGOs and multilateral institutions to help small island developing states address energy security and climate change issues	Has helped nine small island developing states bld capacity, increase awareness and implement energy efficiency and renewable energy projects. It has spent about $1 million on the preparation of national energy plans, biofuel feasibility studies, energy efficiency training and renewable energy projects
Clean Energy Ministerial	CEM	Various	A high-level forum to promote policies and programs that advance clean energy technology, share lessons learned and encourage sustainable energy transitions	Creates and implements action plans on three global climate and energy goals: improving energy efficiency, enhancing clean energy supply and expanding energy access. Currently manages 14 current initiatives including a Global Superior Energy Performance Partnership for commercial buildings, a Clean Energy Education & Empowerment (C3E) women's initiative and a Solar and LED Energy Access Programme (SLED)
Lighting Africa Programme	LAP	Washington, DC, United States of America	A joint World Bank -International Finance Corporation programme launched with the aim of improving access to clean and affordable lighting throughout Africa	Mobilized at meeting the goal of distributing high quality clean lighting to 2.5 million people from 2007 to 2012 and to 250 million people by 2030

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Note

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United Nations
ECLAC

الاسكوا
ESCWA
الأمم المتحدة - اللجنة الاقتصادية والاجتماعية لغربي آسيا
United Nations Economic and Social Commission for Western Asia

United Nations
Economic Commission
for Africa

UNITED NATIONS
ESCAP
Economic and Social Commission for Asia and the Pacific

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ECONOMIC COMMISSION
FOR EUROPE