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STUDY

ACCESS TO ENERGY IN DEVELOPING COUNTRIES

Abstract

Despite the continuous efforts of developing countries and the international community to reduce energy poverty, some 2.7 billion people around the world still rely on traditional biomass for cooking and heating and 1.3 billion people do not have access to electricity. Over 80% of the energy poor live in rural areas and roughly two thirds in sub-Saharan Africa and India – the focus regions for this study. While fossil fuels will inevitably play a major role in expanding on-grid energy supply, this study shows that renewable energy sources – and especially small decentralised solutions – have huge potential for providing reliable, sustainable and affordable energy services for the poor, particularly in rural areas of developing countries. Many challenges remain, including financing, capacity building, technology transfer and governance reforms. A careful assessment of the environmental impacts of renewable energy technologies, particularly those on water, is an important prerequisite for donor finance. With the right design, energy access projects can also bring a host of developmental co-benefits. It should be possible for international initiatives including the UN's Year of Sustainable Energy for All and the EU's partnership with Africa to build on the rich experience and lessons learned from pilot projects over the last two decades in order to optimise donor effectiveness in this area.

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EXECUTIVE SUMMARY

Access to reliable, sustainable and affordable energy is instrumental to serve basic human needs and to foster economic and social development. Yet some 2.7 billion people around the world still rely on traditional biomass fuels for cooking and heating and 1.3 billion people do not have access to electricity. The majority of people in energy poverty live in rural areas in South Asia and sub-Saharan Africa. Meanwhile, parts of the developing world are undergoing rapid industrialisation, population growth and rising consumer demand, which will drive unprecedented power capacity additions over the next 20 years. Much of the new and planned generation will service mainly urban and industrial regions, further widening the gap between rich and poor.

Given these twin trajectories, energy poverty is receiving renewed attention amongst the international community, with an emphasis on economic, social and environmental sustainability. The United Nations has designated 2012 as its *Year of Sustainable Energy for All* with the goal of universal energy access by 2030. This is an opportunity for all stakeholders to better coordinate and catalyse existing and potential new initiatives to increase energy access globally. The European Union expects to make a major contribution here, given its regional energy partnership with African states, and its energy and climate technical and financing capacity. The EU can help to put universal energy access on the agenda in the context of the international climate change negotiations and to agree on related targets and roadmaps at the Rio+20 summit in June 2012.

The IEA and IIASA (both 2011) show that universal energy access is feasible with annual costs of between USD36-48 billion until 2030. More than half of these investments (up to more than 90% in IEA projections) will flow into electricity generation, transmission and distribution. Fossil fuels are likely to continue to play a role in providing access to electricity, especially where on-grid generation is feasible. However, centralised power capacity and grid extension targets have often failed to improve energy services for the poor. In the last two decades, a learning curve in projects aimed at increasing access to energy has shown that decentralised solutions are often more successful and cheaper. Small-scale mini-grid and off-grid generation activities in sparsely populated rural areas are proving particularly effective.

In this context the use of renewable energy technologies is essential for developing countries to reduce their dependence on fossil fuel imports and related price volatility, as well as to foster a sustainable, low-carbon and green economy. Decentralised renewable energy systems such as hydro, solar, wind and modern biomass provide the opportunity for clean and cost-effective electricity and heat generation in rural off-grid regions. Although beneficial in terms of greenhouse gas emissions reductions, large renewables projects (hydro or energy crops) can have severe social and environmental consequences to local populations. Within this context the impact of renewable energy projects on water resources have been assessed. In many developing countries water is an increasingly scarce resource and competition over it is set to intensify with the onset of climate change. For poor communities, access to clean water is especially critical – and a priority over energy – so it is crucial that energy projects are thoroughly evaluated for their impacts on clean water availability.

The sustainable introduction of renewable energy technologies in developing countries requires a range of supporting tools and processes. In poor rural settings without access to modern energy, the success of a project relies on host government, donor and implementer's efforts to build national and local level governance and regulatory capacity, develop local markets, raise public awareness and develop appropriate skills through training activities. Furthermore, technology transfer is facilitated with more stringent and widespread environmental policies and incentives for adoption of low-carbon technologies in developing countries. Developed countries can provide assistance with the national design and roll-out of such policies.

In terms of finance, a number of funds and mechanisms have been set up to handle the energy investment requirements for developing countries, in particular through the mechanisms related to reduce emissions created by the United Nations Framework Convention on Climate Change, from the Clean Development Mechanism to the newly established Climate Investment Funds. The influence of the EU will depend on the internal coordination between the member states, its own institutions and the bilateral development banks. Efforts have been already undertaken internally through better coordination within the European Development Funds and programmes run individually by member states. Recently new grant and loan blending facilities have reinforced the collaboration between member state donors, the EU institutions, the European Investment Bank and European bilateral development banks. Concrete examples are the blending instruments created for Africa and Asia (Infrastructure Trust Fund, Investment Facility for Central Asia and the Asia Investment Facility) that could be expanded and reinforced to increase the bankability of access to energy projects.

However, there is still some lack of clarity over how the EU's development investments and the new international funding mechanisms will be coordinated to deliver additional finance for access to energy and the EU's development strategy for energy is not fully defined. For example, the Infrastructure Trust Fund (ITF) – while an interesting concept in cooperation – only finances large cross-border regional projects and cannot intervene in local energy programmes.

In addition, with increasing focus on the use of public-private partnerships and attracting funds from private financiers, the financial attractiveness of local renewable energy projects may be further diminished. Such projects are less "bankable" than major, grid-connected projects, which often serve large industries. Services to more vulnerable, low-income population groups appear far riskier in terms of potential returns on investment. There are of course numerous policy and finance tools to enhance their bankability such as the feed-in-tariffs and other incentive schemes, which several developing countries are pursuing. The EU and some EU member states have an obvious technical advantage in these mechanisms and there is potential for increased coordination on experience sharing and technical training.

To ensure cost effectiveness, there is a need to analyse the best and most sustainable strategies for implementation based on needs and capacities on the ground. Experience has shown that in many cases, large-scale power generation projects (both fossil fuel and renewable) fail to benefit the poor. This study argues that the EU should promote a focus on clean, small-scale renewable energy technologies and the governance capacity building to enable replication and scale-up.

1. INTRODUCTION

Energy plays a crucial role in socioeconomic development. In much the same way that energy transitions provided for the industrial revolution and thus for increasing productivity and wealth in Europe, today's developing countries require access to affordable, reliable and sustainable energy services to fight poverty. Yet, some 2.7 billion people continue to rely primarily on traditional biomass fuels such as wood, dung and crop residue for cooking and heating and 1.3 billion people do not have access to electricity at all (IEA, 2011). Most of these people live in South Asia and sub-Saharan Africa (SSA), in the rural areas of the world's poorest countries.

The implications of energy poverty are manifold (see IIASA, 2011, WHO/UNDP, 2009, UNDP, 2007 and IEA, 2002). First, the extensive use of biomass entails numerous *economic costs*, direct and indirect. These include the costs of fuel wood and other sources of energy, the cost of using wood instead of modern fuels for cooking in inefficient stoves, reduced agricultural productivity due to the drain of potential fertilisers towards household use, and the opportunity costs of collecting biomass (instead of going to school or generating income). Second, there are severe *health risks* associated with the indoor use of solid fuels which lead to more than 2 million deaths per year (WHO/UNDP, 2009, Rao et al., forthcoming). Third, there is the *environmental dimension* resulting from the fact that fuel wood collection and charcoal production leads to ecological damage such as deforestation or reduced soil productivity. Fourth, there is a *gender dimension* because it is largely women and young girls that spend hours gathering traditional biomass. Women and children are also most exposed to the health effects of energy-inefficient appliances. Finally, insufficient access to modern energy sources in rural areas exacerbates *urbanisation*, putting additional pressure on cities to provide adequate services to their citizens and thus increasing the number of the urban poor further.

The reduction of energy poverty, although not one of the eight Millennium Development Goals (MDGs) itself, is thus vital for making progress towards most goals including the reduction of poverty and hunger, the elimination of gender disparities in primary and secondary education, the reduction of maternal health and child mortality and the achievement of environmental sustainability.

The European Union (EU) is providing assistance to increasing access to energy through a variety of initiatives, including the EU Energy Initiative (EUEI) and the related ACP-EU Energy Facility, the Africa-EU Energy Partnership (one of 8 partnerships of the Africa-EU Joint Strategy for development) and the Global Energy Efficiency and Renewable Energy Fund (GEEREF). On the international level, it is represented in the UN High Level Group on Sustainable Energy for All, which – inter alia – aims to develop an international agenda towards universal access to modern energy services within the context of the upcoming 2012 *International Year of Sustainable Energy for All*.

Against this background, this study first reviews the current status and projected future development of access to energy services in developing countries (Chapter 2). It then surveys current trends in donor financing for projects affecting access to energy and presents three case studies (Chapter 3). The study emphasises the role of renewable energy sources (RES) and assesses options to enhance their deployment in view of increasing access to energy in developing countries. Within this context, the study also looks at impacts of certain RES technologies on water resources (Chapter 4). Finally, Chapter 5 gives an assessment of the role of the EU in promoting sustainable access to energy vis a vis other development actors and its current funding mechanisms. The study concludes with a number of policy recommendations on how access to energy services can be enhanced in developing countries and on where EU action should focus on.

The study focuses on SSA and South Asia – India in particular, as the largest proportion of the world's people without access to modern and clean energy live in these regions.

2. OVERVIEW OF ENERGY ACCESS IN DEVELOPING COUNTRIES

There is no universally recognised definition or list of indicators to define "access to energy". As noted by IIASA (2011), modern energy access usually includes three forms of energy: less polluting household energy for cooking and heating, electricity for powering appliances and lights in households and public facilities, and mechanical power from either electricity or other energy sources that improve productivity of labour. A definition of "access to energy" should thus take into account the targeted beneficiary (e.g. households, public facilities, manufacturing, industry), the type of energy source provided (e.g. energy for cooking and heating, electricity, grid-connected or off-grid, fossil fuels or renewable energy sources), and the characteristics that make these energy services accessible (e.g. affordability, reliability, quality and adequacy) (IIASA, 2011).

A simple yet useful approach has been presented by the United Nations Secretary-General's Advisory Group on Energy and Climate Change (AGECC, 2010: 13), which defines universal energy access as "access to clean, reliable and affordable energy services for cooking and heating, lighting, communications and productive uses". Contrary to the AGECC (2010), the IEA (2011: 12) focuses solely on households and defines modern energy access as "a household having reliable and affordable access to clean cooking facilities, a first connection to electricity and then an increasing level of electricity consumption over time to reach the regional average". Both sources refer to clean cooking facilities mainly in terms of biogas systems, advanced biomass cooking stoves and liquefied petroleum gas (LPG) stoves. As regards a definition of minimum energy needs, there are no international norms for this indicator. IIASA (2011), however, reports that countries often define their own lifeline energy entitlements, which typically fall into the range of 20-50 kilowatt-hour (kWh) for electricity to households, 6-15 kg of LPG for cooking and 10-30 kWh of useful energy per square meter of living space for heating per year. These estimates differ from basic human energy needs defined in AGECC (2010), which are estimated at 50-100 kWh for electricity and 50-100 kg of oil equivalent for modern fuels and technologies for cooking and heating. The IEA (2011) has the highest initial threshold level of electricity consumption of 250 kWh per year for rural households and 500 kWh per year for urban ones. In comparison, average electricity consumption of a 3-person household in Germany is roughly 3900 kWh per year.

2.1 Present situation of access to energy in developing countries

2.1.1 Access to electricity

The IEA (2011) estimates that 1.3 billion people - over 20% of the global population - still lack access to electricity. The majority of these people live in South Asia and in sub-Saharan Africa, mostly in rural areas (Table 2.1). In many world regions, the absolute number of people without access to electricity has decreased in the past few decades. IIASA (2011) notes that between 1990 and 2008, almost 2 billion people gained access to electricity. Progress has been particularly pronounced in Latin America, North

Africa, the Middle East and East Asia. However, especially in SSA, population growth has outpaced electrification and the number of people without access to electricity increased (IIASA, 2011).

In India, some 289 million people live without access to electricity, or 75% of the population. 93% of these live in rural areas (Table 2.1). In recent years, India has added substantial additional electricity generation capacity. However, according to OCI et al. (2011), this additional capacity has not brought a sufficient increase in access to energy to the poor, particularly in rural areas. This is mainly due to income disparities between rural and urban areas, which are growing due to the increasing purchasing power of urban communities. As a consequence, in order to ensure that the demands of the urban centres are fully met, rural areas have often been neglected (OCI et al., 2011).

The greatest challenge, however, is in sub-Saharan Africa. Despite the fact that SSA has considerable energy resources, its electricity production and consumption levels remain low. Nearly 70% of the total inhabitants do not have access to electricity (IEA, 2011, Table 2.1). This means that less than a third of the population can benefit from electricity, the lowest level in the world. Countries with the lowest rate of electrification in SSA include DR of Congo (11% of the population have access to electricity), Tanzania (14%), Kenya (16%) and Ethiopia (17%) (IEA, 2011). Excluding South Africa, the electrification rate of SSA falls to 28%. To make a comparison with a developed country, the 19.5 million inhabitants of New York consume roughly the same quantity of electricity per year (40 terawatt-hours) as the 791 million people of SSA (excluding South Africa) (IEA, 2010; WHO/UNDP, 2009).

Bazilian et al. (2010) carried out a study analysing trends in installed electricity capacity in SSA. They found that installed electricity capacity in SSA (excluding South Africa) grew relatively steadily by an annual average of 1.7% over the last two decades. However, exact data on installed capacity, power plant output, and technical and non-technical transmission and distribution losses for SSA is often unavailable or inaccurate. For instance, several hydro power plants, such as the Kariba Dam of Zambia and Zimbabwe, date from the 1950s. Diesel generators in N'Djamena, Chad and Bissau, Guinea-Bissau are equally old. Due to wear and tear over time, the installed capacity can deviate significantly from the actual output capacity.

Table 2.1. Number of people without access to electricity (absolute number and share of population) by region in 2009 (millions)

	Rural	Urban	Total	Share of Population
Africa	466	121	587	58%
Sub-Saharan Africa	465	121	586	69%
Developing Asia	595	81	676	19%
India	268	21	289	25%
Developing countries*	1,106	208	1,314	25%
World**	1,109	208	1,317	19%

Source: IEA, 2011
**Includes Middle East countries; **Includes OECD and transition economies*

While the numbers provided in Table 2.1 give an indication of energy poverty in developing countries, it does not give the full picture due to the fact that even when access to electricity is provided, it is often unreliable and prone to power shortages and interruptions. For example, Mathanpura, a grid-connected rural village in India, experiences frequent power outages that can last 10 to 15 days (OCI et al., 2011). In SSA, cumulative average interruptions are estimated at three months of lost service per year (IEA, 2010) entailing economy-wide costs of up to 7% of GDP (Foster and Briceno-Garmendia in IIASA, 2011). Costs are mainly associated with the provision of costly diesel generators for back-up power. Unreliable power supply can also damage industrial equipment, reduce agricultural productivity, and reduce the time available for studying after sunset.

2.1.2 Access to clean cooking facilities

The IEA (2011) estimates that about 2.7 billion people – roughly 40% of global population - still live without clean cooking facilities. In SSA, some 653 million people rely on traditional biomass (wood, charcoal, tree leaves, crop residues and animal dung), equivalent to some 80% of the population. The dependence on traditional use of biomass is highest in DR of Congo, Tanzania (94% each) and Ethiopia (93%) (IEA, 2011). In India some 836 million people, or 72% of the population use traditional biomass for cooking (Table 2.2). In SSA, 73% of those relying on traditional biomass live in rural areas, in India the share is even higher at 90% (IEA, 2011).

Table 2.2. Number of people relying on the traditional use of biomass (absolute numbers and share of population) by region in 2009 (millions)

	Rural	Urban	Total	Share of Population
Africa	480	177	657	65%
Sub-Saharan Africa	476	177	653	78%
Developing Asia	1,680	240	1920	54%
India	749	87	836	72%
Developing countries*	2,221	441	2,662	51%
World**	2,221	441	2,662	39%

Source: IEA, 2011

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

IIASA (2011) reports that there has been little progress in expanding access to modern fuels and technologies for cooking and heating in developing countries over the past 25 years. In fact, it finds that "populations with no access to clean cooking fuels have continued to increase over the last decade, except in the case of China" (IIASA, 2011: 12).

2.2 Likely future developments without additional policies

Without additional policies aimed at increasing access to energy in developing countries, there will only be little progress towards reducing energy poverty. The IEA (2011), for example, in its New Policies Scenario,[1] estimates that the share of the global population lacking access to electricity will decline from 19% in 2009 to 12% in 2030. This still leaves more than 1 billion people without electricity, mostly in rural areas. The absolute number of people without access to electricity is expected to decrease in all world regions until 2030, with the only exception being SSA where population growth outpaces the rate of new connections. As a result, the number of people without electricity access increases in SSA from 586 million people in 2009 to some 645 million people in 2030. The share of people lacking access to electricity, however, declines also in SSA from 69% in 2009 to 49% in 2030. Progress in rural electrification will be slowest, as projected by the Global Energy Assessment (IIASA, 2011). Rural electricity access in SSA is expected to increase from 10% in 2005 to 15-30% in 2030 in the no new policies case.[2]

In terms of clean cooking fuels, the IEA (2011) in its New Policies Scenario estimates that the number of people without access to clean cooking facilities will remain at 2.7 billion in 2030, which is the same level as in 2009, however representing a smaller share of the global population (33%). Similar to the electricity case, there are improvements all over the world in terms of reducing the absolute number of people without clean cooking facilities, except in SSA. The IEA projects that the number of people without access to clean cooking facilities in SSA will increase by 40% to reach more than 900 million by 2030. The largest share of this increase will take place in rural areas. Both IEA (2011) and IIASA (2011) project that the percentage of the population dependent on fossil fuels will decrease until 2030. Yet, according to WHO/UNDP (2009) estimates, household air pollution from the use of biomass in inefficient stoves would still lead to over 1.5 million premature deaths per year by 2030. This is greater than estimates for premature deaths from AIDS or from malaria together.

2.3 Achieving universal access to energy in developing countries

The demand for energy services in developing countries is projected to increase rapidly in the coming decades, as the economies of those countries develop and populations grow. Yet, there is sufficient evidence that universal access to electricity and modern cooking facilities is possible, even in the face of economic growth and continued population growth in many developing countries. Several countries show that strong government commitment can lead to significant increases in the number of households with access to electricity over a relatively short period of time. Figure 2.3 shows the development of electrification rates in 10 countries. Some examples are particularly striking. Thailand achieved full electrification in a bit more than a decade (in the 1980s). Brazil also made considerable progress in the 1980s. However, taking the countries represented in Figure 2.3 into account, it seems that many countries need at least three decades to move to full electrification and others much longer (see also Bazilian et al., 2010).

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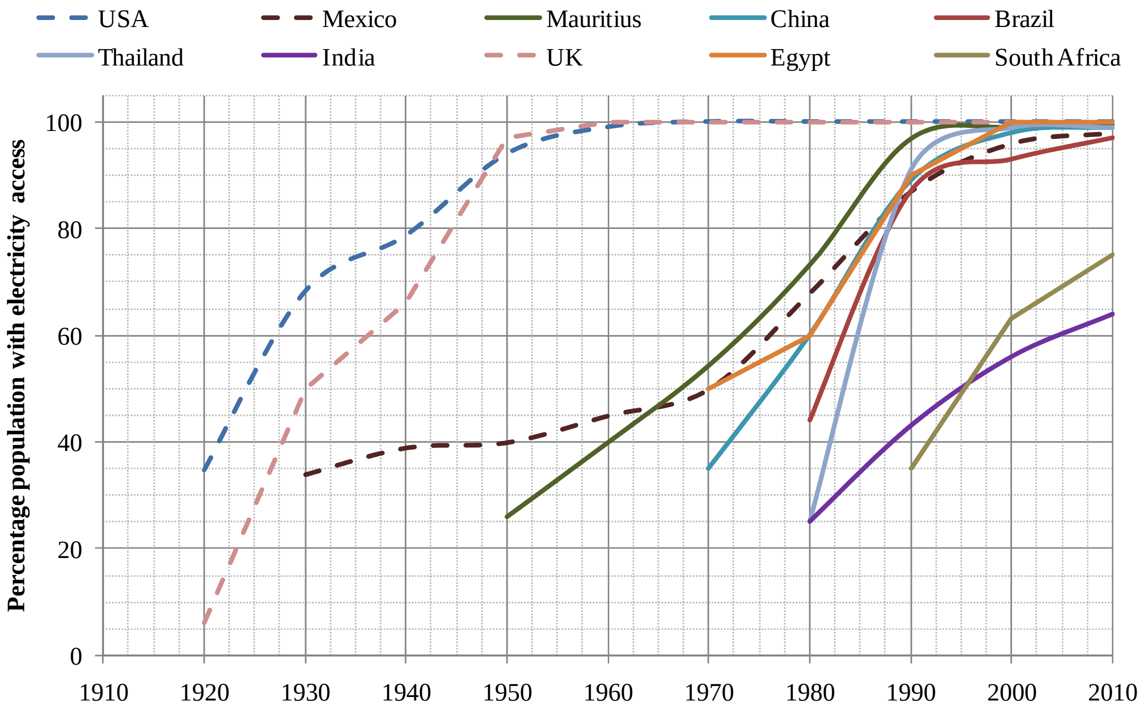
[1] The New Policies Scenario is one of the three scenarios for the world's energy future calculated by the International Energy Agency (IEA). It is based on current policies and new policy commitments that have already been announced.

[2] It should be noted that IEA's New Policy Scenario is not fully compatible with IIASA's No New Policy case, however, they both project a world without much additional efforts to combat energy poverty and are thus included here to give a broader picture.

Figure 2.3. Evolution of household electrification over time in selected countries



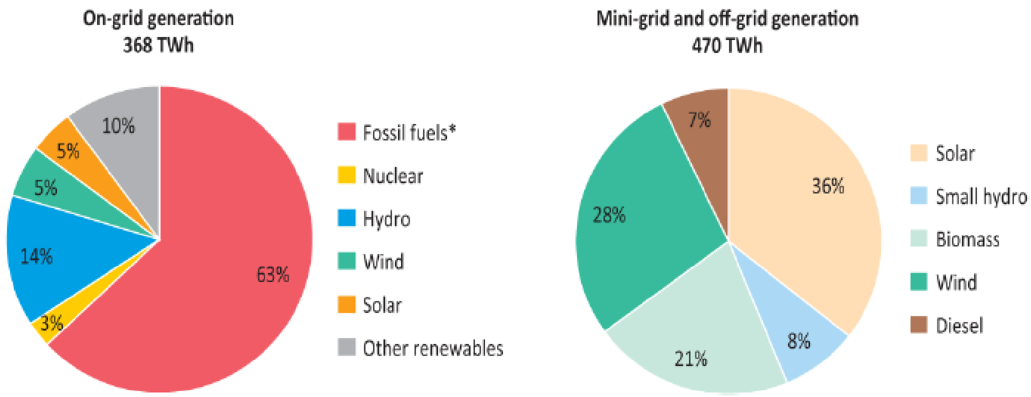
Source: Pachauri et al. (2011)

To achieve universal energy access by 2030, electricity output needs to increase by 840 TWH and power generation capacity by some 220 GW (IEA, 2011). According to the Energy for All Case of the IEA (2011), around 45% of the additional electricity needed in 2030 would need to be generated and delivered through the extension of national grids (i.e. on-grid generation), another 36% through mini-grid generation and 20% by isolated off-grid generation.[3] All urban areas and around 30% of rural areas are expected to be connected through grid extension. However, on-grid electricity access is not cost effective in more remote and sparsely populated rural areas. Therefore, about 46% of rural areas will need to be connected with mini-grids and the rest (25%) with small, stand-alone off-grid solutions (IEA, 2011).

Fossil fuels are projected to dominate additional on-grid generation, with more than 50% being coal-based and another 13% on other fossil fuels. Renewables, on the other hand, are expected to dominate additional mini-grid and off-grid generation, with 36% to be provided by solar, 28% by wind and 21% by biomass (see Figure 2.4).

[3] Mini-grids are village and district-level electrical networks with loads of up to 500 kilowatts (this can adequately supply energy to approximately 25-30 households). A stand-alone system is an autonomous power system, i.e. it does not depend on the main grid.

Figure 2.4. Additional electricity generation by grid solution and fuel in the Energy for All Case, 2030



* Coal accounts for more than 80% of the additional on-grid electricity generated from fossil fuels.

Source: IEA (2011)

In terms of clean cooking facilities, efforts are likely to concentrate on advanced biogas cookstoves, on liquefied petroleum gas (LPG) stoves and on biogas systems. In total, some 560 million households will require additional access to clean cooking facilities. The IEA (2011) estimates that biogas cookstoves will need to be supplied to 250 million households, LPG stoves to nearly 240 million households and biogas systems to another 70 million households.

Providing universal energy access by 2030 is estimated to increase global energy demand by 179 million tonnes of oil equivalent (Mtoe) or by 1.1% compared to the New Policies Scenario. 54% of this increase will be based on fossil fuels, raising the question of the impact of universal energy access on global GHG emissions. However, according to the IEA (2011), the provision of universal energy access would increase global energy-related CO_2 emissions by a modest 0.7%, compared with the emissions levels calculated in the New Policies Scenario. IIASA (2011) presents similar findings. Also taking into account other climate forcing emissions (e.g. methane, Black Carbon etc.) it concludes that the climate impacts are negligible or even beneficial, also at high levels of LPG use. This is mainly due to the fact that new technologies and fuels displace large quantities of traditional biomass use, which are inefficient and associated with significant emissions, also (and in some cases particularly) of non- CO_2 Kyoto gases such as methane.

It should be noted, however, that current GHG emissions of the poorest countries, notably in SSA and in rural areas of many developing countries, are negligible due to the low levels of industrialisation. Therefore, even if fossil fuel consumption in these countries grew at a high annual rate until 2030, the per capita level of CO_2 emissions would still remain at low levels compared to those in high-income countries (World Bank/UNDP, 2005)..

2.4 Potential requirements to fill the gap

2.4.1 Technology options for electricity services

In urban areas, using the conventional electricity grid and extending it to peri-urban areas is generally the most common solution to provide electricity for households. However, this does not necessarily ensure adequacy, reliability, and affordability of supply. Unreliable services and appliances can lead to high costs for consumers and the economy through impacts such as lost productivity and revenue for businesses, or as a result of damaged goods (e.g. if refrigeration capacity is lost) (see also Section 2.1.1). In many poor urban areas, electricity is "stolen" from the grid rather than being properly connected (given the high fee for connection) which leads to unsafe conditions for users and puts additional pressure on the electricity system. Power companies are often unwilling to enter slum areas because of physically difficult conditions and associated personal risks. The technical challenge here is to provide safe household connections - often to improvised dwellings - that discourage theft. One apparently successful example involved the use of service drops[4] high on utility poles and prepayment cards for households' meters in the Khayelitsha slum on the outskirts of Cape Town (USAID, 2004). The main barrier to the expansion of electricity to individual houses in urban and peri-urban areas, however, is not a technical one but high upfront costs associated with connecting a house to the grid (World Bank/UNDP, 2005). The initial costs could be overcome by providing connection subsidies for low-income populations (as is the case in a USAID-led slum electrification project in Mumbai for example, see Chapter 3/Appendix 1).

In rural communities with no electrical service at all, both a centralised and a decentralised approach could be adopted in order to provide access to electricity. This choice depends on many factors such as geographical sparseness, overall population density, availability of local renewable resources, widely dispersed, sparsely populated community centres (villages) and any pre-existing grid power (World Bank/UNDP, 2005). Those factors determine the cost of transmission and distribution infrastructure, which is the main cost component when expanding electricity to rural areas. A centralised approach could be viable in areas like Lake Victoria in East Africa, where there are closely grouped rural settlements. For this population, the average distance between community centres is generally no more than 2 kilometres. This would allow people to exploit networked options for electricity services (World Bank/UNDP, 2005).

However, as shown by recent efforts to expand electricity access in India (see Section 2.1.1), this may not be the most efficient solution in rural areas both in terms of quality (i.e. rated voltage and frequency) and quantity (i.e. hours of use and availability) of the electricity supplied and in terms of cost-effectiveness (OCI et al., 2011). Considering the typical low density of rural areas, the effective cost of creating new transmission infrastructures to extend the grid to rural communities can be very high. Moreover, the damages that households experience due to poor quality electricity and frequent power cuts are a major barrier to economic development. For example, many rural villages in India, which receive grid-connected electricity from conventional power, get access for just 2 to 6 hours per day. This is often not enough to light even a single tube-light (OCI et al., 2011). One way to address this issue could be to enable access to electricity through small-scale, decentralised energy technologies that do not depend on the main grid.

[4] The point at which the electrical line running to a customer's building is connected to the utility pole.

Decentralised technologies such as mini-grids or stand-alone systems (off-grid), which are powered by diesel or hybrid motors or rely on small-scale renewable technologies to create mechanical power and electricity, can help create economic opportunities and alleviate poverty (WHO, 2006). The electricity system in Urambo Village in Tanzania provides a good example of a successful application of a mini-grid system. The diesel mini-grid is serving approximately 250 households, an estimated 2,000 people. However, decentralised technologies relying on renewable forms of energy (e.g. solar, wind, hydro or some combination of these technologies) may be the most promising approach to rural electrification (see Chapter 4).

2.4.2 Technology options for cooking and heating services

It is important to provide cleaner and more efficient cooking and water heating options to all people still relying on traditional use of biomass. Three technologies will be critical: LPG stoves (both in SSA and in India), advanced biomass cookstoves (more so in India than in SSA) and biogas systems (more so in SSA than in India) (IEA, 2011). Which cookstoves are used depends on several factors, including cost effectiveness, ease of use, taste, cultural preferences and other contextual conditions like geography, whether, urban/rural setting etc. (IIASA, 2011). Adapting technologies to these circumstances is crucial for programmes to have a positive impact.

For those who are unable to switch to modern fuels for cooking, further measures to encourage the use of improved cooking stoves, increased sustainable biomass production, and cleaner use of biomass fuels should be taken (World Bank/UNDP, 2005). Passive installations can also provide cooking and heating services in both rural and urban environments – simple solar water heaters for example offer a cheap alternative to burning fuel to heat water if the initial financing and installation challenges can be overcome (see Chapter 3/Appendix 1 for more examples).

Policy reforms that encourage investment in energy infrastructures – including the handling, transport, and distribution of fuels, as well as measures that reduce the cost burden of LPG cylinders and stoves for the poor - are needed to improve the affordability and availability of safe cooking fuels (UNDP, 2007; SEI, 2009).

2.4.3 Financing requirements

1.1.1.1 Investment needs

Achieving universal energy access by 2030 will require a substantial increase in the level of investment geared towards the alleviating energy poverty. While in 2009 these investments amounted to USD9.1 billion, the IIASA (2011) suggests that they need to quadruple to between USD36-41 billion annually to achieve universal energy access by 2030. The estimates of the IEA (2011) are even higher, suggesting annual investments of USD48 billion (about five times the 2009 level). In fact, the Energy for All Case (IEA, 2011), estimates that a total of about USD1 trillion of additional cumulative investment will be required between 2010 and 2030 in order to achieve universal access to electricity and clean cooking facilities. More than 90% of the additional investment needs will be required for providing access to electricity and only USD95 billion (or less than 10%) for the provision of clean cooking facilities.

Most investment aimed at achieving universal electricity access will be required in SSA, mostly for connection with mini-grids and off-grid solutions in rural areas. Some 60% of additional finance will be needed in SSA, compared with around 20% in India (IEA, 2011). Together, these two regions are thus in need of 80% of the additional investments in electricity connection.

The region south of the Sahara will also need to be the largest recipient of investments in clean cooking facilities. Some 30% of the additional investments in clean cooking facilities will be required in SSA, compared with some 23% in India (IEA, 2011). Together, these two regions thus account for more than half of additional investment needs in clean cooking facilities.

In order to provide guidance on how much is required for one country, UNDP and the UN Millennium Project (2006) calculated the cost of providing universal energy access in Senegal. This study shows that USD12.20 per capita per year (or USD1.7 billion over 10 years) is necessary to meet the targets of providing electricity for households and communities, cleaner cooking systems, and mechanical power for agro-processing and water. More specifically, the amount required would be USD4.30 per capita per year for electricity, USD5.40 for cleaner cooking systems, and USD2.52 for mechanical power. This amount is equivalent to 1.7% of GDP per capita, (using a GDP per capita of approximately USD700) (UNDP, 2007). This is a manageable amount to provide. The main challenge is finding an effective way to mobilise investments.

1.1.1.2 Financing instruments

Financing an average of USD36-48 billion required annually to reach universal access to basic energy services is a major challenge. So far, investments have been considerably below needs, especially in sub-Saharan Africa. All sources of finance will eventually be required: international funds, public-private partnerships, bank finance at multilateral, bilateral and local levels, microfinance, loans and targeted subsidies.

The public sector will need to cover the costs of creating the necessary investment climate, most importantly by establishing the necessary legal and regulatory framework. Moreover, it should encourage energy service providers to set cost-recovery tariffs and collection mechanisms that will allow all users to pay for energy services, including the poorest (World Bank/UNDP, 2005). It should also provide loans, leasing finance, grants, and subsidies to help households afford both the high upfront investment cost and operating costs (IEA, 2010).

The public sector alone will not be able to provide all the financing needs required to significantly expand energy access (AfDB, 2011). Effective partnerships between the public sector (to establish appropriate institutions and regulations), the private sector (to develop, deploy and administer energy service utilities), and communities and local governments (which are in charge of managing public services for consumption of energy) will be necessary to expand access to sustainable energy services. For example, "opportunities for adding generation capacity and developing local grids are frequently missed due to lack of a suitable framework that allows independent power producers to obtain licensing and feed electricity into the grid and local small utilities to develop" (World Bank/UNDP, 2005: 66).

Microfinance has proved particularly useful – especially to poor women – for building energy businesses or purchasing energy services by providing small loans needed to run a small business. In many cases, however, the scale of microfinance is insufficient to make large inroads into energy poverty (IEA, 2010). See for example the case study on Grameen Shakti in Bangladesh in Chapter 3.

International support will be essential to help developing countries with the challenge of scaling up energy access. Developed countries, through bilateral donors and multilateral agencies, will be important sources of finance (Weischer et al., 2011). Their support, for example, should consist in subsidised capital and risk mitigation to face investments needs and high upfront costs, as well as grant-based international financing to cover additional costs.

Existing energy programmes and funds (such as the Global Energy Efficiency and the Renewable Energy Fund (GEEREF), the Climate Investment Funds administered by the World Bank and implemented jointly with other development banks) can be utilised to administer and distribute finance, but they need to be scaled up significantly.

Yet the efforts of those institutions alone will not be sufficient to provide the level of financing necessary to promote universal access to energy services (IEA, 2010). The implementation of all international financing programs will improve only if they are grounded in national policies (Yumkella and Strivastava, 2011). Indeed, the role of the public sector is instrumental in enabling the right environment, creating effective regulatory frameworks, and developing energy implementation strategies.

2.5 Conclusions and policy recommendations

Expanding energy access is extremely challenging. However, universal energy access is feasible and the barriers that hinder the achievement of this goal can be overcome. There are many examples showing that universal access to energy can be achieved over a relatively short period of time if governments provide leadership and incentives. In the case of Thailand, the share of the population with access to electricity went from 25% to almost 100% in just over a decade (from 1980 to the early 1990s) (Bazilian et al., 2010). China has provided 500 million people in rural areas with access to electricity since the beginning of the 1990s and is expected to achieve universal electricity access by 2015 (IEA, 2011).

The necessary technology options are available, as well as knowledge about the financial resources needed and about how to meet energy demand efficiently. What is needed is political prioritisation (Yumkella and Strivastava, 2011).

This section seeks to illustrate key priority areas where progress has to be made to reduce energy poverty. It is important to bear in mind that every country/region has specific energy resource endowments, infrastructure and needs. These, together with the socioeconomic, cultural and capacity specificities of local communities, need to be taken into account when addressing energy poverty.

Energy access needs to be set as a national priority. Defining national energy access goals in development strategies, policies and programs, and assessing the costs of meeting those targets is a first step to progress in expanding access to energy (IEA, 2010; UNDP, 2007; WHO/UNDP, 2009; Yumkella and Strivastava, 2011).

Institutional capacity needs to be developed and an effective regulatory framework designed. Lack of institutional and regulatory capacity in developing countries is a key barrier for integrating energy into national development strategies and for mobilising investment. Political commitment is necessary to build a framework of market conditions that could reduce energy poverty. Macroeconomic and fiscal policies would encourage the participation of private entrepreneurs as well as communities in the planning, execution, and end-use of energy services (IEA, 2010; UNDP, 2007; WHO/UNDP, 2009; World Bank/UNDP, 2005).

Additional investments need to be mobilised. Investments in energy need to be scaled-up significantly (to some USD36-48 billion annually). It is crucial for developing countries to remove the barriers that hinder private investment, including unfavourable conditions faced by private and foreign investors (particularly corruption and fragile governments) coupled with fairly low rates of return associated with typical energy investments (UNDP, 2007; World Bank/UNDP, 2005). Replicable business models should be encouraged (IEA, 2011).

Human capacity needs to be enhanced through education, training and research. This applies to all stakeholders, including planners, technicians, community workers and businesspeople (World Bank/UNDP, 2005).

Identifying the most promising indigenous renewable energy resources and implementing policies that promote their sustainable development (UNDP, 2007; IISD, 2005).

3. ON-GOING AND PLANNED PROJECTS TO IMPROVE ENERGY ACCESS

3.1 Ongoing access to energy projects and funding trends in Sub Saharan Africa and South Asia

On-going and planned donor–financed energy projects affecting access to energy range from multi-billion dollar thermal and hydroelectric power and transmission projects to NGO- or private sector-led community initiatives deploying energy services tailored to household needs. The following surveys the current trends in project design and approach. A more detailed list of selected projects can be found in Appendix 1.

Amongst the largest tranches of international donor funding for energy are directed at fossil fuel-related projects, particularly coal-fired power generation. These are aimed primarily at rapidly increasing reliability of power supplies in countries facing chronic shortages and rising demand. Several major international funders including the Asian Development Bank, the World Bank, the US Exim Bank, the Chinese Development Bank, the Chinese Exim Bank and the Korean Exim Bank have committed hundreds of millions of dollars to finance India's roll out of coal-fired supercritical Ultra Mega Power Plants (UMPPs). There is little attention devoted to new connections and where promised, these account for a tiny percentage of total power generation (see the Tata Mundra example, in Appendix 1). One of the most controversial power projects on the World Bank's lending portfolio is the 4800MW Medupi plant in South Africa.[5] All donor financing for coal has come under severe criticism for its future impacts on the local and global environment, not just for GHG emissions but also the acid rain and land degradation that accompanies mining operations (e.g. CIEL, 2011; Co2Scorecard, 2011) (see also entry in Appendix 1).

Hydropower is also a strong focus for the World Bank, ADB, AfDB, the EIB and countries with expertise in this area, namely China, Brazil and Norway. This form of energy currently provides around 60% of electricity in sub-Saharan Africa excluding South Africa, 21% in India and over 80% in Bhutan. In theory,

[5] Although the justification for the project was framed in terms of development needs and lack of access, the project does not specify increasing grid connections. Rather, the Bank claims that financing the addition of major new supply will allow ESKOM to meet its target of connecting the remaining 19% of South Africa's population without electricity access (World Bank, 2010).

there is huge untapped potential for energy from this source in both regions. Many of these projects also seek funding by the Clean Development Mechanism (CDM). One of the most ambitious proposals is for a fourth hydroelectric plant of 39,000MW on the Inga river in the Democratic Republic of Congo (DRC) (see Appendix 1). This is intended to supply DRC and "light up Africa" but benefits to those without current access are unclear and current hydroelectric plants on the Inga do not supply energy to local communities and are mired in a history of poor governance. These and many other existing hydroelectric dams are aging and suffer from inefficiency and breakdowns. Refurbishment and retrofitting can have dramatic improvements to reliability of energy supplies – for example, the Akosombo Dam in Ghana underwent a successful World Bank funded retrofit in 1999 which added 108MW of additional capacity and an efficiency increase of 31%.[6]

Nevertheless, these do not necessarily increase access for the poor. This aim is being better served through the rehabilitation and addition of mini hydro (under 1MW) or micro hydropower units (under 200kW) for local rural demand (GTZ, 2010). These avoid the social and environmental drawbacks of larger projects and have had success in supplying poor communities in Nepal, Bhutan and other hilly areas of Asia. There are several initiatives to increase their use in India and Africa, such as UNIDO-led projects in Zambia and Rwanda, which also aim to enable commercial upscale of rural hydro mini-grids. Small hydro projects are funded by a range of donors including the Global Environment Facility (GEF), the European Commission, UNIDO, UNEP and several European governments along with private investors.

Beyond geography, a key obstacle to getting electricity to the lowest income communities is national and local level governance and capacity. In India for example, the grid extends to many rural village a lack of accountability and the technical challenge presented by non-pukka dwellings often mean that no one bothers to connect individual homes. Several major initiatives focus on power sector governance reform and efficiency packages, sometimes linked to new generation or transmission and distribution. One example is the World Bank financed Uganda Electricity Sector Development Project, which has a specific target of 84,000 new customers (some 655,000 people) by 2025. It involves connecting the South Western region of the country to the national grid and providing technical assistance and capacity building for Uganda Electricity Transmission Company. Smaller initiatives funded by development aid may subsidise the electricity connection cost and provide technical training and quality control such as a GPOBA[7] funded USAID/Reliance Infrastructure initiative to bring electricity to the Mumbai slums.

Increasingly, national projects specifying rural access also take into account local energy service needs more than just grid connection. For example, the World Bank financed Accelerated Electricity Access (Rural) Expansion programme in Ethiopia has succeeded in electrifying 320 towns over five years with a combination of new connections and the provision of energy efficient street lighting, lamps and improved cooking stoves. A similar programme in Benin, includes decentralised generation systems and modernisation of biomass services in rural areas, including training 300 workers in production of efficient woodstoves.

Given the difficulties of scaling up decentralised rural energy projects, and creating markets for renewable energies (see Chapter 4), several new or recent multi-country projects promote local SMEs in

[6] This was attributed to the innovative bidding process which involved potential contractors competing to design of the new runners which produced a highly efficient model *Report on Lessons Learned in the Akosombo Retrofit Project*, Task Manager; Joel J. Maweni, World Bank.

[7] The Global Partnership on Output-Based Aid

this field and work with governments to create a conducive legal and regulatory framework. The USD13.9 million multi-donor funded 'Lighting Africa' initiative aims to lower barriers to entry for the off-grid lighting – specifically solar – market. The EU is particularly active in this area within SSA. The EU/Dutch-funded 'Energy Enterprises Project for East Africa' aims to enable the spread of energy enterprises to increase energy services to the rural and peri-urban poor whilst also creating local business opportunities. The EUR138 million German-Dutch Energy Partnership (GDEP)-financed multi-country Energising Development programme focuses on building self-sustaining markets and research centres for green energy services which will encourage scale-up (see Appendix 1). The latter now sits beneath the umbrella of the Africa-EU Energy Partnership (AEEP), which has specific targets on energy access within a wider-ranging strategic agenda (see Chapter 5).

One recent private sector driven phenomenon is the link between ICT and energy services in developing countries. The mobile phone industry in particular is promoting solar charging posts in remote areas, which can often fulfil other energy needs (GSMA, 2011).

A host of smaller scale, decentralised energy projects (such as the small hydropower ones mentioned above) - are financed and implemented by a combination of international development agencies, local and international NGOs and private companies. Renewable energy solutions are now routinely employed, particularly in projects in remote rural areas (given the benefits described in Chapter 4). A few of these are receiving funding by the Clean Development Mechanism (CDM).[8]

The more recent projects take on board the lessons learned over the last two decades in terms of building in measures to promote sustainability of energy services, most significantly in the design of tariffs, opportunities for local ownership and market linkages. The following case studies give three examples of the different models being piloted and their progress. More are listed in Appendix 1.

3.2 Project Case Studies

3.2.1 The Lighting a Billion Lives Campaign (LaBL) in New Delhi

This campaign is implemented by The Energy and Resources Institute (TERI), New Delhi. The Campaign aims to bring light into the lives of one billion rural people by replacing the kerosene and paraffin lanterns with solar lighting devices. In terms of physical targets, it translates into 200,000,000 solar lanterns in use, assuming that each solar lantern benefits five members of a family. Over 360 million people in India lack access to electricity and more than 60 million households in rural India use kerosene to meet their lighting needs. Kerosene, while subsidised by the Government also has a negative impact on the health of the users. The LaBL campaign has twin objective: taking solar lanterns as a non-polluting means of night illumination to poor rural households that lack electricity and making such service self-sustainable after it is established.

The donations to LaBL are invited on an individual basis or on a corporate level. A number of companies such as Power Finance Corporation (PFC), Unitech Wireless Pvt. Ltd (Uninor), Union Bank, ICICI Bank, Kottikolan Edavalath Faizal and Rural Electrification Corporation (REC) have financed more than 600 villages in the year 2011. The project also has a range of partner organisations as well as technology partners.

[8] The UNFCCC is now collecting evidence of developmental benefits, including access to energy, of CDM-funded projects. A list of these can be found at http://cdm.unfccc.int/about/ccb/index.html.

The campaign started in 2008 and has until now managed to utilise around 38,350 lanterns spread across 742 villages, in 16 Indian states (500 in Myanmar). It is estimated that close to 200,000 lives have benefited so far.

The market is still at an early stage of development. It is being undertaken on donation basis and it will need some time before it becomes fully commercial. It has nonetheless attracted a number of financing institutions and solar companies. It also fits well with the strategy of Jawaharlal Nehru National Solar Mission (JNNSM) to enhance off-grid solar projects. The project has also received support by a prominent national news channel, NDTV, which runs a fund-raising campaign ever year to raise money. In 2011, money for 580 villages was raised.

The LaBL campaign is a flagship program of TERI. The rural entrepreneurs are trained to manage and run a central solar lantern charging/distribution centre where lanterns are rented. This creates financial opportunities for the entrepreneur. Thus, apart from providing reliable and ensured lighting to households at an affordable rate, the Campaign also facilitates entrepreneurial development among rural communities. The campaign links and synergises the initiatives and commitments of the governments, private sector and donor agencies towards socioeconomic development of the communities using lighting as a means for facilitating and advancing their initiatives. Health services, ICT based educational services, water purification services etc. can be provided to the communities by expanding the capacity of the solar charging stations in future.

The user not only uses the illumination from the solar lantern to facilitate his/her daily chores; but is also empowered to facilitate the education of his/her children, initiate livelihood activities, and have better access to health and sanitation facilities. In lieu of these benefits, the user pays a rental to the entrepreneur for managing the charging station. The charging station is modelled as a business activity for the entrepreneur. Users are continuously encouraged to develop a new business model to promote the charging station. The entrepreneur receives technical training to effectively operate the charging station and better manage the business.

The Campaign offers local and global environmental benefits. Each solar lantern in its useful life of 10 years displaces the use of about 500-600 litres of kerosene, thereby mitigating about 1.5 tonnes of CO_2. The Campaign benefits both the user and the supplier of services. So far no negative environmental impacts have been reported.

Apart from the environmental benefits, the most important aspect of the campaign is that it provides 1) health improvements by substituting paraffin lanterns and 2) a business model which has the potential to provide a range of environmental and developmental benefits to remote areas: This intervention not only provides access to a cleaner source of energy but it also enhances the technological capabilities while providing confidence to the rural entrepreneurs. The campaign also promises to open up a new market, which cannot be reached by the usual sources of grid based power sources. It also raises awareness about the clean sources of energy in rural India.

3.2.2 Yeelen Kura in Mali: Testing the feasibility of rural energy service companies (RESCOs)

Only around 2-3 percent of the population of rural Mali have access to grid electricity. In the mid-1990s, EdF (Electricité de France) developed the idea of Rural Energy Service Companies (RESCOs) and initiated the project in Mali based on three key criteria: profitability, sustainability, replicability. The idea was to bring decentralised electricity to Southeastern Mali communities, replacing the use of polluting fuels and stimulating economic activity. This project ran alongside other similar models in Mali, South Africa and Morocco. The aim was to introduce electricity from renewable sources to around 6,700 potential households and stimulate local economic activity. The initial project cost was EUR5.5 million covering 2001-2005. The service company, Yeelen Kura (meaning "new light") was created to be commercial with EdF and Dutch energy and water company Nuon each taking a 50% share. The intention was to transfer management and eventually ownership to locals. The French Agency ADEME provided training to locals and support in the operation of electricity infrastructure and a Dutch Government grant subsidised the connection of 1,500 SVP Solar Home Systems (SHSs).

By 2004, the project had increased rural electricity access, fulfilling domestic demand for lighting, television and radio but additional power needs (especially for business) were still lacking. The tariffs, though designed to be affordable, prevented access for the poorest households. The company was successfully transferred to 100% Malian staff and management and set up 15 local energy stores but growth and reach was limited by financing difficulties and the difficulty of finding qualified local staff. Yeelen Kura was intended to be self-sufficient with customers paying a monthly bill depending on the service they opt for. But legal and administrative start-up costs were higher than expected. Tariffs were too high for the poorer sections of the population to afford and the existing local economy (based on cotton) too fragile to provide stable incomes. Because the Dutch government grant specified the supplier of equipment, Yeelen Kura was burdened with additional expense when poor quality regulators for the solar kits shortened the life of batteries. There were also lengthy bureaucratic processes to overcome facilitate the company's operations in a former monopolist market. The company failed make a profit to enable expansion.

Following a thorough evaluation by 2006, the project attracted multilateral donor (chiefly through the World Bank) support package addressed these needs. The involvement of the World Bank enabled the Malian government to establish an improved institutional framework and partial liberalisation of the electricity market to allow the model to be replicated by other companies. By 2008, Yeelen Kura had installed SHSs to 5000 households. The expansion plan also enabled low-voltage micro-networks powered by diesel generators. Subsidisation allowed a decrease in tariffs and the company appears to continue to increase rural access.

Environmental impact has been minimal with substantial CO_2 savings from the use of SHSs in place of candles and kerosene and also from efficient diesel generators in place of car batteries and biomass. These also improved indoor air quality. There was initially a problem with lack of facilities for used battery disposal but EdF have since helped to establish recycling companies.

The fee-for-service model proved popular but showed that additional funding/subsidisation is likely to be necessary to offset start-up costs, serve the poorer households and insulate company from fragility of local economy. Pre-existing low level of skills and economic activity also need to be taken into account when planning financing as project may need to set up the necessary supply chains and services. Transparent bidding processes should also be used to ensure the best technology. The World Bank's intervention proved useful in helping the host Government to change legislation and implement regulation to facilitate operation of RESCOs. This would be helpful to renewable energy small- to medium-sized enterprises where there is a state monopoly on utility provision.

1.1.2 Grameen Shakti, Bangladesh: Microcredit to enable access to green energy and empower women

In Bangladesh, 55% of the population (over 90 million) is not connected to the national grid. The government's vision is electricity access for all by 2020.

The not-for-profit enterprise, Grameen Shakti (GS), established 1996 on of the family of Grameen companies, uses microcredit to fund rural electrification. The idea is based on providing for the specific needs of the rural communities and businesses with an emphasis on transferring ownership of the technology to local people. It works with various renewable energy sources (solar, wind, biogas from farm waste) to avoid fuels detrimental to health and the environment. In 2003, a government programme, supported by the World Bank's International Development Association (IDA) and the Global Environment Facility (GEF) embarked on a programme to install 50,000 Solar Home Systems (SHSs) by 2008 – this was coordinated by the government owned Infrastructure Development Company Limited (IDCOL). GS was chosen as one of the implementers, which catalysed its operations. The target was reached by 2005 (at USD2 million below estimated cost), with GS installing 65%. By 2010, GS had installed over 450,000 SHSs (est. around 4 million beneficiaries) and plans to install 1 million by 2012. The success of the programme attracted additional funding from the German GTZ (now GIZ) and KfW, as well as from the Asian Development Bank (ADB) and the Islamic Development Bank (IDB).

IDCOL provides GS with the initial loan and a small subsidy for each solar panel supplied – this is then repaid to the government through collection of small payments from villagers over two or three years. The initiative in turn provides employment, often to women, through a scheme in which locals receive training on installation and repair of solar panels and wind generators. The microcredit scheme entails an initial down payment plus service charge on repayments. Monthly repayments are based on the idea that household can own a SHS for the same amount it would spend on kerosene.

One reason for its success where other decentralised renewable projects have failed is the experience in micro-credit for the poor came – most of the board and top management were founders of Grameen Bank. Another is the effort that goes into supporting the customers. GS has over 1100 field offices and 8500 staff covering 40,000 villages. These offices develop community awareness, visit customers once a month, provide a free repair and maintenance service during the period of repayment, and are able to feed back information about how a scheme is working. It has also established technology centres to train local women in the installation and maintenance of equipment. GS has also created jobs for women as technicians in assembling SHS equipment.

These schemes have increased economic activity, enabling households to generate additional income from home and the start up of small businesses. One example is the Polli-phone whereby a woman borrower will operate a village pay phone using her SHS as a charging source. GS's work and the IDCOL programme in general have promoted the manufacturing industry for batteries and solar accessories within Bangladesh.

Environmental impact appears be minimal or positive. GS maintains an agreement with one of its battery suppliers to take back, recycle, and safely dispose of used batteries. The replacement of kerosene and biomass reduce GHGs and benefit human health.

Even with the microcredit scheme, the SHSs are expensive for the poorer families as panels and some parts have to be imported. Critics mainly point to the problem with micro credit more generally – that it can encourage poor families into a cycle of debt whereby they take out additional loans with much higher interest rates to replay the initial loans. Adapted GS schemes include several families sharing the cost of one SHS and the improved cooking stoves program which offers cheap, locally manufactured stoves, producing clean methane gas from cow dung with the by-products usable for fertiliser and fish feed.

The IDCOL programme in general benefited from technical and financial monitoring to ensure any technical and repayment problems would be addressed by the implementer/partner organisation. The micro-credit model allowing ownership of the technology encourages attention to care of the systems and deterred theft. The user-training program and training of local engineers and a free/low cost maintenance scheme for customers are essential for sustainability of a high-tech system such as solar PV. Above all, popularity in target communities has been aided by GS's adaptive approach, which considers energy services required rather than 'access to energy' and works on social acceptability issues. However, it is not clear that the GS model would travel well, given the micro-credit history of GS and its hands on approach to lending.

4. IMPROVING ACCESS TO ENERGY BY USING RENEWABLE ENERGIES

This chapter considers the relevance of modern renewable energy (RE) applications in increasing access to energy services in rural regions of developing countries. In particular, it considers the merits of small-scale decentralised RE solutions in contrast to large-scale on-grid generation, barriers to the introduction and sustainability of REs in poor rural areas and the various financial tools available to enable RE investments. Given that pressures on water are a critical issue in many developing countries, the last section deals with the impacts of different RE technologies on water.

4.1 Renewable energy use in developing countries

4.1.1 Traditional biomass use

The use of traditional REs in form of biomass (e.g. burning wood, dung or agricultural residues) for cooking, heat and light is widespread in developing, countries, especially in rural areas. As spelled out in the introduction, this practise has severe consequences for health, especially in women and children.

There is also a question of how 'renewable' the use of biomass is in a given context. The environmental effects of large wood use are leading to deforestation, degradation of land and even to desertification in some regions.

4.1.2 Use of modern renewable energy

Modern RE sources such as wind, sun and hydro have a huge potential to satisfy the demand for energy services in developing countries. Fossil resources such as oil, gas, coal and uranium are available only in certain areas and subject to volatile prices on the world markets. The burden of fossil fuel imports is especially high for developing countries, which usually subsidise their domestic sales of fuel and electricity (IMF, 2011). In contrast, energy from renewable sources is available in some form in every country. Most of the developing countries are situated in areas with access to abundant renewable energy sources, especially wind and solar.

Replacing[9] traditional and conventional fuels with modern renewable energy applications offers a range of benefits. These include 1) infiniteness: RE sources cannot be depleted; 2) independence: local energy sources contribute to energy independence and reduce the exposure to volatile prices of

[9] "Replacement" is to be understood to comprise both, replacing existing usage as well as covering new demand with modern RE instead of traditional and conventional energy sources.

resource imports; 3) health: hardly any impacts on health; and 4) environmental protection: comparatively small environmental effects, e.g. with respect to local air pollution (nitrates and sulphates) and climate change (greenhouse gas emissions).[10]

Nevertheless, the impact of modern REs on society and the environment is not necessarily neutral, as will be outlined in the next section.

4.1.3 Large-scale vs. small-scale off grid solutions

Renewable energies provide the opportunity for large and small-scale as well as grid-connected and off-grid solutions.

Historically, large-scale renewable projects (above 100 MW) have often been implemented to supply energy to industrial production or for export (Bast and Krishnaswamy, 2011) and have rarely increased access to energy for local communities. Connecting remote and poor rural areas to centralised on-grid RE facilities encounters similar difficulties as connecting them to conventional energy resources (see Chapter 2). Poverty and social conflict may even increase due to the negative effects of large power projects on the local population. For example, the Three Gorges Dam in China mainly supplies high-paying customers such as those in the city of Shanghai while the local population is subject to the displacement of more than 1.3 million people, the flooding of cultural and archaeological sites and significant and on-going environmental damage, including an increased risk of landslides and contamination of drinking water (see e.g. International Rivers, 2008; Yang, 2007). In addition to large hydropower projects, large energy crop cultivation for the production of biofuels (mainly for export) has been criticised as it has large impacts on local livelihoods and may lead to resource conflicts. Problematic issues such as land grabbing, substitution of food production and land degradation are widely discussed in this context (e.g. World Bank, 2011).

In contrast, decentralised, small-scale RE applications can avoid the problems noted above and are more suitable for the low demand and specific needs of poor rural communities. Small-scale applications such as run-of-the-river hydropower, wind and solar PV systems provide electricity, which can be used for lighting, water pumping, communication and for small industry. Wind and hydropower can also provide mechanical energy for water pumping. Biofuels can be used as a fuel for existing diesel generators, thus reducing pollution and (partly) reducing fuel costs. Solar thermal, biomass or biogas applications can be used for space and water heating or cooling as well as for cooking (e.g. in improved cooking stoves, which use biogas instead of wood).

Passive infrastructure can also make use of RE sources directly to provide functions or services that would normally require fuel or electricity. These include solar water heaters, solar cookers, solar crop drying, water and wind-driven grain mills and air-cooling towers.

When tailored to the socio-economic context, decentralised renewable energy systems can result in developmental and environmental improvements as well as increasing access to energy. In Bangladesh, for example, the installation of biogas digesters at poultry farms reduced the environmental hazards and turned them into energy sources, hence also improving the economic feasibility of the farms in the longer run. The reduction of excrement and waste releases lead to an improvement of water quality and

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[10] Further examples of negative environmental effects of traditional or conventional energy sources are landscape destruction and water contamination by coal mines, or the production of pollutants during electricity or heat generation such as ashes, heavy metals or nitrogen oxides, or the waste and radiation problems connected to nuclear energy.

to a reduction of methane emissions (IISD, 2005). In India, the "Lighting a Billion Lives" project (see Chapter 3) improves access to lighting via the allocation of solar lanterns while improving air quality (and therefore health) by replacing paraffin lanterns. The Grameen Shakti example (Chapter 3) also shows that an access to energy project can also address gender inequality when focused on training women technicians. In Rumpura, a small rural village in Northern India, an 8.7 kilowatt (kW) power plant powered by solar energy was set up by Norway-based Scatec Solar in 2009. The village community together with a local NGO, Alternative Developments, mobilised to take control of the management of the power plant. Since then, Rumpura has not been without energy for one day (OCI et al., 2011).

However, financing, 'technological strangeness' and lack of local market development and governmental capacity can prove serious obstacles to the introduction, sustainability and up-scaling of such schemes due to the fact that the use of various RE technologies deployed at the local level depends on the local willingness and capacity to use, maintain and repair the equipment. Scaling-up the use of as RE technology in a given area will require not only the necessary technical and business skills but also certain market conditions and supply chains. These issues will be dealt with in the following two sections.

4.2 Capacity constraints

The need for developing countries to have access to environmentally sound technologies to promote sustainable and low-carbon development has long been recognised on the international level. Under the United Nations Framework Convention on Climate Change (UNFCCC), developed and developing countries agreed that "all practicable steps [shall be taken] to promote, facilitate and finance, as appropriate, the transfer of, or access to, environmentally sound technologies and know-how to […] particularly developing country Parties" (Article 4.5 of the UNFCCC). The successful transfer of modern renewable technologies to developing countries is a multi-faceted challenge: Even where the initial capital can be accessed to pay for a technology or make investment commercial viable (see Section 4.3), the transfer of RE technologies to developing countries is impeded by a set of economic, institutional, informational, and social barriers. These include *inter alia*:

Lack of market demand and fragile local economies: In developing countries, especially in rural areas, financial resources may be too low to make the initial investment or to pay for services (see Section 4.3); the fragility of local economies may also lead to the sale or theft of RE installations or to the stripping for precious metals. Several mechanisms that involve individual household ownership or community bill-payment can work to disincentivise this.

Lack of skills and a supporting market: Communities in many of the developing countries do not have the appropriate skills and training to successfully adapt, install, and maintain technologies. Several decentralised RE projects have failed to deliver energy after a few years when equipment fell into disrepair and spare parts could not be obtained. RE projects in this context require an explicit connection between the technologies and training programs (IPCC, 2011). For example, the success of the Grameen Shakti solar home systems initiative in Bangladesh is largely due to the hands on, long-term support it provides to customers and the training of local engineers and technicians.

Major donors and implementers now also widely recognise the need to enable scale-up of successful RE solutions and schemes. In the past, the transfer of technologies to developing countries was a large-scale public investment based on foreign technology and soft loans with minimal knowledge transfer and domestic capacity building. Technical assistance, including training and R&D activities, has become a standard component of technology transfer financed by multilateral agencies (see also Metz et al., 2000). But lack of skills and lack of awareness of business opportunities can still present a problem. As demonstrated by the Yeelen Kura case study (Chapter 3), even where a private service company is prepared to conduct technical and business training for its staff, the basic level of education for potential recruits may be lacking in communities without access to modern energy and this imposes additional start-up costs.

Most target regions will also lack a supporting service industry to provide for maintenance, spare parts, insurance and recycling services etc. These may need to be initiated by project implementers – for example, the disposal of used batteries for solar kits from the Yeelen Kura project in Mali became an environmental hazard so EdF created a company to recycle them.

Low public capacity to create an enabling environment: The public sector's low capacity to develop and enforce laws, policies and regulations to promote energy access, the ability to monitor progress and enforce laws, as well as the competence to measure progress has proved an obstacle to both introduction and scale-up of RE technologies. Technologies tend to flow towards countries where environmental policies incentivise their use (IPCC, 2011). The innovation rate and likelihood of transfer is likely to increase with more stringent and widespread environmental policies and incentives for adoption of low-carbon technologies. Many of the countries and communities will require help to develop enabling environments for the adoption of extant technologies and the institutions to support energy access campaigns (Marcellino and Gerstetter, 2010).

Insufficient transparency and accountability: Technology suppliers and/or installers are often imposed with a grant or loan which can result in a lack of accountability if there are problems with the equipment or service and may not result in the best value for money for the customers (see the Yeelen Kura example). In addition, technology suppliers often do not have sufficient knowledge and fail to provide support to correctly install, maintain and repair the applications.[11]

Low acceptance of the local communities: Local communities may not use new energy applications even when they are available, as they prefer to stick to traditional methods. They may also not feel responsible for maintaining and repairing new devices, especially if they are not participating in the decision-making process from the outset. In some cases, a technology may lack cultural acceptance. The use of human waste in biogas production, for example, was widely rejected by potential users in a study conducted in Burkina Faso (Aschaber, 2011).

These barriers should be thoroughly addressed when setting up renewable energy projects as they can impede the successful implementation and long-term use of the installations. A country or funder's willingness to invest in capacity over time, in terms of technical expertise, training and know-how is essential (IPCC, 2011). Technology transfer should not be seen as a one-off event, but rather understood as part of a longer-term sustainable development relationship.

[11] This may also link to the discussion about intellectual property rights (IPRs). IPR regimes are often cited as an impediment to technology transfer, as the majority of technology patents is registered by a handful of advanced economies. IPRs have received an inordinate amount of attention in the negotiations around technology transfer; however, research indicates that the attention IPRs have received does not match their impact on the issue of technology transfer (Marcellino and Gerstetter, 2010). This is especially true for "low tech" renewable applications such as basic biogas installations or solar cookers.

4.3 The financing challenge

Financing REs remains a critical factor in the dissemination of energy solutions in developing countries. The IPCC (2011) states that the current costs for energy from many RE technologies are generally still higher than conventional energy prices. However, some renewable energy technologies are already broadly competitive at existing energy prices such as hydropower, onshore wind energy, small-scale biomass applications or solar thermal heating (IPCC, 2011). Others would become competitive over the long-term if the initial capital costs could be covered.

Investors face a host of other challenges in developing countries, which can increase the costs of introducing RE but there are potential sources to finance their investments. The costs depend inter alia, on regional circumstances such as renewable energy quality, local transaction costs and the capacity issues mentioned in Section 4.2. For grid-connected RE, one main barrier is the regulatory and market environment. Examples include monopolies in energy generation and transmission leading to difficulties in receiving power purchase agreements (PPAs), low (subsidised) energy tariffs and inconsistent or opposing governmental strategies. Decentralised electricity and heat generation projects are often not implemented, as rural communities have no means to buy the modern energy services (UNIDO, 2009).

Some developing countries[12] are lowering the barriers for grid-connected REs by introducing feed-in tariffs (FITs). FITs ensure grid access, fixed tariffs per unit of energy and purchase agreements from the national utilities. However, the implementation of a FIT system raises one core challenge in developing countries: The incremental costs of the price premium paid to renewable electricity producers are generally divided between all electricity consumers. This puts an extra burden on consumers, which leads to social and related political difficulties in poor countries where consumers might not be in a position to cover the extra cost. Governments are addressing this problem in different ways. For example, Tanzania limits costs by determining the level of the FIT on a case-by-case basis instead of setting a general feed-in tariff; the Kenyan government has established a capacity limit for each type of renewable energy to limit the costs; in South Africa the Integrated Electricity Resource Plan determines the volume of each technology that the national energy regulator may license (IEA Global Renewable Energy Database; Mendonça, Jacobs and Sovacool, 2010; Global Feed in Tariffs, 2010).

Even in developing countries where policies to increase RE use has already been adopted, the resources to encourage private sector investment and kick-start RE capacity expansion is often lacking. Governments of developing countries already come up with a range of innovative ideas such as the Ecuadorian Government proposing the Yasuní ITT-Initiative[13] or the South African Government's South African Renewables Initiative (SARi). SARi seeks to spur renewable electricity growth at a scale that would unlock opportunities for local industrial development, regional development, export competitiveness and medium-term energy security. Domestic sources of finance include anticipated increases in the electricity tariff (which is currently heavily subsidised), as well as new policy measures, namely a "green energy purchase" contribution by energy intensive users and a non-renewable electricity levy. These are complemented by various sources of international finance including

[12] Some of the emerging economies have opted for feed-in tariffs, including China and India. In Africa, five countries have adopted feed-in tariffs to date: South Africa, Algeria, Kenya, Tanzania and Uganda. Most of the feed-in tariff schemes have been introduced only recently, and almost no information on their implementation is yet available.

[13] The Ecuatorian Government offers to prevent oil drilling in the Yasuní national park if international donations are made available. The donation is likely to be spent mainly on renewable energy projects.

concessional loans and donor grants. However, the concept is still under development and no final (financial) commitments have been made by either the South African government or international donor countries (Bausch et al., 2010).

More "traditional" finance is provided by multilateral and bilateral loans and grants or via direct finance e.g. provided by development assistance expenditures. Multilateral funds on a project basis are e.g. the Clean Technology Fund (CTF) or the Strategic Climate Fund, both administered by the World Bank. On an UNFCCC-level the "Green Climate Fund" is still under negotiations but is expected to provide considerable financial resources for clean technologies in the future. On the European level, the Global Energy Efficiency and Renewable Energy Fund (GEEREF), administered by the European Investment Bank via the European Investment Fund, supports, *inter alia*, access to sustainable energy services (see Behrens, 2009).

To fulfil the goal of clean technology transfer as stated above, the Clean Development Mechanism (CDM)[14] has been set up under the UNFCCC to provide market-based incentives to developed countries to transfer technologies, including RE, to developing countries. Projects can generate income via the generation of certified emission reductions, which can be sold on international emissions trading markets. Under the CDM, over 4,300 renewable energy projects have been registered to date, including more than 1,700 hydropower and 1,600 wind power projects. The main host countries for CDM projects turned out to be rapidly industrialising developing countries like China and India (UNEP Risoe, 2011). Less developed countries often lack the capacity to register for CDM certification and built up required institutions. Furthermore, the contribution of the CDM to technology transfer has decreased over time as more traditional means, such as trade and licensing agreements have taken hold (IPCC, 2011). Redesigning and improving the CDM and offering better options for least developed countries is an on-going topic at the UN climate negotiations. The CDM is not able to fulfil complex political goals like providing decentralised energy supply in rural areas.

Small-scale projects in the developing countries, especially for cooking, lighting and heating in rural areas, are financed by the campaigns or support programs of NGOs, often with international donor grants. These projects usually prioritise access for the poorest communities and tend to take into account the development needs of energy users. Examples are numerous: The Solar Cookers International (SCI) distributed or inspired more than 500,000 solar cookers focusing on developing countries that have abundant insulation and diminishing forest sources such as Kenya, Haiti, Zimbabwe, and Tanzania (Aid for Africa, 2011). Another example is the "Lighting a Billion Lives" project (see Chapter 3) where the Energy and Resources Institute (TERI) is allocating solar lanterns to improve access to clean lighting and improve human health.

Another growing source of finance comes from energy customers themselves. Willingness to pay amongst even the lowest income communities is now widely acknowledged (OCI et al., 2011) if the right payment schemes can be applied. Fee-for-service and local ownership via micro-finance are two models being applied by both private sector and non-for-profit enterprises (see case studies on Yeelen Kura and Grameen Shakti in Chapter 3). Both models still require some subsidies but the element of local buy-in and engagement can help increase the sustainability of RE schemes and the potential for scale-up as well as disincentivising theft or resale of equipment. The Grameen Shakti model sets repayments for solar home systems based on the price a household would be paying

[14] Article 12 of the Kyoto Protocol defines the new Clean Development Mechanism (CDM) is a multilateral mechanism to assist Non-Annex I Parties (developing countries) in achieving sustainable development while allowing Annex I Parties to comply with their reduction commitments.

kerosene on a monthly basis. After the payback period the monthly energy costs are much lower or even zero.

4.4 Aside: The Impact of Renewable Energies on Water Resources

Some of the RE technologies rely on local water resources and in turn can affect water availability and quality. Water is crucial for ensuring communities' physical and economic resilience in developing countries. A lack of access to clean and sufficient water and sanitation puts poor communities at risk for diseases including malaria, filariasis, schistosomiasis, and intestinal worms. Water is also crucial for poverty reduction in agrarian communities. In rural sub-Saharan Africa, between 80% and 90% of families are farmers whose livelihoods depend on access to water (UN-Water, 2007). Biofuels derived from energy crops, hydropower and concentrated solar power (CSP) provide the greatest potential conflicts between renewable energy and water resources.

4.4.1 Biofuels

Growing certain crops for the production of biofuels can have negative effects on water resources, first by increasing demand for water and depleting already scarce water resources, and secondly, by polluting groundwater and aquatic ecosystems through the increased use of pesticides and fertilisers. On average, a single litre of biofuel requires 820 litres of irrigation water. But in India, where biofuels are largely produced from irrigated sugarcane, nearly 3,500 litres of irrigated water are withdrawn to create one litre of bio-ethanol. Increased production of sugarcane-based fuel will further strain a country already subject to regional and seasonal water shortages (de Fraiture et al., 2008). However, not all biofuel crops require increased water use. The *jatropha curcas* tree, a crop used to produce bio-diesel, consumes less water than natural vegetation in South Africa (Water Research Commission, 2008). Jatropha cultivation has been successful in villages in Mali, where the trees are grown as barriers between fields, jatropha oil runs machinery, and the 'press cake' left over from oil production serves as a high grade organic fertiliser (Mali Folke Center, 2007). However, others (Luoma, 2009) report that planting jatropha on agricultural irrigated lands in India has actually increased water use and puts the trees in competition with food crops.

Growing biofuel crops can lead to increased water pollution. Pesticides and fertiliser use results in organically contaminated wastewater that, if released untreated, could increase eutrophication of surface water bodies (FAO, 2008). While rapeseed, corn, and millet are 'high risk' biomass crops, perennial plants raised with sustainable cultivation methods require fewer fertilisers and pesticides (Sachverständigenrat für Umweltfragen, 2007). Biofuel production may also impact water ecosystems more broadly. Africa's wetlands hold half of the world's freshwater. The conversion of wetlands and forests into palm oil plantations or sugarcane fields would decrease the quantity and quality of the water that reaches these rich ecosystems (Sielhorst et al., 2008).

4.4.2 Large-scale hydropower

Hydropower consumes very little water (only a limited amount is lost due to evaporation) but can alter water quality, change river ecosystems, cause sedimentation and erosion of river deltas and bring about conflicts over water usage (Nüsser, 2003; Kumar et al., 2011). The problems associated with hydropower mainly pertain to large dams and not to small and micro hydropower projects (for information on small hydro power see Gaul, et al., 2010). The impact on water quality mainly derives from filtering solid wastes from rivers and increasing water oxygen levels, yet dams may also redirect a river and alter timing of its flow, increasing the temperature of the water downstream, which impacts ecosystems such as fish populations. Furthermore, unlike swiftly flowing rivers, the reservoirs created by flooding in order to maintain spare capacity can breed waterborne diseases including malaria, river blindness, dengue or yellow fever. Water stored in reservoirs may also contain a harmful level of mercury (Kumar et al., 2011).

In arid and semi-arid areas, sediments get caught in hydropower plants, leading to land erosion in river deltas and to saltwater inundation of groundwater in river delta regions. The High Aswan Dam in Egypt has led to a lowering of the Nile bed by two to three meters and interfered with irrigation (Helland-Hansen et al., 2005). In Tanzania, hydropower generation in the Rufiji and Pangani basins is downstream from agricultural lands. During dry months, electricity generation is prioritised over agricultural uses, reducing the water available for agriculture and affecting local farmers (Mdemu and Magayane, 2005).

Resettlement of inhabitants of the flood zone has rarely been successful and the effects can last for decades. For example, the Tonga people who were displaced by the building of the Kariba Dam in the 1950s between what is now Zambia and Zimbabwe still campaign to be compensated for the loss of their lands, livelihood and culture. In India, some dam projects have been delayed for decades due to civil society protests (e.g. the Narmada Valley Development Project in India). In some cases, it may be possible to avoid such problems with the proper social and environmental strategies. Run-of-river designs can avoid some of the above-mentioned impacts as they do not require substantial flooding of the upper part of the river – the 1450MW Ghazi-Barotha project in Pakistan, which has been running for 8 years, is one example.

4.4.3 Concentrated solar power

Concentrated Solar Power (CSP) systems use mirrors or lenses to concentrate solar energy and generate electricity through a steam cycle. CSP projects require two to four times the water used in natural gas plants for cooling during the steam cycle, and also require water to clean the mirrors. Because water is often scarce where sunlight is most plentiful, water is a limiting factor in CSP systems (US DOE, 2008). So far there are only few CSP plants in operation and none in a developing country. Thus, hardly any experience of possible water conflicts has been reported.

4.5 Conclusions

Implemented correctly, the use of renewable sources to provide energy services can offer an economic solution in developing countries with benefits to health, the environment and local development. Local RE sources contribute to energy independence and reduce the exposure to volatile prices of resource imports.

However, large-scale RE projects can have severe social and environmental impacts, especially large hydropower and excessive crop planting for biofuels. Therefore, large and small-scale RE services need to be differentiated. Small-scale REs have in general positive effects on local communities and almost no negative effects on the environmental. As grid-connection is mainly absent in rural regions and extending the grid is not an economically viable option, there is a great potential for decentralised RE systems. They can provide services without the negative health and environmental effects of traditional and conventional energy sources.

The sustainable introduction of RE technologies in developing countries, however, requires a range of supporting tools and processes. In poor rural settings without access to modern energy, the success of a project will rely to an even greater extent on the efforts of host government, donor and implementer to raise public awareness, conduct on-going training, build local and possibly national governance and regulatory capacity and help develop local markets.

Furthermore, the likelihood of technology transfer increases with more stringent and widespread environmental policies and incentives for adoption of low-carbon technologies. Developed countries can provide assistance with the national design and roll-out of these policies. Governments of emerging economies increasingly recognise that their own efforts can help to increase the number of renewable energy projects while benefitting from international financial sources.

Any RE project should be evaluated against local circumstances including sustainability criteria such as social and environmental effects. In India and sub-Saharan Africa, water resources are crucial to the economic development and health outcomes of poor communities and should thus be treated with special care. RE projects such as large-scale biofuels or hydropower projects may have a significant impact on water resources. Thus, local water scarcity and quality, as well as the livelihood of the populations need to be taken into account when planning especially large-scale projects. In particular, the participation of and added-value to rural communities must play a larger role than it does in current decision-making frameworks.

5. THE EU ROLE, NEW FUNDS AND PROSPECTS FOR COORDINATION

The dual challenge of increasing access to energy and mitigating climate change in the energy sector call for increasing collaboration between international organisations, states, multilateral development banks (MDBs) and other development banks. The multiplicity of donors and lack of coordination require a further push to improve coherence in development aid in line with the Paris Declaration on Aid Effectiveness (2005) and the Accra Agenda for Action (2008)

However, at present finance for clean energy technology and greenhouse gas emissions reductions and finance for increasing access to energy are not necessarily joined up or coordinated. At the international level, the major players in delivering the energy-related funding, development assistance, technology and technical support to India and sub-Saharan Africa include the European Union, the USA, Japan, UNFCCC, UNDP, World Bank (International Bank for Reconstruction and Development, IBRD, and the International Finance Corporation, IFC), the Asian Development Bank (ADB), and the African Development Bank (AfDB). In terms of funding, the EU has funded energy projects in developing countries through the European Development Fund (EDF) and partially through the neighbourhood policy, in particular North African States. However, European Commission managed funds only represent approximately 20% of total development aid by the EU. In addition, it is clear that funding cannot be delivered solely through public budgetary transfers, but needs to include large targeted flows from development loans and private funding.

In terms of volumes of funding the OECD has published figures up to 2008 of aid to energy. It estimates that total annual average aid commitments in 2007-2008 were EUR7 billion. Table 5.1 presents the distribution of donors.

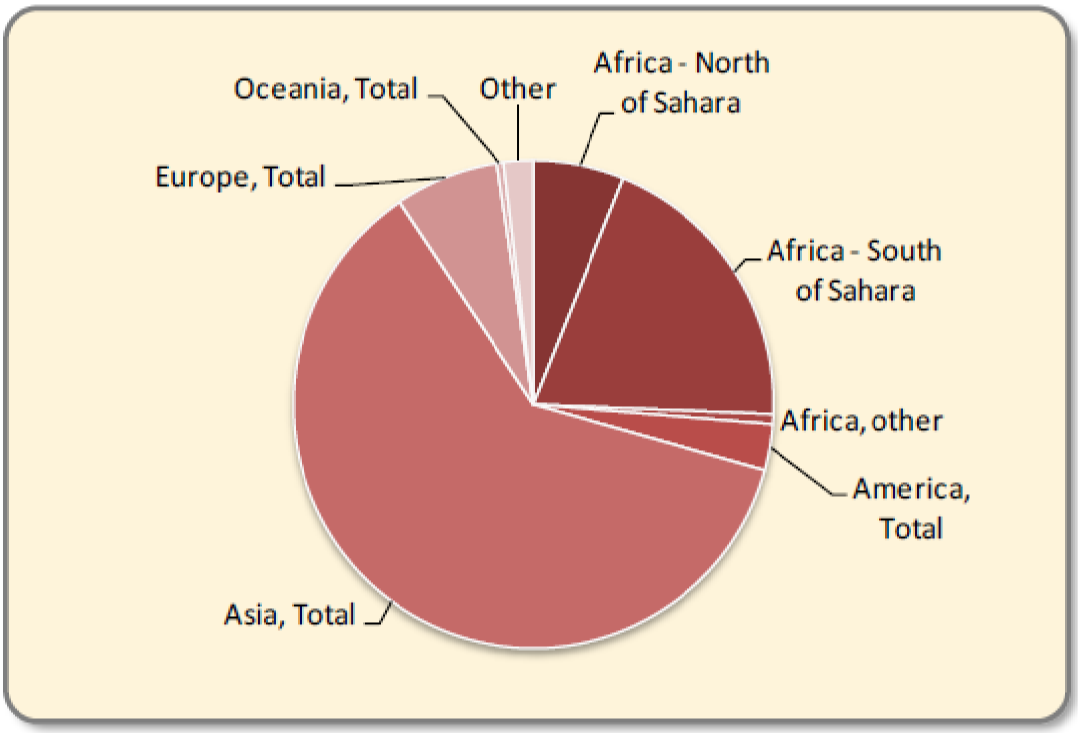
Table 5.1. Aid to energy by donor

	Commitments, USD million			% of Donor Total			Disbursements, USD million	
	2003-04	2005-06	2007-08	2003-04	2005-06	2007-08	2005-06	2007-08
Australia	0	8	21	0	1	1	5	13
Austria	1	7	9	1	3	2	5	9
Belgium	11	5	30	1	1	3	3	5
Canada	16	15	10	1	1	0	13	9
Denmark	45	50	45	4	4	5	43	49
Finland	17	37	6	5	8	1	4	9
France	103	106	108	2	2	2	94	126
Germany	313	564	844	7	10	12	242	465
Greece	0	0	1	0	0	0	0	1
Ireland	0	0	0	0	0	0	0	0
Italy	50	194	27	8	24	3	100	76
Japan	1829	1092	1428	26	13	13	756	1108
Luxembourg	0	1	2	0	0	1	1	2
Netherlands	70	66	139	3	2	4	43	80
New Zealand	1	2	1	1	1	0	1	1
Norway	68	74	177	5	4	8	115	219
Portugal	1	1	0	1	0	0	1	0
Spain	80	42	261	6	3	9	52	73
Sweden	56	45	59	4	2	4	46	51
Switzerland	22	19	19	3	3	2	21	14
United Kingdom	181	137	45	5	3	1	76	50
United States	1598	1212	1413	10	7	7	1555	1060
Total DAC countries	***4463***	***3676***	***4642***	***9***	***6***	***6***	***3175***	***3420***
AfDF	71	55	198	5	4	14	41	40
AsDF	92	38	75	5	3	5	..	..
EC	165	507	567	2	5	5	152	321
IDA	791	715	1448	7	8	12	473	879
IDB Sp.Fund	..	19	23	..	4	8	..	..
UNECE*	..	..	1	..	..	14	..	1
UNDP	0.4	1	1	0	0	0	1	1
GEF*	..	..	16	..	..	12	..	..
Total Multilateral	***1119***	***1335***	***2328***	***5***	***6***	***9***	..	..
Total	***5582***	***5011***	***6971***	***8***	***6***	***7***	**..**	**..**

Source: OECD (2010)

While the sources of energy funding are interesting, their destination is particularly interesting. According to the OECD, assistance to Africa is far behind the assistance to Asia (Figure 5.2)

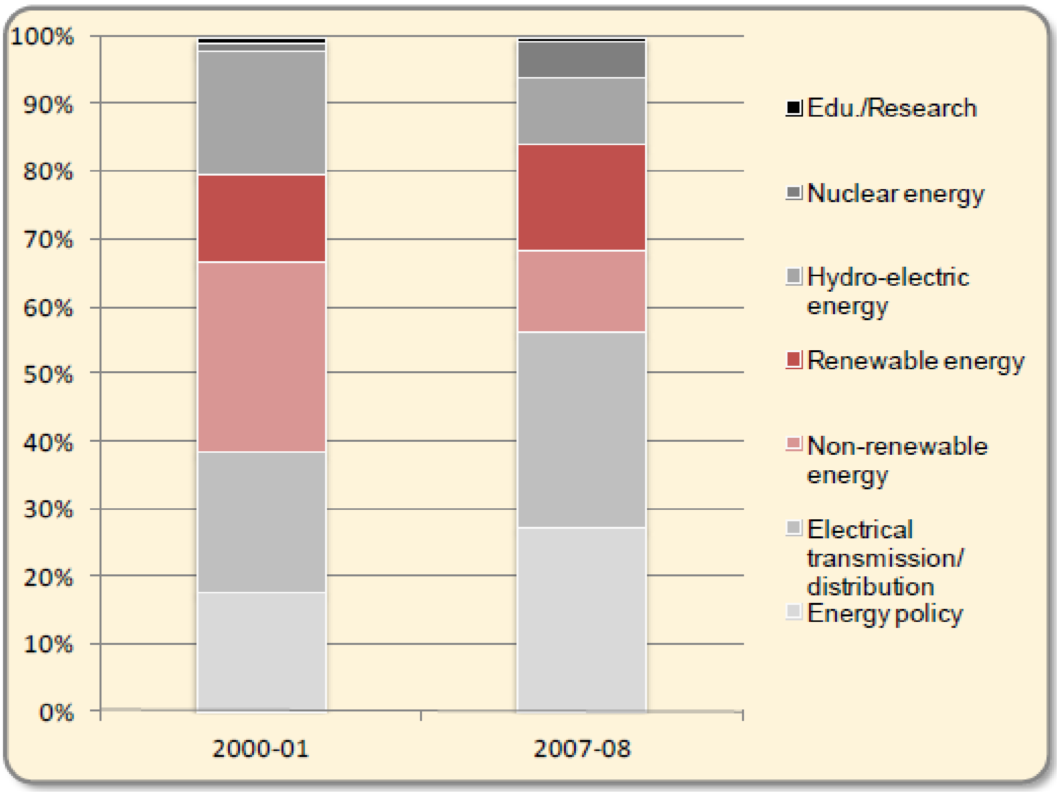
Figure 5.2. Regional breakdown of aid to energy (commitments 2003-2008)



Source: OECD (2010)

One of the findings of the study is that the composition of aid has shifted towards renewable energy (Figure 5.3). Electrical transmission and distribution and energy policy have increased considerably.

Figure 5.3. Sub-sectoral breakdown of aid to energy



Source: OECD (2010)

The energy needs in developing countries are urgent and often complex. Ensuring that those needs are covered in a more equitable way and through a low carbon path calls for global solutions and concerted action amongst donors. This section considers new major funds that could contribute to this agenda and some of the challenges in maximising their effectiveness.

5.1 New global climate investment funds

Until recently energy investments for development have been dominated either by direct development aid from developed countries, loans from development banks or the Clean Development Mechanism (CDM) (often supported by development banks). The Global Environment Facility (GEF) also has a role in financing energy projects that assist in mitigation.

A new instrument with a focus on climate-related investments, and thus to a large extent for energy, is the Climate Investment Funds (CIF) administered by the MDBs.[15] These are intended to manage the international financial commitments to climate change agreed at the COP-15 of the UNFCCC in the Copenhagen Accord of 2009. The CIF Funds are to be disbursed as grants, highly concessional loans or risk mitigation instruments.

The CIFs is composed of two trust funds, the Clean Technology Fund (CTF) and the Strategic Climate Fund (SCF). The mandate of the CTF is the following (UNFCCC, 2009):

(a) providing positive incentives for the demonstration of low carbon development and mitigation of greenhouse gas emissions through public and private sector investments;

(b) promoting scaled-up deployment, diffusion and transfer of clean technologies by funding low carbon programs and projects that are embedded in national plans and strategies to accelerate their implementation;

(c) promoting realisation of environmental and social co-benefits thus demonstrating the potential for low-carbon technologies to contribute to sustainable development and the achievement of the Millennium Development Goals;

(d) promoting international cooperation on climate change and supporting agreement on the future of the climate change regime;

(e) utilising skills and capabilities of the MDBs to raise and deliver new and additional resources, including official and concessional funding, at significant scale; and

(f) providing experience and lessons in responding to the challenge of climate change through learning-by-doing.

The SCF has three programmes, for forests, for climate resilience and one for 'Scaling-Up Renewable Energy in Low Income Countries (SREP)', which is aimed at promoting low carbon development pathways in the energy sector through renewable energy solutions. The SREP is focused particularly on renewables and energy access.

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[15] African Development Bank, Asian Development Bank, European Bank for Reconstruction and Development, Inter-American Development Bank, and World Bank Group.

5.2 EU Financing instruments for energy in developing countries

EU development aid finances energy programmes in developing countries through a number of instruments. However, for Africa the EU has recognised the need for a more concrete and well-structured policy on energy. As a result, in 2008, the EU launched the Africa-EU Energy Partnership (AEEP) one of 8 partnerships of the Africa-EU Joint Strategy for development.

The aim of the strategy is to improve access to sustainable energy sources in Africa, focusing also on the need to achieve the MDGs. The partnership instruments and goals are described in a roadmap,[16] which includes an overview of the EU financial instruments financing energy projects in Africa.

The biggest support to energy projects has been offered by the European Development Fund (EDF); the 9th EDF (2002-2007) offered EUR448 million mainly as interest rate subsidies and Technical Assistance through the European Investment Bank in ACP countries.[17] For the 10th EDF (2007-2013) there should be a similar amount invested in energy, but no precise figures exist. The Energy Facility I programme (2005-2008) financed EUR220 million through EuropeAid on energy access and has been followed by Energy Facility II (2009-2013) with EUR200 million. The ENRTP[18] programme financed between 2007-2010 EUR120 million on energy. The GEEREF[19] managed by EuropeAid and the EIB invested EUR70 million in energy related investment, in particular renewables and energy efficiency. Smaller programmes by EuropeAid have an energy component in particular for technical assistance. In addition, the recently established Infrastructure Trust Fund (ITF) for Africa which coordinates and blends EU budget and loans from EU development Banks is mobilising large sums for regional energy projects. The Fund itself dedicated around 40% of its EUR108 million fund on energy between 2008-2009 and is expected to again use around 40% of its EUR300 million fund for 2009-2013. This fund is primarily used as a risk guarantee or interest rate subsidy, thus leveraging large funding from the EDF and other sources. Between 2009 and 2011 the ITF approved 19 projects with a grant value of EUR175 million, leveraging close to EUR1.3 billion in loans from EBFIs and IFIs for a total project cost value of EUR2.2 billion (Nunez Ferrer et al. 2011, this is further elaborated in section 5.3).

The Africa-EU Energy Partnership (AEEP) and its sub-programme for renewable energy seems primarily to focus on large projects and interconnectors with less emphasis to local energy solutions. A bias towards traditional large centralised power sources seems to be clearly present. The document has a very strong top down policy approach and does not seem to incorporate the increasingly promising potential of local solutions, which also bring higher local benefits and a sense of ownership. The repeatedly mentioned need to leverage for higher private financing, which in Africa is due to higher risk complex and expensive, may create an excessive focus on more profitable (and thus more expensive to customers) rather than the more simple need of financial sustainable projects which require lower margins.

Unfortunately, it is difficult to estimate the total EU assistance to developing countries in the area of energy, as approximately 20% EU development aid is managed by the European Commission through the EU budget and the EDF. The Road Map of the Africa-EU Energy Parnership does not record member state assistance.

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[16] Africa-EU Energy Partnership Road Map, created 9 September 2009 and revised 19 August 2010,

[17] Countries from Africa, the Caribbean and the Pacific.

[18] Environment and sustainable management of natural resources, including energy

[19] Global Energy Efficiency and Renewable Energy Fund

There are initiatives in the area of energy in which the EU and its institutions have little or no role in the operations and funding. This latter is the case for example of the CDKN Climate and Development Knowledge Network funded by the UK Department for International Development (DFID) and also the Dutch Ministry of Foreign Affairs.

5.3 Cooperation within the EU and with key multilateral stakeholders

The EU is an important stakeholder within the Multilateral Development Banks and the international bodies handling action on energy and climate in developing countries, although it is not represented as an entity but through the participation of its member states. Thus while the EU is often considered as a key player in the multilateral negotiations such as those of the UNFCCC, its influence is diluted by the lack of formal representation as a partner within the institutions. As witnessed at Copenhagen in 2009, the absence of the EU proper undermines its influence and is de facto confusing (see Alessi et al., 2010).

Nevertheless, the EU is the largest aid donor with a commitment to assist in the development of sustainable energy solutions in developing countries. This calls for internal and external coordination.

Within the EU, development assistance comes from a number of important players, which need to offer a coordinated response. These include the development aid budgets of the member states, the development funds of the European Union, the European Investment Bank (EIB) and a number of European bilateral development financial institutions (the largest ones being Agence de Development de France (ADF) and KfW of Germany).[20] In addition there are other European international financial institutions, chiefly the European Bank for Reconstruction and Development (EBRD) which, although mainly engaged in the territories of the former Soviet Union, finances projects in developing countries through the Clean Development Mechanism (CDM). Other smaller development banks and institutions may also play a part, but will not be treated here.

The EU could further coordinate the action of the different institutions involved to ensure coherence of objectives and optimum impact of aid and investments. A leap forward has been already achieved through the development of new region-specific EU loan and grant blending instruments to pool development assistance from the EU member states and to link the EU budget to the joint lending facilities of European bilateral development banks. These include the Infrastructure Trust Fund (ITF) for Africa, which has been involved in large regional energy projects and two new instruments being developed for Asia: the Asia Investment Facility (AIF) and the Investment Facility for Central Asia (IFCA)[21]. For the implementation of large projects and the development of energy infrastructures, these recently created funds can provide an important impetus in the financing climate related infrastructure needs. Grants offer either forms of risk guarantees or direct funding for specific parts of projects, such as preparatory technical assistance, which increases the bankability and interest for the development banks to undertake larger investments. The multiplier effect in terms of leveraging additional loans with a small number of grants has been considerable. It has jump-started a level of unprecedented collaboration amongst European development banks, which are increasing integration across their operations beyond the joint investment facilities.

[20] To give an idea of the role of the EIB, ADF and KfW have committed approximately EUR6650 million during 2009 to climate finance, mostly mitigation actions related to energy (UNDP (2010).

[21] The EU has introduced this model for its neighbourhood policy NIF (Neighbourhood Investment Facility), for the Western Balkans WBIF (Western Balkan Investment Framework) and is expanding it also to Latin America LAIF (Latin America Investment Facility).

Collaboration with Multilateral Development Banks (MDBs) is increasing by encouraging collaboration and cooperation with the MDBs. Joint projects and the participation of MDBs in the ITF are increasing, allowing better coordination and greater leverage of funds. This is all in line with the Paris Declaration on Aid Effectiveness (2005) and the Accra Agenda for Action (2008) as well as the European Code of Conduct on Division of Labour in Development Policy (2007).

While this increased coordination between the EU, international organisations and MDBs is positive, there are unresolved tensions over the future handling of the finance, particular climate funding in the energy sector. Through blending facilities, such as the ITF, the EU has become a visible development actor in Africa with a clear influence on the recipient countries. The possibility of the EU having to choose between using mechanisms like the Climate Investment Funds (CIFs) or its own European instruments may eventually arise. The role of the MDBs in the European blending facilities also remains unclear. While collaboration is encouraged, the participation of the MDBs within the facilities as equal partners is a subject of controversy.

The design of EU-wide investment mechanisms also encourages participation of the private sector in developing country energy sector projects. This is now widely recognised to be an important factor in increasing the effectiveness and sustainability of aid. Energy investments generally require high upfront capital costs which should be recovered over a certain period of operation. In developing countries, the initial investment is often hampered by higher risk factors (which may include political risk and low or negligible returns on investment due to subsidised domestic energy prices) and the lack of domestic financial institutions, infrastructure and regulatory and technical capacity. These risks may be higher for investments in RE projects. This means that for a large number of investments, the optimal solutions are not pure grants and loans from development banks, but joint public-private partnerships, which can be tailored to local needs. The European blending instruments allow and encourage the participation of local financial institutions in the projects as partners, and have a central role in offering technical assistance.

The size of grants and the level of concessional loans (low interest subsidised loans) depend on the local circumstances and the risks for development banks. Risk can be regulatory, costs overruns and in particular, interest rate and exchange rate instability. For Africa, the perception of higher risks has proved a major barrier to the use of loans and PPPs.

The European Union is a stakeholder in a number of Global initiatives on Energy, such as the Renewable Energy & Energy Efficiency Partnership (REEEP) supported by a number of EU and non-EU developed country governments and the private sector. In 2009 the International Renewable Energy Agency (IRENA) has been established as part of a UN initiative. With its interim headquarters based in Abu Dhabi (UAE), IRENA currently has 148 signatory countries, 84 countries of which are members including as an entity the European Union. Important in the area of development in support of the environment is the Global Environmental Facility (GEF) set up by the United Nations and which invests considerable in renewable and local energy projects.

5.4 Improving EU assistance in the area of access to energy in developing countries

The European Union can play an important role in assisting developing countries to provide energy access to their citizens. It is a large donor and advanced in the development of energy solutions. As a key member and donor of international initiatives such as IRENA and GEF the EU can play an important role. With the Africa-EU Energy Partnership the EU has a strong influence in Africa and is directly involved with partner countries to develop their energy strategies. This influence can help coordinating and streamlining the development of energy systems in Africa not only from European donors but also other donors and MDBs.

Nevertheless, European development assistance still lacks coordination. The problems due to the multiplicity of donors have been well documented by a study financed by the European Commission (European Commission, 2008). While efforts have been done to implement the European Code of Conduct on Division of Labour in Development Policy agreed in 2007, further efforts are needed. A coherent strategy and actions by the EU can also streamline and better coordinate the work of other non-EU donors, indirectly benefitting the developing countries through more coherent strategies. The energy partnerships in Africa will in turn influence the work of organisations involved in the developing countries, getting those partnerships backed by appropriate strategies designed in partnership with the beneficiary countries is essential. In the forthcoming Fourth High Level Forum on Aid Effectiveness in Busan, South Korea in November 2011, there is an opportunity for the EU to promote further harmonisation and discuss the need for ensuring that development aid for energy focuses on sustainable low carbon technologies.

In addition to better coordinate EU government donations, the actions of the separate European bilateral development financial institutions need to be further streamlined. The experiences of the Infrastructure Trust Fund (ITF) in Africa and other similar financial blending mechanisms in the Neighbourhood policy point to the benefits and needs to reinforce such instruments. As funding becomes scarcer, finding the most efficient funding distribution between the public and the private sector becomes imperative. Nevertheless, the ITF operations are very restrictive, only funding large cross-border projects. While other instruments, such as the Energy Facility programme handle smaller projects, there is a need to develop more coherent strategies.

Questions need to be raised on the kind of energy networks, which are most appropriate for the client countries. Should energy solutions for local communities be more prominent or larger more centralised energy sources? The choices can have strong repercussions on the development of the countries and the sustainability and access to energy will need a balance between solutions. Large energy installations may be favoured, by donors and recipient governments for reasons of visibility, and by investors and financiers for the financial dividends, which are easier to monitor and appropriate. Large infrastructures may, however, not suit the economic and social structure of the country and fail to provide energy access to the poor, for whom smaller local energy sources may be more appropriate. The choice of different development paths and their environmental and social impact need to be analysed more closely. Energy choices and what kind of development is to be promoted are questions, which have not been treated well enough to date.

As an important donor, the EU has a privileged position in shaping with the recipient country a development path for the countries. There is a need for the EU internally to determine what it is going to support in developing countries and how to create a workable partnership with the beneficiaries. At the present state, the EU instruments and its relations to the beneficiary countries are too top down and partially disconnected with the realities on the ground.

6. CONCLUSIONS AND POLICY RECOMMENDATIONS

There is an urgent need to combat energy poverty by increasing access to energy, especially in rural areas, where about 85% of those without energy live. Improved access to energy is now widely acknowledged as essential for the achievement of the Millennium Development Goals, to which the EU has subscribed, and there is impetus at the UN level to catalyse efforts towards the goal of universal energy access by 2030. But challenges remain. Estimates show that some USD36-48 billion in investment is needed annually to meet this goal. With competing demands for development funding and straitened economic circumstances in many donor countries, it is not clear if this will be forthcoming. In light of these challenges and the EU's growing role in this area, this study has surveyed the current status of energy poverty in the worst affected regions, reviewed the current approaches in donor-funded energy projects and made specific observations relating to the promotion of environmentally-sustainable energy solutions.

In the short-term, the cheapest ways to increase power capacity or provide basic off-grid energy needs are often environmentally unsustainable with damaging impacts for the poorest groups. Concerns about developing countries building infrastructure today that will lock them into long-term dependence on volatile markets for fossil fuels and escalating GHG emissions are well documented. Moreover, this study makes clear that additions of large-scale grid connected electricity, for various economic and governance-related reasons, are unlikely to benefit the poorest communities who reside in slums or sparsely-populated rural areas. The latter still largely rely on the traditional use of biomass, coal and kerosene – with negative effects on their health and environment.

The need to improve health in the poorest social groups, and the longer-term human security requirement of setting a country onto a sustainable, low emissions path and ensuring biodiversity demand a more visionary approach. The market and current government policies in many countries suffering from energy poverty do not incentivise these longer-term goals. Therefore, there is a need not only for donor finance but also wide-ranging efforts to ensure that investments are sustainable, socially, environmentally and, in time, economically.

This presents a daunting challenge for both developing countries and donors because the demands to respond to immediate crises, e.g. in the power sector of industrialising economies are often pitted against the on-going hardships faced by those without access to modern energy services and with little consumer power. However, as this study showed, there are numerous advantages to be capitalised – the abundant renewable energy resources available in developing countries; the economic opportunities to introduce off-grid solutions which avoid the high transmission and distribution costs of extending the grid and can better suit local needs; and the potential for energy access projects to bring a host of developmental co-benefits.

Progress in Thailand and China, for instance, shows what is possible given political will. In terms of donor-funded projects, there is now a growing literature on the lessons learned from pilots over the last two decades, which offer innovative ideas for bringing energy to poor rural and peri-urban communities. While fossil fuels will inevitably play a major role in expanding energy supply in developing countries generally, the examples given in this study show that renewable energy sources have huge potential to fulfil the needs of those without access, or with poor access, to modern energy services. The successful examples demonstrate the capacity for scale-up of decentralised, renewable energy solutions, which could avoid the expensive legacy of carbon-intensive development undergone in OECD countries.

The following points summarise the findings of this study, also drawing on relevant proposals made by other institutions, especially the African Development Bank (2011), the IIASA (2011), and the IEA (2010; 2011). These are followed by a number of policy recommendations for donor governments in general and the EU in particular. These are put forward within the context of the principles of ownership and alignment,[22] acknowledging the support that donor countries and organisations can offer developing countries in their efforts to increase access to modern and clean energy.

6.1 Summary of conclusions

- Donor countries have an important role to play in scaling up successful initiatives to expand access to modern energy services in a way that will help to alleviate negative health, environmental and economic impacts.
- Investments need to be scaled up considerably to achieve the UN target of universal access to energy by 2030. Estimates show that some USD36-48 billion will be required per year to meet this goal. About two thirds of the required investments will need to be borne by the public sector (multilateral and bilateral development sources and governments in developing countries in almost equal parts) and the rest by the private sector.
- Access to energy initiatives have the greatest chance of success where there is political will from the leadership to achieve energy access goals and well-defined national energy access targets built into development strategies, policies and programmes. Conversely, lack of long-term political commitment and the necessary legal and regulatory framework to incentivise implementation is a barrier to mobilising investment and enabling the private sector. In addition to providing financial resources, bilateral and multilateral donors with the relevant experience may increase the success of investments by working with developing country governments to develop targets, policies and strategies and build the necessary capacity.
- There is no one-size fits all model for extending access to energy. Each country/region has specific energy resource endowments, infrastructure and needs. The most successful projects to increase access to energy have been those that take into account not only the national context but also the socioeconomic, cultural and capacity specificities of target communities. Flexibility and monitoring and evaluation in project design are key. Many initiatives have benefitted from adapting and evolving in response to experience.
- The involvement of local communities in the planning and implementation of the energy service strategies is likely to increase sustainability and can bring multiple co-development benefits from stimulating income-generating activities to empowering women.
- Decentralised, small-scale and off-grid solutions are often more appropriate than centralised large scale power projects in meeting the specific needs of poor rural communities. In terms of access to electricity, off-grid solutions can be more economical than grid extension in many parts of rural sub-Saharan Africa and South Asia due to the low population density, relatively low energy demand and lack of existing infrastructure.

[22] The principle of ownership is enshrined in the Paris Declaration on Aid Effectiveness (2005) and the Accra Agenda for Action (2008) and calls on developing countries to set their own strategies for poverty reduction, improve their institutions and tackle corruption. The principle of alignment requires donor countries to align behind these strategies and use local systems.

- Market conditions have usually deterred the private sector from financing the start-up and service costs for small-scale projects in poor regions so they are dependent on donor aid and/or state subsidy. However, the willingness to pay amongst even very low-income groups is now widely acknowledged and their financial contribution can help to increase the sustainability of a project. Specially-designed mechanisms such as micro-finance, affordable tariffs, community billing and a shares in a service company can also help improve the commercial viability of a project, helping to attract private sector participation.
- The EU can make a significant contribution to the goal of universal energy access, as a strategic trading partner for sub-Saharan Africa, as a major development donor with influence at the international level and with its wealth of member state experience in innovative energy solutions. Its role in the coming years will involve both helping to harness the necessary finance internationally and ensuring the effectiveness of its own aid and investment transfers.
- Climate-related funds could increase access to energy in some cases. However, the Clean Development Mechanism (CDM) is not necessarily the best fit for increasing access to energy. There remains low capacity to access such funds in sub-Saharan Africa. The Climate Investment Funds (CIFs) (and in particular the SREP: Scaling-Up Renewable Energy in Low Income Countries) and support from the European Development Fund (EDF) and other EU and member state development assistance offer more promising mechanisms.

6.2 Recommendations

- The EU's development assistance to enhance energy access in rural areas should focus on harnessing renewable energy sources rather than on fossil fuel alternatives, although there are cases where the deployment of these, e.g. in the case of diesel generators and LPG, is preferable to the traditional use of biomass. Support for small-scale energy solutions tailored to individual community needs and capacities should be prioritised. Large-scale, on-grid power generation capacity can improve supplies to on-grid consumers, but should not be conflated with access to energy objectives.
- Renewable energy investments will require a range of capacity building activities and innovative financing mechanisms, which should be supported by the EU. Several on-going initiatives by the EU or EU member states promote local SME operation to scale-up delivery of energy services to the poor and increase developmental benefits. The EU could, in its capacity in the high level UN group, encourage the learning curve by facilitating opportunities for sharing experience and best practice with other donors and partners.
- The EU should develop clear guidelines on environmental sustainability criteria for renewable energy project financing. These would address the impacts on the local communities, the environment and other resources, particularly water quality and availability and advise on the circumstances in which certain technologies and practices should be avoided. These guidelines would help EU, EU member states and partner organisations better navigate this area. The consultations surrounding the World Bank's review of its energy strategy should be useful in this regard.
- The EU and its member states should advocate a stronger focus on sustainable universal access to energy in relevant international negotiations. The Rio+20 summit in June 2012 is an opportunity to propose concrete targets on how to abolish energy poverty and a roadmap on how to achieve them as an integral strategy for greening the economy.
- The EU should further coordinate the action of the different institutions and countries involved in development assistance. A leap forward has been the establishment of region-specific EU loan and grant blending instruments to pool development assistance from the EU member states and

to link the EU budget to the joint lending facilities of the European bilateral development banks. These initiatives should be expanded and reinforced.

- New efforts aimed at increasing energy access for the poor should be guided by the experience of programmes or projects that have developed contextually appropriate models of production, financing, and distribution and that can be self-sustaining. The lessons learnt need to be carefully assessed against the local conditions they originate from and best cases adapted where possible. The EC could provide an online resource to collect and organise member country and global experience to assist with this learning curve.

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Appendix 1. Selected energy projects with international donor financing in South Asia and Sub-Saharan Africa

The table below details a selection of planned and ongoing energy projects with objectives to either increase the quality and reliability of access of, or extend access to, energy.

Country /project/goal	What's involved	Financing	Notes on progress/challenges/impacts
Hydropower – large scale, supplying national grid			
Uttar Pradesh, India – *Vishnugad Pipalkoti Hydroelectric Project* To improve availability of power to 9 states in North India which currently suffer severe shortages; extend access to electricity.	Construction of 444MW run-of-river hydropower scheme on the Alaknanda River.	2011 – 2017 Total: $922m IBRD loan: $648m Implementer: THDC India Ltd.	Submergence of uninhabited area for 3.63mcm reservoir. Estimated saving of 1.6mt of GHG per year if coal or oil-fired plant with same capacity had been built instead Relocation of 265 families and compensation of loss of community forest claimed to exceed national policy requirements. Each project-affected household to receive 100kW of free electricity per month for 10 years. 1% of annual revenue to provide for local development.[23]
Democratic Republic of Congo (DRC) - *Grand Inga/Inga 4Mega Project* A fourth dam on the Inga Would be the world's single largest hydropower plant, to 'light up Africa', and export power to the Middle East and Europe.	Construction of dam and 39,000 MW hydropower plant at Inga Rapids and over 10,000km transmission lines to connect to regional powergrids.	Proposal stage $80bn + Potential funders/supporters: WEC; World Bank; AfDB; SADC; NEPAD. AfDB financing $13.4m feasibility study awarded to AECOM and EdF in Feb. 2011.	Feasibility study phase. Would involve damning the Congo River and diverting along the Bundi Valley. Environmental and social impacts would be massive. Uncertain benefits to poor communities. Local communities in vicinity of Inga I and II do not receive electricity as these were built to supply a mining province 2000km away. Lack of consultation and compensation for local communities in the vicinity of ongoing Inga III dam raises concerns for this project.[24]
Ethiopia *Gibe III Power Plant, Omo River* To increase reliable electricity supply	Construction of 1870MW hydroelectric power plant and transmission lines.	2006-2013 Total cost: $1.7bn Ethiopian Government; EIB; Italian	Under construction. Controversy over inadequate consultation process, inadequate social and environmental impact assessment, no bidding process.

[23] See World Bank project information at http://www.worldbank.org.in/WBSITE/EXTERNAL/COUNTRIES/SOUTHASIAEXT/INDIAEXTN/0,,contentMDK:21388730~pagePK:141137~piPK:141127~theSitePK:295584,00.html [accessed on 3 October 2011].

[24] See 'Congo's Inga: Great Power for Whom', International Rivers, 1 August 2006 http://www.internationalrivers.org/en/africa/grand-inga-dam-dr-congo/congo-s-inga-great-power-whom [accessed 23 on September 2011].

following several blackouts and brownouts in last decade; earn revenue from exporting power to region; offer flood protection.		Development Corporation; Industrial Commercial Bank of China (ICBC); Exim Bank of China; Implementers: construction and installation: Salini Costruttori (Italy).	Dam threatens to destroy riverbank cultivation practises and negatively impact on the ecosystems of the Omo River and Kenya's Lake Turkana, a World Heritage Site.[25] AfDB, EIB and Italy have withdrawn funding considerations.
Coal			
Gujarat, India - *Tata Mundra Mega Power Project* 81,000 new households promised power	*Construction of 4000 MW coal power plant with supercritical technology*	2008-2014 Total: 4.25bn; IFC loan: $450m (2008); ADB loan: $450m Korean Export Insurance Corp (KEIC), The Export-Import Bank of South Korea (KExim) and The State Bank of India (SBI) Implementer: Tata Power Company	On track to be completed two years early in 2012 according to Tata. Will require 11-12mt of imported coal per annum. One report points out that only 0.1% of Tata Mundra's total generated electricity is allocated for households with no access.[26] Even the use of supercritical technology, results in significant emissions per kWh.
South Africa *Eskom Investment Support Project* To increase SA's energy security; increase reliability of supply following power crises of 2008 and 2009.	Completion of 4800 MW Medupi coal-fired power station, using efficient supercritical technology; US$485m for low-carbon energy efficiency components, incl. a railway to transport coal.	IBRD Loan $3.5 billion 04/2010. Construction of Medupi had already begun prior to the WB loan in 2008.	Medupi was around 40% complete in 2011. Commissioning of first unit scheduled for 2012, last unit by 2015. Highly controversial funding decision. Will lock in increasing demand for coal. Water intensive processes may impact on local availability; potentially increased acid drainage from coal mining poisoning water systems. Critics claim project more dollar-based debt and impose 'cost recovery' on ordinary/poor households rather than industry.[27]
Botswana - *Morupule B Generation and Transmission Project* Increase reliable electricity supply; low-carbon diversification strategy; institutional capacity building.	Construction of 600MW coal-fired power station; transmission lines and water supply system; development of "low-carbon" strategy.	2009-2014 Total project cost: $1662m Standard Bank & ICBC: $825m; IBRD Guarantee: $242.66; IBRD investment loan: $136.4 (2009); AfDB $153m; Engineer: Fichtner; Power plant	In progress, expected completion of power station in October 2012. Dependent on ESKOM in South Africa for over 60% of power. Suffered severe power shortages and blackouts from 2007. Similar environmental and debt concerns as above.

[25] *African Dams Briefing*, International Rivers, June 2010.

[26] 'The World Bank's Coal Electricity Headache', Co2 Scoreboard, 24 May 2011 http://www.co2scorecard.org/home/researchitem/19 [accessed on 24 September 2011].

[27] ESKOM and the World Bank: Implications for Ordinary South Africans, presentation by Bobby Peak, groundwork, Friends of the Earth, South Africa. www.ddp.org.za

		contractor: CNEEC (China)	
Gas			
Nigeria - *Nigerian Electricity and Gas improvement Program (NEGIP)* To improve reliability of generation and capacity and efficiency of transmission	Gas and power generation reinforcement and improvement of network transmission; support for gas sector reforms; increase electricity supply in selected cities	2009-2014 $600m ($200m IDA Credits to improve supply $400m in Partial Risk Guarantees (PRGs) in support domestic gas market development.	Nigeria currently flares most associated gas produced so improving the use of this for electricity and heat would help solve its chronic energy shortages but subsidised domestic fuel prices, inadequate distribution networks and security issues have put off investors.
Geothermal			
Kenya – *Menengai Geothermal Power Project.* 1st Phase (PPP project). To develop Menengai geothermal steam field for 200MW power generation. To meet rapidly increasing demand for power in Kenya. No specific plans to connect new customers or serve local communities.	This phase of the upstream activities involves the development of the steam field and steam production. Being donor financed to enable the mitigation of the drilling risk and enable the crowding in of the private sector for the construction of the power plant. Urgency for project underscored by shortages caused by drought reducing Kenya's hydropower capacity in recent years.	2011 – 2016 Total: $497m Geothermal Development Company/ Government of Kenya equity: $189 Agence Française de Développent (AFD) loan: $112; AfDB loan: $80m; IDA loan + grant: $66m; EIB loan: $24m; Scale-up Renewable Energy Program (SREP – Climate Investment Fund) loan + grant through AfDB: $16m; SREP through World Bank: $10m. Implementer: Geothermal Development Company Ltd (GDC)	Project appraisal completed Sept. 2011. Drilling will use water from local spring – water will need to be treated before use - but project claimed to increase local water supplies in long-run. Project to create 912 skilled and about 300 unskilled jobs. Clean energy project with limited impacts on air quality and noise during drilling.[28] Other geothermal projects in Kenya have had little negative environmental impact.[29] Power plant construction to be financed by private investor. GDC in discussions with Chinese Government for $166m and JBIC for $200m in financing for next stage.
Decentralised energy systems - renewable energy focus			
Bangladesh – *IDCOL Solar Home Systems Project* Support Bangladesh's efforts to raise	IDCOL channels grant and refinancing to renewable energy projects in rural areas carried out by Bangladeshi NGOs and MFIs.	2007-2015 World Bank (Carbon Finance Unit) $1m (2007); World Bank: $7.2m	See case study

[28] "Kenya Menengai Geothermal Power Project GDC: Environmental and Social Impact Assessment", prepared by ONEC, African Development Fund, 3 August 2011.

[29] Bw'Obuya, N. M. (2002): *The Socio-Economic and Environmental Impact of Geothermal Energy on the Rural Poor in Kenya: The Impact of a Geothermal Power Plant on a Poor Rural Community in Kenya*, AFREPREN/SIDA/SAREC.

levels of social development and economic growth; reduce carbon emissions – within GoB's vision of 'Electricity for All' by 2020. To install 1milliion SHSs by 2012	Quality assurance program; promotion of indigenous technology	(2010); Additional support from GEF, GTZ, KfW. Executer: IDCOL Implementers:16 NGOs/MFIs	
Energizing Development (EnDev) – various countries including 13 African countries, Nepal and Bangladesh To provide 8.01 million poor people in developing countries with sustainable access to modern energy services by 2014, thus contributing to the MDGs.[30]	Establishing self-sustaining markets for affordable energy technologies, fuels and services adapted to needs. Focus on devleoping institutional and technical capacity. Implemented in coordination with host government, NGOs and private sector partners. Technologies chiefly: photovoltaic energy, grid densification, micro-hydropower, energy-efficient cooking stoves and biogas.	2005-2015 (initially 2005-2009, extended in a second phase) Total: €138m Financed by the German-Dutch Energy Partnership (GDEP)[31]; implemented by GTZ with NL Agency; Local partners	By December 2010 more than 7.2 million people have been provided either with electricity or improved cooking technologies in households Achievements included supporting the establishment of the first solar technology training centre and two university centres of excellence for hydropower in Ethiopia. This programme comes under the EU Africa Energy Partnership.
Zambia - *Renewable energy-based electricity generation for isolated mini-grids in Northern Province and Luapula Province* To help reduce GHG emissions; promote rural RE minigrid scale-up in Zambia.	3 mini-grids: 1MW biomass gasifier, and 1MW small hydropower station and 36kW solar energy minigrid). Promotion of legal, institutional and policy framework and financial mechanism to enable commercial upscale of rural minigrids. Community involvement and transfer to local ownership.	2005-? Total: $7.506m GEF grant: 2.950m; Govt of Zambia: 1.256m; Private Sector investors: 2.75m; UNIDO 0.5m; UNEP: 0.05m Executer: UNIDO	No information available

[30] Figures for this target are given differently in various sources; this figure is based on the GTZ EnDev Factsheet May 2011.

[31] The German-Dutch Energy Partnership (GDEP) is an impact-oriented global sector initiative between the German Federal Ministry for Economic Cooperation and Development (BMZ) and the Directorate-General for International Cooperation of the Dutch Ministry of Foreign Affairs (DGIS)

Kenya, Tanzania, Uganda - *Developing Energy Enterprises Project - East Africa* To result in access to energy products and services to 1.8million people in rural and peri-urban households and provide employment	Enable development of sustainable and widespread industry of micro and small energy enterprises to increase energy services. Project to help start up 1800 MSEs, train 300 business mentors, raise awareness of modern energy services and opportunities amongst 12,000 rural and peri-urban community members.	2008- 2013 Total cost: €4m EU grant €2m Dutch government: ? Partners: The Aga Khan Foundation's Coast Rural Support Project, Kenya; IT Power East Africa; Practical Action East Africa; The East African Energy Technology Development Network.	New businesses enabled by project include briquettes from waste in Uganda, solar mobile-phone charging in remote areas of Tanzania, biogas stoves in Kenya.
Africa - *Lighting Africa* Programme to help develop commercial off-grid lighting markets in Sub- Saharan Africa Goal: to provide safe, affordable and modern off-grid lighting to 2.5million people in Africa by 2012 and 250 million by 2030.	Lowers barriers to entry for off-grid lighting market from design to distribution. Includes quality assurance programmes, market research, help to access finance and consumer education initiatives. There are benefits beyond lighting e.g. some solar kits can also be used to power irrigation pumps.	WB/IFC Initiative 2008 Donor partners: AFREA; Asia Sustainable & Alternative Energy Program; ESMAP; Good Energies Inc. ; Italy, Luxembourg, Netherlands; Norway; PPIAF; REEEP; US Total funding commitments as of 2007-2010: $13.9m	Pilot projects in Kenya and Ghana. Now expanding to Tanzania, Ethiopia, Senegal and Mali Grassroots organisations assisting in training local engineers etc. Health and environment benefits from replacing kerosene lamps with clean energy alternatives. Problems with gaining capital for SMEs, need for more microfinance. Initial cost of solar kits high compared to monthly spend on kerosene.
Malawi, Mozambique, Zimbabwe – *Catalysing Modern Energy Service Delivery to Marginal Communities in Southern Africa* (Regional Micro Hydro) Project. Aim to reach 45,000 people in rural areas and develop 10 private energy enterprises.	Regional micro-hydro project with 15 demonstration plants (rehabilitating 6 existing installing 9 new) adapting best MHS practise models used in Nepal. Includes creation of community based organisations, training of locals in management, technical and manufacturing skills; addressing policy and investment barriers to promotion of decentralised community MHS.	Jan 2008-Dec 2012 Total cost: €2.2m European Commission funding: €1.6m Implementer: British NGO - Intermediate Technology Development Group (Practical Action). Partners; Kwayedza Simukai Manica (KSM), Mozambique; Mulanje mountain Conservation Trust (MMCT), Malawi.	

India - *Renewable energy supply for rural areas* Community-based model to demonstrate feasibility of decentralised power generation.	Setting up a generation and distribution systems for biogas and electricity for productive uses and according to the local availability of renewable energy sources (biomass, non-edible oilseeds, solar). Includes jatropha plantation.	2008 to 2011 Total: €3.5m: GTZ (now GIZ) €2.5m; Partner contributions: €1m (including National Thermal Power Corporation Limited and village energy committees) Executer: Ministry of New and Renewable Energy, Government of India	In 30 rural communities, eight village energy committees have been formed and registered, consultation and planning phase completed, soon to begin generation. Emphasis on linking intermediate products (seeds, oil, press cake, biogas, etc.) to markets.[32]
Ethiopia, Tanzania, Uganda, Senegal & Burkina Faso - *Africa Biogas Partnership Programme* Augmenting the Africa Biogas Initiative (launched 2007) – which aims for 2 million biogas plants installed benefiting 10m Africans by 2020.	Aims to construct 70,000 biogas plants, providing about 0.5million people with energy by 2013. Overall goal to contribute to the MDGs through dissemination of biogas through the dissemination of commercially viable biogas sector.	2010-2013 DGIS, Ministry of Foreign Affairs, Netherlands Government financial contribution: €30m Programme and funds manager: Hivos Implementer: SNF	Several agreements signed including one with Ethiopia to deliver credit financing for biogas households as part of Ethiopia's National Biogas Programme aiming to construct 14,000 digesters to benefit 70,000 people by 2013. Reduces GHG emissions, reduces indoor air pollution, increases productivity from food waste, animal dung, human waste, creates employment. Lack of regulatory framework/commercial incentives for biogas.
Efficiency/infrastructure change			
Uttarakhand Pradesh India *Energy/Electricity Transmission and Distribution* The Project supports the GoI's goal of "Power for All" to provide universal power supply by 2012.	Augmentation of substations and construction of transmission line connecting northeastern to northern/western regions. Tranch 1 to increase grid-connected supply capacity – funding for substations and transmission lines	ADB multi-function financing (MFF) $600m for Facility Concept; $400m for Tranch 1; Tranch 3 under proposal Implementer: Power Grid Corporation of India Limited	Contracts awarded for northeastern-Northern/Western Interconnector
Uganda- *Electricity Sector Development Project*	Construction of 137km Kawanda-Masaka transmission line and substation construction/upgrades; technical assistance and capacity building for Uganda Electricity	2006 – 2015 Total: $153.2	Some areas of the transmission corridor will be affected, resettlement of displaced persons, disturbance of wetland ecosystems. Detailed

[32] GIZ website, http://www.gtz.de/en/weltweit/asien-pazifik/indien/30495.htm [accessed on 22 September 2011].; 'Renewable Energy Supply for Rural Areas: Introduction and Current Status by Jens Burgtorf, http://www.dialogue4s.de/_media/Burgtorf_E.pdf [accessed on 21 September 2011].

By 2015/16: connect 6500 new customers in SW region. By 2020, 59,000 customers (46,000 people); by 2025 84,000 customers (655,000people).	Transmission Company Ltd. Includes funds for resettlement of displaced people.	IDA Loan: $120m (2010)	environmental review and management plan.
Ethiopia – *Accelerated Electricity Access (Rural) Expansion* Initial Goal: 320 towns electrified by 2011.	Rural town electrification; capacity building; energy efficiency & demand side management. Includes distribution of energy efficient equipment – e.g. lamps and stoves.	2006-2012 Total project cost: $184.21m IDA Loan: $133.4m (2006)	65% Progress on initial 320 towns – target now increased to 382 towns. Supported deployment of 5 million energy efficient lamps; lamps helped reduce peak load during power crisis; replacement of inefficient street lighting, installation of efficient streetlighting in new towns. Success of project motivated GoE to ask for Bank support to buy a new batch of 5 million lighting units.
Benin – Access to Modern Energy Project To improve efficiency of the transmission and distribution system and expand access to electricity. Target of 400,000 people with improved access to energy services	Electrical network upgrading; electrification and modern energy services; sustainable energy services. 310km new transmission lines; installation of 200,000 CFLs and efficient air conditioning units; rural electrification fund; 4 decentralised stand-alone generation systems and promote modernisation of biomass energy services including training 300 workers in production of efficient woodstoves.	2009-2015 $176.69m IDA Loan: $70m; GEF grant: $1.82m; Nordic Development Fund grant: €1.5m Specific investment loan	Procurement underway.
India – *Improved Electricity Access to Indian Slum Dwellers (Mumbai)* Project to result in 26,250 safe and legal electricity connections; 8-12000 new connections by 2011.	GPOBA provide one-off subsidy to cover over half the connection cost for households; community awareness building, training electricity contractors; quality verification. Project is part of the larger 'Slum Electrification and Loss Reduction Program' USAID in cooperation with International Copper Promotion Council (India)	2006 – Global Partnership on Output-Based Aid (GPOBA): Subsidy for connection: 1.65m Partners: USAID; Reliance Infrastructure Ltd.	No information available.

Sources: ACP-EU Energy Facility Monitoring www.energyfacillitymonitoring.eu; African Development Bank: www.afdb.org; Asian Development Bank: www.adb.org; Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ): www.giz.de; GIZ EnDev Factsheet: https://www.gtz.de/de/dokumente/giz2011-en-factsheet-Energising-Development.pdf; Global Village Energy Partnership (GVEP): International: www.gvepinternatonal.org; International Rivers: www.internationalrivers.org; Netherlands Development Organization: www.snvworld.org; Netherlands Ministry for Economics, Agriculture and Innovation (AgentschapNL) http://www.agentschapnl.nl/programmas-regelingen/energising-development; Practical Action website www.practical action.org; The Renewable Energy and Energy Efficiency Partnership (REEEP): www.reeep.org; The World Bank: www.worldbank.org; UNFCCC CDM: http://cdm.unfccc.int; United Nations Development Programme: www.undp.org; United Nations Industrial Development Programme: www.unido.org; Yeelen Kura website: www.yeelenkura.com

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