UNIDO CONTRIBUTION to the **4TH UN CONFERENCE ON LDCs**

ENERGY SERVICES

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The material for the background paper draws heavily on the recent literature.

1. Introduction

Access to sustainable, modern, affordable, and reliable energy service is central to addressing many of today's global development challenges, including poverty, gender inequality, climate change, food security, health and education. Yet nearly one-third of humanity lacks access to modern energy forms and services (IEA, 2009). Although energy is not an explicit part of the Millennium Development Goals (MDGs), the provision of modern energy services is recognised as a critical foundation for sustainable development (e.g. UN-Energy, 2005; DFID, 2002; Modi et al., 2005; UNDP, 2005). Yet, progress is far behind what is needed. If current trends continue, more people will be without access to modern energy services in 2030 than at present (IEA, 2009a), a situation that is clearly unacceptable. Changing this trend requires international political commitment that goes beyond abstraction and sets out targets, actions and associated benchmarks (Bazilian et al., 2010a).

Energy services have a profound effect on productivity, health, education, safe water, and communication services. Therefore, it is no surprise that access to energy has a strong correlation to social and economic development indices (e.g. Human Development Index, life expectancy at birth, infant mortality rate, maternal mortality, and GDP per capita).

A few success stories do exist - countries such as China have improved the access for their citizens substantially in the last decades – but all across sub-Saharan Africa, and in parts of Asia, people are living without basic energy services. The demand for energy in these regions is expected to grow dramatically, with increases in population and improvements in living standards adding to the scale of the challenges. It is stunning to realize that, if 'business as usual' conditions are maintained, over the next decades the total number of people without access to modern energy services will not decrease (IEA, 2009). Current efforts are insufficient in scale and scope, and attempting to address the issue in the same way that we have in the past is clearly not remotely adequate. This is why in April 2010 the UN-Secretary-General's Advisory Group on Energy and Climate Change in its recommendations called on the adoption of a target to achieve universal access to modern energy services by 2030 (AGECC, 2010).

The obstacles to energy access are well known. These barriers, while complex, can be overcome, and international cooperation can help this process. What cannot be overstressed is that there are no fundamental technical barriers – we know how to build power systems, we know how to design good cook stoves, and we know how to meet energy demand efficiently. Equally important is a clear understanding that local communities must be deeply involved in the planning, execution, and end-use of energy services. Energy access interventions must be guided by an awareness of local communities' unique situations and needs (Bazilian, 2010b).

What is now required is a sustained political focus. Energy access must move up the political and development agendas to become a central priority.

2. The Scale of the issue

The IEA WEO 2010 had a special chapter on energy poverty. It gives an excellent sense of the scale of the issue: The numbers related to household access to energy are striking. We estimate that 1.4 billion people – over 20% of the global population – lack access to electricity and that 2.7 billion people – some 40% of the global population – rely today on the traditional use of biomass for cooking (Table 1).

Table 1: Number of people without access to electricity and relying on the traditional use of biomass, 2009 (million) (IEA, 2010)

	Number of people lacking access to electricity	Number of people relying on the traditional use of biomass for cooking
Africa	587	657
Sub-Saharan Africa	*585*	*653*
Developing Asia	799	1 937
China	*8*	*423*
India	*404*	*855*
Other Asia	*387*	*659*
Latin America	31	85
Developing countries*	1 438	2 679
World**	**1 441**	**2 679**

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

Note: The *World Energy Outlook* maintains a database on electricity access and reliance on the traditional use of biomass, which is updated annually.

Source: IEA databases and analysis.

Worse, IEA projections suggest that the problem will persist and even deepen in the longer term in the New Policies Scenario[1]; 1.2 billion people still lack access to electricity in 2030, 87% of them living in rural areas. Most of these people will be living in Sub-Saharan Africa, India and other developing Asian countries (excluding China). In the same scenario, the number of people relying on the traditional use of biomass for cooking rises to 2.8 billion in 2030, 82% of them in rural areas. The current electrification rate in selected LDCs is shown in Figure 1.

[1] In the *World Energy Outlook 2010* the New Policies Scenario takes account of broad policy commitments that have already been announced The time frame for the projections is to 2030.

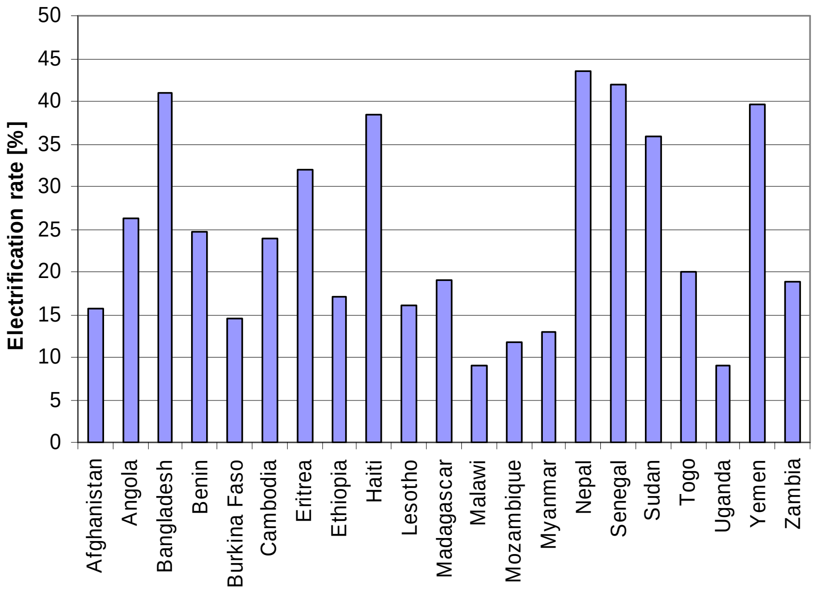

Figure 1: Rate of electrification in 2009 in selected LDCs (IEA, 2010)

3. The importance of energy access

Universal access to modern energy services is fundamental to socio-economic development. Without access to modern fuels and electricity it is highly unlikely that any of the objectives of the Millennium Development Goals will be achieved.

A lack of access to modern energy services hampers healthcare, gender equality, education, and poverty alleviation. For example, cooking on open fires and insufficiently ventilated and inefficient stoves that use biomass and coal-based fuels, results in an estimated 1.5 million premature deaths every year, disproportionately affecting women and children.[2] Many times this number of people suffer from debilitating respiratory infections. Women are further burdened by the long distances they need to travel to collect biomass for fuel – in extreme conditions, women in some areas of rural Tanzania walk 5-10km a day collecting and carrying firewood, with loads of over 30kgs.[3] It is also difficult for children relying on inefficient and poor-quality sources of lighting, such as candles and kerosene, to learn after dark.

The ability of poor communities to make productive use of their natural resources, time and human energy is severely hampered by the lack of mechanical power. Low-income households typically spend 7-15 per cent of their income on energy, but in countries where energy sources are more difficult to come by or prices are comparatively high, energy can account for as much as 30 per cent of the household's monthly expenditure.[4] In certain cases, there will be financial benefits from replacing traditional fuels

2 UNDP & WHO, 2009

3 UNDP, 2008

4 World Bank, 2008; Madubansi & Shackleton, 2006; Abdullah & Markandyab, 2009; ADB, 2005

with modern alternatives. Electric lighting in particular offers substantial cost savings over the most common alternatives (batteries, kerosene and candles).

In addition to these development aspirations, universal energy access is also important for the climate agenda. While universal access to basic levels of energy services will have a limited impact on greenhouse gas emissions (IEA estimates suggest that basic universal electricity access would add around 1.3 per cent to total global emissions in 2030),[5] increasing the level of energy provision and consumption for productive uses could substantially increase this. This underscores the importance of the accelerated deployment of low emissions technologies, where possible. This applies to both the supply side (including lower-emissions fossil fuel-based technologies) and the demand side, where energy-efficient end use devices reduce the amount of power consumed. Ensuring access to these technologies and developing new products and services geared to the needs of low-income communities is therefore critical.

In addition, in many cases there are environmental benefits to providing energy access, either through newer, lower-carbon-emitting technologies (e.g., solar LED lighting), or reducing deforestation by replacing charcoal with modern fuels (e.g., an estimated 20 per cent of deforestation in the Democratic Republic of the Congo is driven by demand for fuel wood and charcoal). The acknowledgement in the Copenhagen Accord of the importance of reducing emissions from deforestation and degradation (REDD) may create a link between carbon finance and energy access initiatives that reduce deforestation.

Furthermore, black carbon, a key component of soot from incomplete combustion of fossil fuels and biomass, represents a major part of global GHG emissions. About 26 per cent of black carbon comes from the residential sector – essentially from incomplete combustion in cooking stoves that burn fossil fuel and biomass. Solar ovens and improved efficiency stoves can achieve significant reductions in black carbon. The potential climate benefits are startling. Eliminating all black carbon emissions from cooking stoves over 20 years would be roughly equivalent to changing every car and light truck on Earth to a zero carbon dioxide emitter.[6]

4. Defining energy access

One of the challenges facing the global development community is that there is no consensus on exactly what energy access means. It is useful to consider incremental levels of energy access and the benefits these can provide. For the sake of simplicity, one can consider three levels of access to energy (See Fig. 2) (AGECC, 2010).

5 IEA, 2009

6 John C. Topping, Jr., in "How does black carbon change the climate debate?" - http://www.climate.org/PDF/climatealertautumn2009.pdf

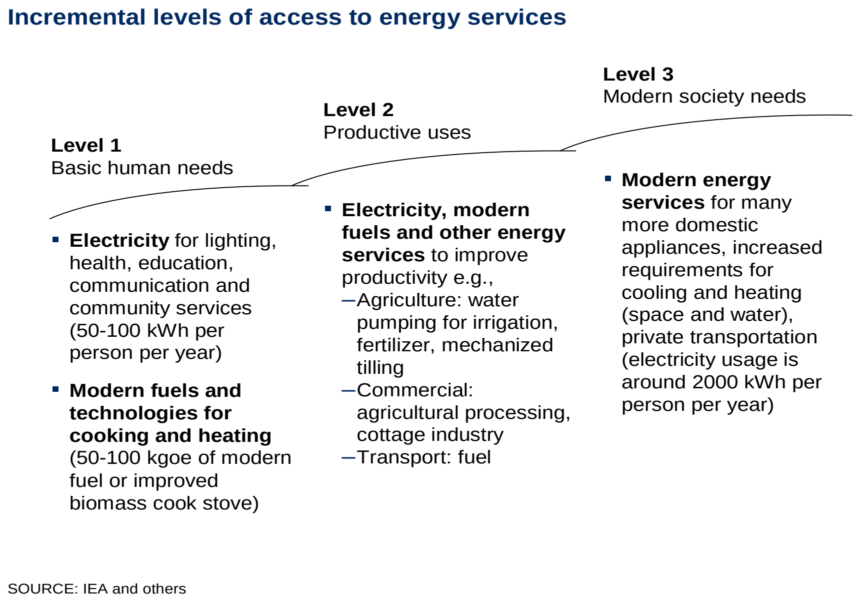

Figure 2: Incremental Levels of Energy Access (AGECC, 2010; IEA, 2009)

The AGECC defined universal energy access as: "access to clean, reliable and affordable energy services for cooking and heating, lighting, communications and productive uses" – i.e., levels 1+2. Even a basic level of electricity access that includes lighting and allows for communication, healthcare and education can provide substantial benefits to a community or household, including cost savings. However, we have adopted a broader definition because access to sufficient energy for basic services and productive uses represents the level of energy access needed to improve livelihoods in the poorest countries and drive local economic development. "Affordable" in this context means that the cost to end-users is compatible with their income levels and no higher than the cost of traditional fuels, in other words what they would be able and willing to pay for the increased quality of energy supply.

In practice, achieving universal access to modern energy services by this definition will entail providing affordable access to a combination of energy services that can be classified in three headings:

- Electricity for lighting, communication and other household uses.
- Modern fuels and technologies for cooking and heating.
- Mechanical power[7] for productive use (e.g., irrigation, agricultural processing) could be provided through electricity or modern fuels (e.g., diesel, biofuels).

It is essential to remember that providing reliable and secure energy services to those currently without access is not simply about supplying electricity for lighting or improved cook stoves. To promote economic development and growth, these energy services need to be put to productive uses that positively

7 In some cases, mechanical power may come directly from renewable sources, such as hydro; in most cases, however, this will require access to robust sources of electricity, over and above the power that would suffice for lighting and communication.

affect livelihoods – providing power for industry, improving health care and education, and improving transportation.

It is clear that access to energy is about more than quantity. Quality is essential. This is true for both electricity and fuels. As an example, high costs and unreliable electricity service constrain economic activity in many countries, and constitute a severe obstacle to business operation and growth. The World Bank indicators (Fig. 3) show the scale of the issue in terms of connection times, outages, the value of lost output, and the need for onsite generation.

Service problem	Sub-Saharan Africa	Developing countries
Electricity		
Delay in obtaining electricity connection (days)	79.9	27.5
Electrical outages (days per year)	90.9	28.7
Value of lost output due to electrical outages (percent of turnover)	6.1	4.4
Firms maintaining own generation equipment (percent of total)	47.5	31.8

Figure 3: Impacts of unreliable infrastructure (World Bank, 2007)

5. National policies

Any global target and measurement tools will need to be grounded in national policies. Not surprisingly, (IEA, 2009b) emphasised that sustained government support is a precondition to successful electrification strategies. (UNDP and WHO, 2009) showed that 68 developing countries have electricity targets (Table 2). (Considerably fewer targets for the other categories of: modern fuels, improved cookstoves, and mechanical power.) These national targets are an excellent foundation to build on.

Table 2: Countries with energy access targets (UNDP and WHO, 2009)

	All developing countries	*LDCs*	Sub-Saharan Africa
Electricity	68	25	35
Modern fuels	16	8	12
Improved cooking stoves	11	4	7
Mechanical power	5	0	5

Figure 4 (UNDP and WHO, 2009) illustrates the number of countries with data available under four categories, namely: electricity, modern fuels, cooking stoves, and mechanical power (with zero).

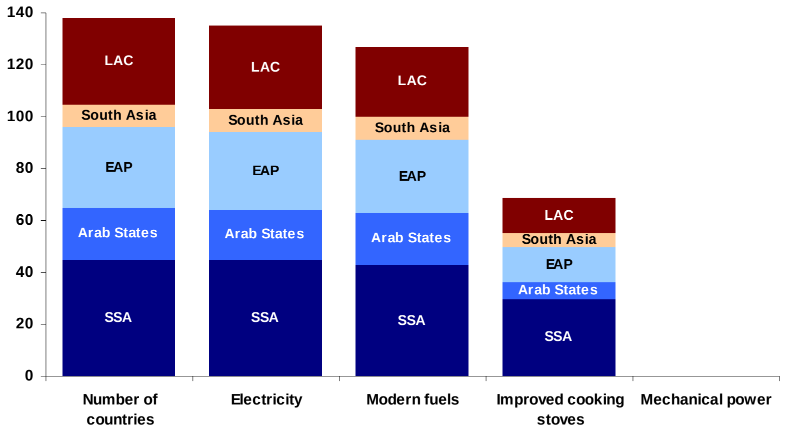

Figure 4: Countries with data on access in four categories (UNDP and WHO, 2009)

There are also several existing regional strategies with targets[8], and a number refer to measurement[9]. As an example, (EAC, 2006) describes four targets each with different target populations (Table 3). UNDP (2007) describes several benefits of regional plans[10], including: achieving economies of scale, and increasing the reliability, and maximizing the use, of local energy resources. In order to meet their targets, these regions and countries will require financial support, capacity development, and better regulation and governance structures. Additionally, many of these countries may have existing structures for measurement and reporting on energy access and it may prove useful to garner best practice in this area. In other cases where reporting structures for energy access do not exist, extensive guidance will be required.

Challenges vary dramatically between different regions; some evidence of this is shown in the fact that the percentage of countries that have energy access targets ranges from 15% to 78% between regions. There are also significant variances in needs and solutions between rural and urban conditions (see e.g. GNESD, 2008). To help define specific targets, new benchmarks and norms may be required that consider these variances, although we also need to be wary of perverse incentives if these are employed. That approach can also encompass issues related to energy efficiency (these topics are beyond the scope of this paper).

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[8] E.g. Economic Community Of West African States (ECOWAS), East African Community (EAC), and the Economic Community of Central African States (CEMAC)

[9] ECOWAS (2005) notes, "…the Steering Committee will have a strategic role in guiding activities and monitoring progress of the energy access work plan on a yearly basis."

[10] In West Africa for example (UNDP, 2007), there are energy information systems in Bénin, Niger, Sénégal, and Togo. New systems are at different stages of planning in Burkina Faso, Cameroon, Côte d'Ivoire, Guinée Bissau, Mali, and Togo. These tools allow both evaluation of progress in extending access to energy and prospective studies to facilitate planning for infrastructure.

Table 3: East Africa Regional Energy Access Strategy (EAC, 2006)

Target	Population Focus	Energy Service	Access to Energy in 2004: Actual		Goal: Additional Number to Be Reached	Goal: Percent of Category
			no. reached	% of category		
Target 1	Urban poor	LPG, ICS	3.0 million	47%	2.7 million households	73%
	Rural poor	ICS	1.5 million households	11%	6.1 million households	56%
	Nomadic and Conflict	ICS	0.2 million households	11%	0.9 million households	56%
Target 2	Urban poor	Electricity	2.0 million households	43%	5.3 million households	100%
	Urban slums	Electricity	0.5 million households	30%	2.2 million households	100%
Target 3	Schools	Standard level of service	1,848 schools	4%	46,545 schools	100%
	Clinics	Standard level of service	401clinics	4%	10,323 clinics	100%
	Hospitals	Standard level of service	38 hospitals	5%	750 hospitals	100%
Target 4	Rural communities	Electricity or other form of motive power and heating	955 communities	4%	23,240 communities	100%

Note: ICS: Improved Cooking Stoves; LPG: Liquefied Petroleum Gas

While national targets will be the backbone of energy access efforts, translating these targets into utility "obligations" is often the most feasible way to ensure delivery (IEA, 2009b), particularly if accompanied by financial incentives. Obligations on utilities as a policy instrument have considerable precedent and can be designed in many ways appropriate for both fuels and electricity. Obligations can also create the necessary governance frameworks for monitoring progress and improving data.

Ensuring universal access to modern energy services will thus involve providing new electricity connections to around 400 million households by 2030, and modern fuels and technologies to 700 to 800 million households over the same period.[11] For electricity, global access rates will need to increase by just over 2 per cent per year, while in Sub-Saharan Africa an increase of 8 per cent per year is needed.

Providing universal energy access will pose a number of critical challenges related to gaps in national and local institutional capacity and governance required to produce, deliver, manage, operate and maintain these solutions (including strengthening the capabilities of public sector utilities to provide improved services for all their customers in a commercially viable manner and without political interference).

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11 IEA, 2000; IEA, 2006; IEA, 2008; IEA electrification database; Global Insight WMM. Household numbers based on 5-6 people per household.

6. Costs

Additionally, accessing and allocating sufficient financing will be a major obstacle. In order to stimulate economic growth, many countries will naturally prioritize investment in power sector infrastructure for productive sectors (closing the existing supply gap or improving the existing power sector infrastructure) over providing basic energy access.[12] All around the globe, rural electrification is loss-making, and in the developing world this segment of the population is also often the poorest, with the lowest ability to pay. Subsidies are therefore often required to cover capital and, in some cases, operating costs. If the cost of the minimum energy package to end-users should be no more than a reasonable fraction of their income (say 10-20 per cent), it may be necessary to provide temporary subsides to reach affordability in the short-run before economic development accrues. This provides an additional reason why energy for productive uses is so critical: it increases the ability of end-users to pay for energy services, which is key to the long-term financial viability of such services – a virtuous circle.

At the same time, the goal of universal energy access is achievable, if the right elements are put in place. The capital investment required for basic access represents only a small fraction (around 5 per cent) of the total global energy investment expected during this period. While more people need access to modern fuels, the capital costs of closing this gap are substantially lower than for electricity.

The IEA (2010) estimated that, on average, $40 billion annually is required through a mix of financial instruments. AGECC (2010) estimates that grant funding of around $10-15 billion a year and loan capital of $20-25 billion a year will be needed, with the remainder being self-financed by developing countries. The needs for the LDCs represent roughly half of the global figures. Drawing from recent analysis (Bazilian et al., 2010c), the total cost of universal energy access for electricity and clean cooking in LDCs is of the tune of approximately $700 billion in total to 2030.

The incremental investment required to provide sufficient energy for productive uses[13] would be almost entirely for concessional loan capital rather than grant funding. This is because the additional energy capacity will provide people with opportunities for income generation and increase their ability to pay for services, thereby increasing the financial viability of the energy services.

Quantitatively comparing the estimates is challenging for a number of reasons. First, the underlying methodologies and assumptions vary greatly. Second, the information required to make the estimates comparable is often not available. And third, the different studies vary widely in terms of their ambition and scope. To contend with these obstacles, we utilise a common denominator (per capita[14] annual average or per connection).

Figure 5 compares estimates of average annual cost per capita for electrification, split between capital costs, operation and maintenance (O&M), fuel and others (e.g. capacity building) when explicitly available.

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12 World Bank. 2009 - World Bank Africa Infrastructure Country Diagnostic found that investment of $40 billion per year for the next 10 years is required to overcome the challenges currently facing the African power sector

13 Increased electricity generating capacity and other energy related infrastructure for mechanical power is required

14 Although considering the household as a unit would be more appropriate in the case of providing energy to the poor, using per capita figures allows to avoid further assumptions with regard to the typical size of household, which varies greatly between countries, e.g. Cameroon: 2.9; Guinea-Bissau: 7.6 (data from Banerjee et al. 2008).

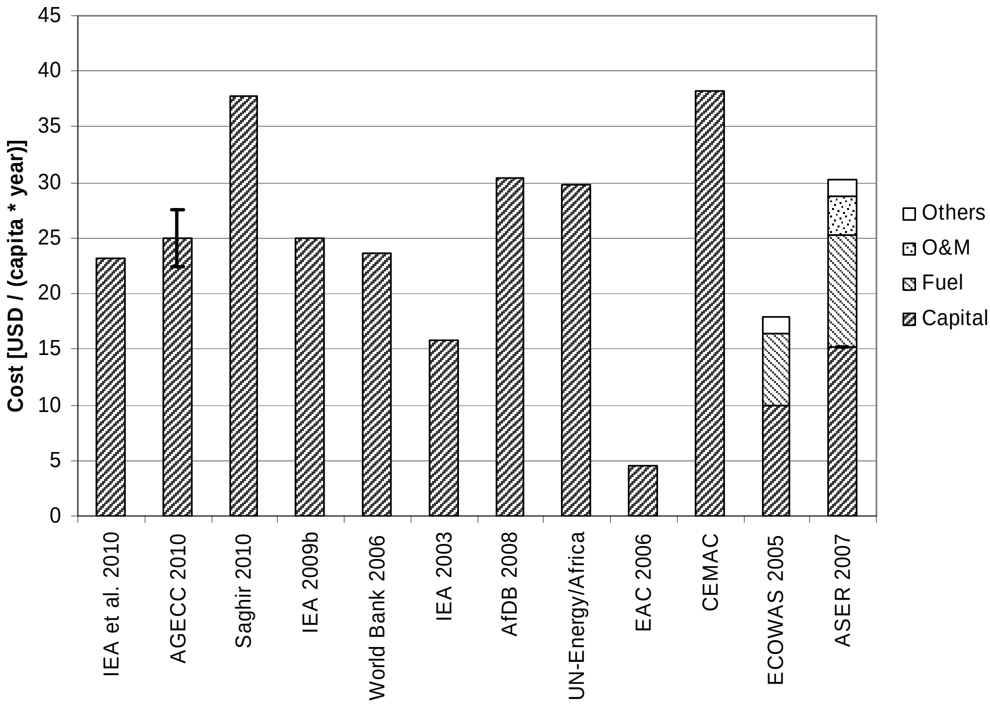

Figure 5: Comparison of cost estimates for electrification (Bazilian et al., 2010)

The estimates of annual costs for capital investment for electrification range from 5 to almost 40 USD per capita, reflecting the large uncertainties associated with such evaluations (and the sensitivity to certain assumptions). One important insight is that the majority of studies focus solely on capital cost and do not consider recurrent (or ongoing) costs (e.g. fuel, O&M), with the notable exceptions of ECOWAS (2005) and ASER (2007).

Various sources of international funding and risk tools could be accessed to help finance capital and capacity building costs. These include ODA and other donor funding targeted at the achievement of the Millennium Development Goals; and climate-related finance, which under the Copenhagen Accord is intended to increase to $100 billion a year by 2020 (for both mitigation and adaptation). Existing energy programmes and funds (such as the Renewable Energy and Energy Efficiency Fund (REEF), the Climate Investment Funds of the World Bank and other Development Banks,[15] and GTZ's Energising Development) can be utilized to administer and distribute finance, but will need to be scaled up significantly. This will require governance structures that better balance the needs of donor countries for accountability and the needs of recipient countries for a stronger voice in how the funding is deployed.

15 For example the Clean Technology Fund, Pilot Program for Climate Resilience and Scaling Up Renewable Energy Program – see www.worldbank.org/cif

Box 1 – GET FiT from Deutsche Bank Climate Change Advisors:

The Global Energy Transfer Feed-in Tariff (GET FiT) Program, developed by Deutsche Bank Climate Change Advisors, is a concept to specifically support both renewable energy scale-up and energy access in the developing world through the creation of new international public-private partnerships. GET FiT would combine a fund of public money directed for renewable energy incentives with risk mitigation strategies and coordinated technical assistance to address project development and financing barriers.

GET FiT would partner with developing countries seeking to establish feed-in tariff policies, and with international partners to address a variety of risks and barriers faced by all renewable stakeholders, including development risk, off-take and counterparty risks, political risk, market risk, reinsurance risk and currency risk. GET FiT would provide premium payments, passed through the national governments and utilities to independent power producers (IPPs). The utility would pay at least the market rate to the IPP, and there would be minimal additional burden on the electricity ratepayer. The transfer payments of the GET FiT premium to the IPP could be guaranteed by the national government, or by the GET FiT Programme, depending on the national context and creditworthiness of the involved parties. An international sponsor would provide an ultimate guarantee for the GET FiT payments. Political risk insurance entities, (e.g. MIGA, OPIC, private sector providers, etc.) could play a role in mitigating sovereign risk, and could also backstop governments' guarantees of renewable energy payment where necessary.

This stabilization of revenue streams would attract significant amounts of private sector capital from both domestic and international sources to build renewable energy projects. The payments would be adjusted to reflect market conditions over time and chart a pathway to grid parity. Based on a preliminary analysis by DBCCA, a $3bn commitment under the GET FiT scheme could facilitate over 1 GW of newly installed on-grid and off-grid renewable energy capacity, with the associated abatement of 100 million tons of CO_2 emissions over funded projects' lifetimes.

7. Different pathways to access to electricity

As discussed, it is useful to consider incremental levels of energy access and the benefits they can provide when planning electricity access programmes. Typically, electricity usage is initially limited to replacing other sources of fuel for purposes such as lighting, and for other low energy consumption devices such as for charging mobile phones. Other appliances that require more electricity to operate (such as televisions and refrigerators) are typically added as people can afford them.

Access can be provided either at the community or household level. For example, community level access could initially be provided to health clinics, education facilities, and central recharging facilities that can be used for battery-powered devices such as LED lights or cell phones. Importantly, this corresponds to the priorities of many ODA and private donor organizations, as well as the commercial interests of private sector players, for example mobile phone operators. Similarly, communal productive capacity could be created, for example to provide access to electricity or mechanical power for basic irrigation or for simple cottage industries such as basic manufacturing or agricultural processing. In other cases, it may be quicker to provide some level of electricity access directly to households. These different levels and types of access are not necessarily sequential, and depend on the local context and priorities.

The scale and nature of the access gap and locations involved means that electricity will need to be provided through both centralized and decentralized energy technologies and systems, combining the following three general models.

- *Grid extension.* An extension of the existing transmission and distribution infrastructure to connect communities to power.
- *Mini-grid access.* Linking a local community to a small, central generating capacity, typically located in or close to the community. The power demand points are linked together in a small, low-voltage grid that may also have multiple smaller generating sources.
- *Off-grid access.* Generating capacity provides power for a single point of demand, typically a solar household system (SHS).

The critical question in electricity access is not which of these solutions should be adopted, but rather in what way a combination of these solutions should be adopted. The optimal choice for each country would be driven by the availability of resources, the regulatory and policy environment, the institutional and technical capacity, and the relative costs of each of these solutions. Each comes with its own set of advantages and challenges, and the highest impact will be achieved when grid, mini-grid and off-grid solutions are appropriately traded off and then combined to resolve the challenges in each different market.

The trade-off between grid solutions, mini-grid solutions and off-grid solutions needs to take into account several critical factors. These elements are not static, however, and decisions about them will need to consider their expected evolution. The following specific issues need to be considered:

- Level of demand: The level of energy access required is dependent on the needs of each community as well as contextual constraints, such as climatic conditions. This is also linked to the ability and willingness to pay.
- Length of time for delivery: Given the distributed nature of both the mini- and off-grid solutions, and the resulting reduction in other dependencies such as transmission rights-of-way and building new capacity, it will typically be possible to deliver these solutions more rapidly than a grid solution. Rather than relying on the incumbent utility to deliver the grid-based solution, services can be provided by private-sector players. The time benefit is especially relevant when there are shortages in generation capacity, as is the case throughout the developing world.
- Cost of solutions: The cost of technologies will differ according to local conditions and available natural resources, and so the least-cost fuel mix and technology options will also vary for any specific community. Different solutions will be cost-optimal for urban and rural communities. In urban areas and peri-urban areas close to an existing grid, the costs of extending the grid are relatively low, while high population densities create aggregated demand. Over time, the non-hydro renewable technologies associated with the off-grids and in particular the mini-grids are likely to have much higher learning curve benefits than the technologies associated with the grids, because they are new technologies. This makes mini- and off-grid solutions even more attractive options for the future.
- Quality of access provided by technologies: Grid-based solutions should (in theory) provide 24/7 access. However, depending on the generation base of the mini- or off-grid solutions, they are often unable to provide this access 24 hours a day, as the generation of wind and solar energy depends on weather conditions and battery storage is limited and expensive. Advances in battery storage technology (which are likely to be rapid due to the R&D investment in electric vehicles) will, however, improve this over time. The emergence of more energy-efficient appliances will also make off-grid and mini-grid solutions more acceptable

There could be considerable interim benefits from starting non-electrified households on a low-capacity supply for certain hours of the day as a step towards a longer-term solution.[16] In Peru, for example, the utility offered both solutions, inviting communities to choose between constant grid access in the future and the less-optimal solution providing more intermittent power much sooner. In most situations, consumers opted for more intermittent access earlier.[17]

The private sector could play an important role in providing initial off-grid electricity supply. For example, mobile phone companies currently use diesel generators to provide power for their antennae in rural areas in Sub-Saharan Africa. By installing solar PV systems, mobile phone operators could be able to generate sufficient power for their requirements and excess capacity, which could be used to power the local health clinic or school. This could be utilized as a charging station for mobile phones, thus providing a commercial incentive for the mobile phone company to invest in the additional capacity.

Box 2: Viet Nam – lessons on leveraging national, local and community level collaboration towards large scale electrification

Viet Nam has achieved very high rates of electrification. Access grew from 3 per cent to 95 per cent in 35 years. The most intensive growth period was from 1995-2008, during which time an average of 3.4 million people were provided with electricity access each year.

This was achieved largely through grid extension, driven (from 1995 onwards) by Electricity of Viet Nam (EVN). Existing infrastructure was severely underdeveloped, requiring a massive new build programme, which tripled the national installed capacity and involved the construction of a 500kV line stretching the length of the country. As a result, EVN had limited additional capacity also to develop the distribution grid, and relied heavily on local distribution utilities (LDUs), community cooperatives and service agents to erect, operate and maintain LV lines as well as managing invoicing and revenue collection. Recovery of operational costs from end-users was critical to success of the programme.

Capital was provided through a coordinated programme of government subsidies, provincial government funds, international loans and grants, and cross-subsidies. IDA helped the government to prepare a Master Plan for Rural Electrification, pulling together government, user and ODA financing into a single, coordinated programme.[18]

Despite the huge overall success, there are a number of challenges resulting from the intense pace of implementation – including limited capacity to ensure quality standards and provide sufficient capability-building to local participants. In certain regions, poor-quality grid infrastructure was installed and subsequent maintenance has been lacking. Grid refurbishment projects are underway and many of the community cooperatives have been incorporated into LDUs in an effort to reduce losses and improve revenue collection.

16 Venkataramanan & Marnay, 2008
17 World Bank expert interviews
18 World Bank, 2009a; World Bank/IDA, 2000; ASTAE, 2008

For all types of electricity access, past successes show that no single institutional model reliably provides better success rates than others. Both large-scale vertically integrated utilities and smaller decentralized businesses can deliver the required solutions, using public, private and cooperative approaches,[19] depending on the strength of the existing utilities and local businesses. In all cases, however, a degree of central programme-level coordination is necessary.[20]

Cost recovery is essential for the ongoing sustainability of services. Governments need to decide what tariff structures and cost recovery mechanisms (e.g., lifeline tariffs or cross-subsidies) to put in place based on the ability and willingness to pay, which will vary according to income levels and the availability of alternative energy sources in the different regions. For example, lifeline or free basic electricity allocations are set at 10kWh/month per connection in the Philippines; at 300kWh/month in Zambia; and at 50kWh/month in South Africa.[21]

8. Access to modern fuels and technologies

There are a wide variety of modern fuels, including natural gas, LPG, diesel and renewables such as biodiesel and bio-ethanol. There are also technology options that are required to make use of modern fuels or use traditional fuels more efficiently, such as improved cook stoves.

The suitability of these options depends on factors such as availability, applicability, acceptability and affordability, including access to finance to cover upfront investments. The declining availability of existing sources of fuel makes switching to modern alternatives a necessity in some places. For example, in many parts of India finding sufficient biomass for cooking is becoming increasingly difficult.

Box 3: Nepal – significant scale up of biogas plant installations

Nepal installed over 170,000 biogas plants, benefiting more than a million people, in a 13-year programme during the 1980s and 1990s. Over 90 per cent of these are still in operation today.

This intensive programme was supported by the development of a local private sector biogas manufacturing and construction capacity, as well as training and certification facilities to ensure that quality standards were maintained. Between 35 and 50 per cent of the capital costs were subsidized through grants from international donors such as the German development finance institution Kreditanstalt für Wiederaufbau (KfW). Loan capital was made available for the remaining capital costs.[22]

19 Barnes, 2007
20 ESMAP, 2008
21 Komives et al, World Bank 2005; Eskom
22 *Ibid.*

The acceptability of the modern alternative to the end-user is essential, as solutions will only gain traction if they meet users' preferences and needs. In many cases, existing methods meet multiple objectives, so providing a replacement that meets only one of these objectives will prove unacceptable. For example, in the South African rural electrification programme, some communities did not switch to electric cooking stoves even when these were provided for free, as they relied on the coal stoves not just for cooking, but also for heating.

The affordability and people's willingness to pay for modern fuels and technologies largely depends on whether and how much people currently pay for fuel. In many cases, modern fuels cost significantly more than people are currently paying or can afford. Furthermore, significant initial payments (e.g., for improved cook stoves or biogas digesters) and/or the need to buy in bulk (e.g., LPG) present major obstacles to the poor, who do not have access to credit.

Subsidies have been used in some cases to overcome affordability challenges (e.g., LPG programmes in Brazil and Senegal). The challenge with subsidies is that they place a significant strain on government resources, and may be unaffordable to many least developed countries. Furthermore, subsidies often end up providing limited benefit to the people who need them most.[23] They are best used only where necessary, in as targeted a manner as possible (e.g., in Brazil the general LPG subsidy was replaced with discounts as part of a conditional social payment programme – Bolsa Familia)[24]

8.1. Improved cook stoves

For people who lack access to sufficient livestock and biomass for biogas production and who are unable or unwilling to pay for LPG/natural gas solutions, one further option is to improve the efficiency with which they burn biomass. Here improved cook stoves (ICS) offer a feasible alternative. These stoves provide numerous advantages: they double or triple the thermal efficiency of traditional fuels, reduce the harmful effects of poor ventilation, and may also provide some co-heating. They ameliorate a number of serious health and environmental problems caused by current practices. More efficient stoves are relatively inexpensive ($15-60 per unit/$3-12 per person).[25] However, experience has shown that higher-quality, more durable models (with associated higher costs) stand a much better chance of sustained impact.

While the success of ICS programmes has often been limited, this appears to be a consequence of poor or ill-conceived business models and inattention to financing realities, rather than any fundamental problem with the concept. For example in Nepal, the limited success was largely ascribed to the fact that there was insufficient promotion, education, monitoring and follow-up. Furthermore, prefabricated models were distributed through a prolonged and difficult transportation process to remote mountainous areas, leading to significant levels of breakage.[26]

For all the modern fuels and technology solutions, increased levels of understanding of their benefits and proper use are essential to ensure uptake. In addition, the development of local capabilities to maintain new technologies (e.g., stoves, biogas digesters) is crucial to success. This should be viewed not

23 World Bank, 2001; ESMAP, 2004; Barnes, 2007

24 Lucon et al., 2004

25 UNDP expert interviews, ESMAP 2005a

26 Shrestha et al.,2003; Basnyat and Shrestha, 2003

as an obstacle but as an opportunity for the creation of sustainable livelihoods. In addition, policy and regulatory frameworks are critical triggers for scaling up investments in renewable energy projects.[27]

8.2. Mechanical power

A recent report (Bates et al., 2009) notes that mechanical power has been used for centuries for agro/food processing, water pumping and other productive uses, providing some of the most fundamental services required for poverty reduction and human development. Indeed, over the past century, technological advances have helped reduce the drudgery and increase the productivity of human labour through the widespread use of mechanical power.

Mechanical power is critical to enhancing the productive use of labour in many ways, directly supporting core day-to-day activities such as transporting and lifting water, irrigating fields, processing crops into edible forms and many more. Mechanical power is often viewed however as being only a derivative of other forms of energy such as electricity, and it is assumed that users will convert in appliances as needed on the "other side of the meter". However this assumption is unsafe and ignores the special contribution of mechanical power itself to rural production and physical processes.

In spite of the importance of mechanical power in meeting every day energy needs at local levels, it is generally under-appreciated and under-considered to the point that data and documentation of the role of mechanical power are almost completely lacking.

The contribution of mechanical power is to increase the efficiency and effectiveness of productive activities supporting development, as well as physical processes fundamental to meeting basic human needs. Mechanical power has been found to provide a range of energy services which may be grouped under the heading of productive uses and basic processing, including a wide range of specific applications in the following sectors: water supply, agriculture, agro-processing, natural resource extraction, small-scale manufacturing and lifting/crossing. Experiences show that mechanical power helps alleviate drudgery, increase work rate and substantially reduce the level of human strength needed to achieve an outcome, thus increasing efficiency and output productivity, producing a wider range of improved products, and saving time and production costs.

Mechanical power generally has relatively low investment costs, and is an effective way to directly benefit poor people who stand to gain most from the services mechanical power technologies provide. In this regard, financing of mechanical power is often one of the most cost effective ways to support poor people. Mechanical power is particularly suitable for generating local investment and a fees-for-service approach; a vital local and private source of revenue enabling the sustainable operation and growth of energy services. Countries should consider mechanical power alongside electricity, transport, and cooking, in energy and development strategy formulation.

9. Measuring Success

Defining energy poverty metrics and respective targets is a complex task. First, there is a need for an adequate understanding of the issue to be measured. Then, a theoretical framework is required and,

27 UNIDO/Africa Union, 2008

finally, sufficient confidence in the set of indicators or the composite index should be gained through thorough testing.

Metrics of energy poverty would likely be best undertaken at the national level. The data could then be reported annually[28] and also serve as a basis for training and capacity development in the energy sector in developing countries. Computing energy poverty metrics would require the creation of new or augmented data-gathering systems and activities. This in turn would help increase the richness of energy planning analyses that could be conducted. These tertiary benefits of implementing measurement activities may prove to be even more valuable than the original impetus for them.

It is envisaged that energy access metrics could be aligned closely with measurements of sustainable development. In general, desirable principles of the metrics should (Atkinson et al., 2002):

- identify the essence of the problem and have a clear and accepted normative interpretation;
- be robust and statistically validated;
- be responsive to effective policy interventions but not subject to manipulation;
- be measurable in a sufficiently comparable way across countries, and comparable as far as practicable with the standards applied internationally;
- be timely and susceptible to revision;
- not impose too large a burden on stakeholders.

Ideally the metrics chosen should allow for comparison over time to evaluate the progress over time. Ranking of countries, although able to provide some insights, should not be regarded as the ultimate objective. The resulting "tool kit" should permit a wide range of additional statistical analysis that provides supplementary policy guidance.

The ultimate objective is to allow for tracking progress towards universal modern energy access. At the national level, data collection and measurement need to be tied to or aligned with central statistics offices. The international community needs to play an active role in building capacity and providing resources to increase the quality and quantity of data. Improving the data is an enormous task, and one that will take years. This exercise will require a cooperative and agreed approach conducted by an international body. Annual reporting, conducted at the national level, similar to that done for the HDI (or other metrics outlined in Section 2), is likely appropriate.

The UN is well placed to help take this work forward in partnership with the IEA, and other organisations. The UN has an interagency mechanism for energy, UN-Energy, which is specifically designed to help coordinate cross-cutting issues, and would benefit from such a mandate. The IEA's well-respected statistical resources would help leverage the UN's strengths (including UN-Stats[29]) and underpin a strong partnership. Dedicated financial and human resources would then be needed to coordinate the effort, maintain the database, report, and further develop and improve the methodology.

Piloting a measurement and reporting programme in 5-7 countries initially would provide valuable insights into: data gaps, data gathering techniques, appropriateness and usefulness of various indicators and proxies, training needs, institutional requirements, useful reporting formats, how best to support

[28] It is recognised that annual reporting may not be feasible for most least developed countries. Programmes could be put in place that begin with, say, 5 year reporting to follow national plans, move to bi-annual and then annual.

[29] United Nations Statistics Division, with a mission to promote the development of national statistical systems.

national policies, and the role of international cooperation. It would also provide the basis for the development of a more generalisable toolkit for policy makers and national statistics offices. This could be in part supported through the IEA statistics office and in-country UN offices. The pilot countries could then issue national reports within 12-18 months.

10. What is required for success?

Based on the lessons learned from programmes around the world to provide access to electricity and modern fuels, a number of building blocks for universal energy access emerge as requirements, at both national and international levels. These will all rely on the mobilization of resources and support at appropriate levels from a range of actors in different countries. In particular:

- **Policy support from governments:** Governments need to prioritize energy access, set aggressive national targets for universal access, and put in place plans and the enabling environment to deliver them. Successful large-scale electrification programmes are underpinned by government targets and priorities that inform a rigorous planning process. The necessary policies, programmatic capabilities, tariff structures and incentives to support these targets and participation from the private sector also need to be put in place. These policies will need to be translated rapidly into regulations and legislation. This process should be supported by multilateral organizations, international agencies such as the IEA and IRENA, and non-profit organizations.
- **Access to financing:** The international community needs to provide financial support to developing countries for meeting the global universal energy access and energy efficiency goals proposed by AGECC. The IEA's reference case estimates that it is possible to provide electricity access sufficient to meet the objectives of the MDGs to the vast majority of the world's energy poor in the next 20 years, for an average capital investment of around $35 billion per year.[30]
- **Capacity development:** Resolving the challenges related to access to financing, and reducing the costs of energy access and end use appliances, will not be sufficient to improve energy access without complementary efforts to develop the capabilities and capacities of local institutions for the provision of delivery, quality monitoring, finance, and operations and maintenance services. Such capacity development is needed in both the public and private sectors, and at all levels – national, sub-national and community – and should leverage and build on the expertise and knowledge base that has been developed by multilateral institutions and international agencies.
- **Utility performance:** Improving the performance of public utilities will be critical for the success of expanding the grid and achieving the universal access target, since utilities in developing countries often have technical losses four or five times higher than their counterparts in developed countries. Expertise from the private sector in the developed and developing world should be leveraged to drive these utility improvements.

Providing global energy access is not a luxury, but a necessity. Lack of access to modern energy services is one of the main factors that constrains development for the poorest populations. Providing access to reliable and affordable energy services is critical for development, and increasing the reliance on

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30 IEA, 2009

clean energy sources for energy access is also important for the climate agenda. Access solutions will vary by geography, by setting and over time. There are many successful examples of access expansion to demonstrate that the ambitious goal of universal energy access by 2030 is achievable.

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