Policy Guide 3

Energy Policy Guide

Energy for All: Harnessing the Power of Energy Access for Chronic Poverty Reduction

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Chronic Poverty Advisory Network

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Preface

The Chronic Poverty Advisory Network (CPAN) is producing a portfolio of sector and thematic policy guides to help policymakers and programme designers use evidence about chronic poverty and poverty dynamics in designing policies and programmes to:

- Contribute to addressing the causes of chronic poverty;
- Assist poor households to escape poverty;
- Prevent impoverishment.

The guides are aimed primarily at policymakers and practitioners in developing countries, working for government, civil society, the private sector and external development agencies. This includes organisations working directly with and for the poor. They are also intended for the intergovernmental, bilateral and non-governmental international agencies that support those domestic actors.

This particular policy guide is intended for policy and programme designers and implementers in energy agencies, as well as policymakers in ministries of energy, rural development and health alongside those in local government. One message from this guide is that co-ordination and inter-sectoral collaboration is required to ensure that the expansion of energy services contributes to poverty reduction.

The guide identifies key areas and new emphases for energy policy and programme development to eradicate poverty and hunger and presents new research results on energy and poverty dynamics. The guide is about what to do rather than how to do it in particular contexts. However, CPAN is very happy to work with policymakers on the ‘how to’ question: please contact us if you would like to adapt the ideas in this guide to a particular context, or to get into more detail on how to design and implement or evaluate policies and programmes.

Reading the guide: if you want policy prescription only, skip Section A, which is analytical. If you have limited time, there is an overall summary at the start of the guide, while Section C also provides an overview of the guide’s recommendations, including by country energy category.

This guide has been written by experts on energy issues (Shonali Pachauri and Andrew Scott) along with members of the CPAN team (Lucy Scott and Andrew Shepherd). It has been supported by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) on behalf of the Federal Ministry for Economic Cooperation and Development (BMZ) and the Swiss Agency for Development and Cooperation (SDC).

Responsibility for the content rests entirely with the writers. The authors also appreciated very useful comments on the first draft from Bob Baulch, Katja Diembeck and Patrick Nussbaumer.

Front cover: A girl studies under the light of a rechargeable solar lamp. Without the lamp she couldn’t study at night as her home in Natore, Bangladesh has no access to electricity.
Photo: G.M.B. Akash/PANOS

Summary

Providing energy for all is a major global challenge for the next two decades. Research and policy evaluation tells us that access to electricity, together with the assets which enable its use in a transformational way, improved cooking technologies, and mechanical power can all help people to escape from persistent poverty. There are three policies which will help achieve this: (i) expanding electricity coverage and distributing clean-combusting fuels and equipment to populations not yet served; (ii) improving the ability of the poorest people to afford these when they are available; and (iii) enhancing the reliability (total duration of interruptions during the scheduled hours of supply) and availability (the actual hours of supply received in a given day for a given season) of energy services. This is important if energy is to contribute in a transformational way to escaping poverty. A minimalist approach will not do - energy is needed by poor households for productive uses as well as domestic and community needs.

Inadequate access to energy contributes to poor people remaining poor across several dimensions and Sub-Saharan Africa and South Asia lag behind the world in energy access. Energy poverty is correlated strongly with income poverty, and is most acute for the poorest households in rural areas. An analysis of poverty dynamics shows that chronically poor households are less likely to have electricity than households which have escaped poverty or fallen into poverty; households which stay out of poverty are more likely to have access to electricity. Lack of access to electricity amongst the chronically poor is due to both the unavailability of a supply and to its unaffordability. Chronically poor households spend more on energy than other groups as a proportion of household non-food expenditure. Gains from access to electricity for the chronically poor are constrained by the additional costs of acquiring appliances.

Affordable modern energy services for the poorest requires some form of financial support for the poorest people. Energy subsidies are often regressive and need to be better targeted. Tariff structures can be used to target subsidies for poor electricity consumers. Finance to lower investment costs for the poorest consumers is as essential as price or tariff support on electricity and fuels. Subsidy reform or removal needs to contain measures to protect or compensate the poorest people for any negative impacts. Alternatives to subsidies, such as cash transfers, can also be considered to enable chronically poor people to access modern energy services.

A transition to cleaner-combusting fuels and/or stoves is as important as access to electricity for reducing energy poverty. Solid biomass remains the dominant cooking fuel for chronically poor households. For the poorest, improved or advanced biomass stoves are a feasible first step in a transition to cleaner cooking, and these can have very large economic and social returns. However, the low success rates of interventions are due to several factors, including the gendered nature of cooking, low incomes, irregular cash earnings, liquidity constraints and easy access to biomass sources. A lack of understanding regarding the severe health consequences of inhaling the smoke emitted while burning biomass, as well as a failure to tackle gender inequalities, have also contributed to a slow transition away from these.

Small scale or pilot interventions have often succeeded but have not been followed by effective scaling up. This requires multiple actions at different levels: dedicated national commitment and vision, engaging users and local actors, arranging financing to make access and use possible for the poorest, developing regulatory and financial frameworks which encourage enterprises to cross-subsidise the poorest regions and people, regular monitoring and evaluation, local level capacity building for maintenance, marketing to the poorest customers, and guaranteeing the supply of clean fuels. The continued dependence on traditional cooking practices contributes to climate change, and climate funds can be used to improve access to clean-combusting cooking fuels and equipment.

Lack of electricity is a constraint on production, enterprise growth, and employment. Households with access to electricity are more likely to have income from a micro-business than those without electricity. Access to electricity can reduce the costs of energy for enterprises and increase productivity, which can have a positive net employment effect – and farm and non-farm employment are critical avenues for escaping extreme poverty. Access to electricity can also lead to increased participation in the labour market, especially for women.

However, electricity alone is not enough to stimulate business investment - business development support services need to accompany electrification and focus on enterprises which will generate additional and decent jobs for relatively unskilled workers. Wealthier households often feel the impacts of electrification more strongly than the poorest. Special measures are needed to improve the distributional impact, especially on financing.

Remote rural regions, where many chronically poor people are concentrated, lack energy infrastructure, are weakly connected to markets for commercial fuels and energy equipment, and may have limited energy demand because of low income levels. The cost of extending access to electricity through a centralised grid can be greater than decentralised alternatives. The least-cost decentralised option depends on the local context and the demand for electricity, as well as local energy supply options. Most of the additional power required in remote rural regions is likely to be supplied by mini-grids or stand-alone systems. Stand-alone systems provide a limited amount of power but can be appropriate for isolated off-grid households, businesses and public services. Access to such systems for the poorest households requires subsidies and end-user financing. Decentralisation of responsibility for the promotion and regulation of electricity to capable local bodies should enable uptake of decentralised energy systems for rural areas.

To achieve a transformational result from energy development which contributes to raising the incomes of chronically poor households, complementary interventions are necessary. Co-ordination and inter-sectoral collaboration is required to ensure that the expansion of energy services contributes to poverty reduction – for example, between energy and business development agencies; energy and local government, energy and health ministries.

The appropriate policies and priorities for addressing energy poverty will vary depending on country context (see the next table), including socio-economic circumstances and energy mix. Lower and middle income countries can be divided into five categories for this purpose, as in the table below. Policy lessons can be learned especially from countries which have made rapid progress in increasing modern energy access for the lowest wealth quintile, which include Vietnam, Egypt and Nepal.

Country Category		Recommendations on electricity access for the poorest	Recommendations on improved cooking for the poorest
1	Extremely limited electrification and use of clean-combusting fuels (under 20% for each)	Focus on extension of electricity (grid and off-grid) to population without access. Establish financial mechanisms (e.g. credit and savings) to enable poor to access electricity, including for productive uses.	Develop and implement strategy to deliver improved cooking technologies and cleaner-combusting fuels to poor. Public awareness and social marketing actions on harmful effects of traditional cooking practices, to promote demand.
2	20-65% electrification rates but less than 20% of population use clean-combusting fuels	Extension of electricity (grid and off-grid) to population without access. Establish financial mechanisms (e.g. consumer credit) to enable poor to access electricity, including for productive uses. Use subsidy or social protection measures to reach poorest quintiles.	Develop and implement strategy to deliver improved cooking technologies and cleaner-combusting fuels to poor. Public awareness and social marketing actions on harmful effects of traditional cooking practices, to promote demand. Establish financial mechanisms (credit and savings) to enable poor to acquire improved cookstoves.
3	Electrification rates of 50-80% but under half population uses clean-combusting fuel	Focus on extension of electricity off-grid to reach rural and remote populations. Establish financial mechanisms (e.g. consumer credit) to enable poor to access electricity, including for productive uses and for domestic appliances. Use subsidy or social protection measures to reach poorest quintiles.	Public awareness and social marketing actions on harmful effects of traditional cooking practices, to promote demand. Establish financial mechanisms (credit and savings) to enable poor to acquire improved cookstoves.
4	Lower and upper middle income countries with over 65% electrification and over 50% clean-combusting fuel use	Focus on extension of electricity off-grid to reach rural and remote populations. Establish financial mechanisms (e.g. consumer credit) to enable poor to access electricity, including for productive uses and for domestic appliances. Use subsidy or social protection measures to reach poorest quintiles.	Establish financial mechanisms (credit and savings) to enable poor to acquire improved cookstoves. Support establishment of market chains for cleaner-combusting fuels and cooking appliances.
5	Middle income countries with almost 100% electrification and over 80% clean-combusting fuel use.	Deploy financial mechanisms (e.g. consumer credit) to enable poor to access electricity, including for productive uses and for domestic appliances. Link electricity supply to business development and technical advice services. Ensure quality of electricity supply. Use subsidy or social protection measures to reach poorest quintiles.	Establish financial mechanisms (credit and savings) to enable poor to acquire improved cookstoves. Support establishment of market chains for cleaner-combusting fuels and cooking appliances. Use subsidy or social protection measures to reach poorest quintiles.

Introduction

Policy makers are trying to balance the demands of three broad objectives in the energy sector; energy security to ensure economic stability and growth; reducing energy poverty, by ensuring access to electricity and clean-combusting fuels and equipment for the poor; and managing greenhouse gas emissions from energy. The World Energy Council has called this the 'energy trilemma' – of how to achieve an appropriate balance between these sometimes conflicting objectives.

Over the past two years, the challenge of providing people living in poverty with access to modern energy[1] has been prominent in policy debates. The UN Secretary General's Sustainable Energy for All initiative is instrumental in highlighting the importance of energy access for poverty reduction. Some developing countries are now drawing-up national strategies for Sustainable Energy for All and over the next few years, attention is likely to continue in debate about the post-2015 development agenda and in dialogue for the UN Decade for Sustainable Energy for All (2014-24).

Governments can overlook chronically poor people (Box 1) in the 'energy trilemma' as they are often the most difficult for energy service providers to reach and are least able to afford services when they are available. They therefore need to be explicitly considered in measures to deliver energy services.

Box 1: Chronic poverty

Nearly half a billion people are trapped in chronic poverty – poverty they experience over many years, often over their entire lives, and commonly passed on to their children. Many chronically poor people die prematurely from health problems that are easily preventable. For them, poverty is not simply about having a low income: it is about multi-dimensional deprivation – hunger, under-nutrition, dirty drinking water, illiteracy, having no access to health services, social isolation and exploitation.

The causes of chronic poverty vary according to context but are usually multiple. The most common causes are combinations of poor work opportunities, insecurity, and poor health, social discrimination, limited citizenship and spatial disadvantages, for instance living in a remote rural area. A set of reinforcing factors mean that chronically poor people cannot advance their economic or social position.

This Policy Guide also uses the term – the poorest. This includes the chronically poor as well as the severely (or food) poor. Most of the latter are also chronically poor, but others are also chronically poor.

Sources: Hulme and Shepherd (2011) and McKay and Perge (2011).

This CPAN Policy Guide provides guidance for developing country policy makers and their advisers when considering the specific measures necessary to ensure that chronically poor people are included in efforts to deliver sustainable energy for all.

The first part gives an overview of the current energy poverty[2] situation in developing countries and presents new analysis of the relationship between access to energy and poverty dynamics (movements of people into and out of poverty over time and being trapped in poverty, or chronic poverty). The second part discusses key questions for policy makers in meeting the challenge of delivering energy services to chronically poor people. Finally, the Policy Guide suggests a categorisation of countries according to the priorities and challenges they face, together with conclusions and recommendations for different categories of country.

[1] We define modern energy to include electricity and clean-combusting fuels and equipment, including improved or advanced biomass stoves, motors, pumps, etc.

[2] Energy poverty is defined as a lack of access to adequate, reliable, affordable and quality energy carriers and technologies to meet the basic needs of lighting, cooking, heating, cooling, communications and livelihoods. Access to energy is a question of degree or level of access, rather than an absolute yes/no question.

A1: Energy Poverty

- *Access to electricity, the assets which enable its use in a transformational way, improved cooking technologies, and mechanical power can all help people to escape from persistent poverty.*

There are three policies which will help achieve this:

- *expanding electricity coverage and the distribution of clean-combusting fuels and equipment to populations not yet served,*
- *improving the ability of the poorest people to afford these when they are available,*
- *enhancing the reliability of energy services, as well as availability and access to them. This is important if energy is to contribute in a transformational way to escaping poverty.*

The findings from research indicate that:

- *Inadequate access to energy contributes to poor people remaining poor.*
- *Energy poverty is correlated strongly with income poverty, though the number of people living in energy poverty may exceed the numbers living in income poverty.*
- *Sub-Saharan Africa and South Asia have the greatest number of people without adequate access to energy.*
- *Energy poverty is most acute for the poorest households and is more severe in rural areas.*
- *Energy is needed by poor households for productive uses as well as domestic and community needs.*

Across the world there has been progress in reducing energy poverty over the past two decades. Yet today, over 20% of global population lives without access to any electricity, and an equivalent share is estimated to have only intermittent access. Over 40% of the global population still cook and heat their homes using traditional practices[3] (GEA 2012; IEA 2012). For many, access to mechanical power is limited[4]. It is also estimated that one billion people are served by health facilities without electricity and more than 50% of children in the developing world go to primary schools without any access to electricity (Practical Action 2013). Not surprisingly, the percentage of global population currently living on less than $1.25 a day at 2005 international prices is also estimated to be about 20% (World Bank 2012). This is not to imply that all populations that are income poor are also poor in energy terms, but clearly there is significant overlap between these two population sub-groups. Research from India suggests that the extent of energy poverty can exceed that of income poverty particularly in rural areas where a lack of infrastructure and markets makes it impossible for even richer households to gain access to electricity, clean-combusting fuels and equipment (Pachauri and Spreng 2011). The extent of these two poverties is more similar and intertwined in urban areas.

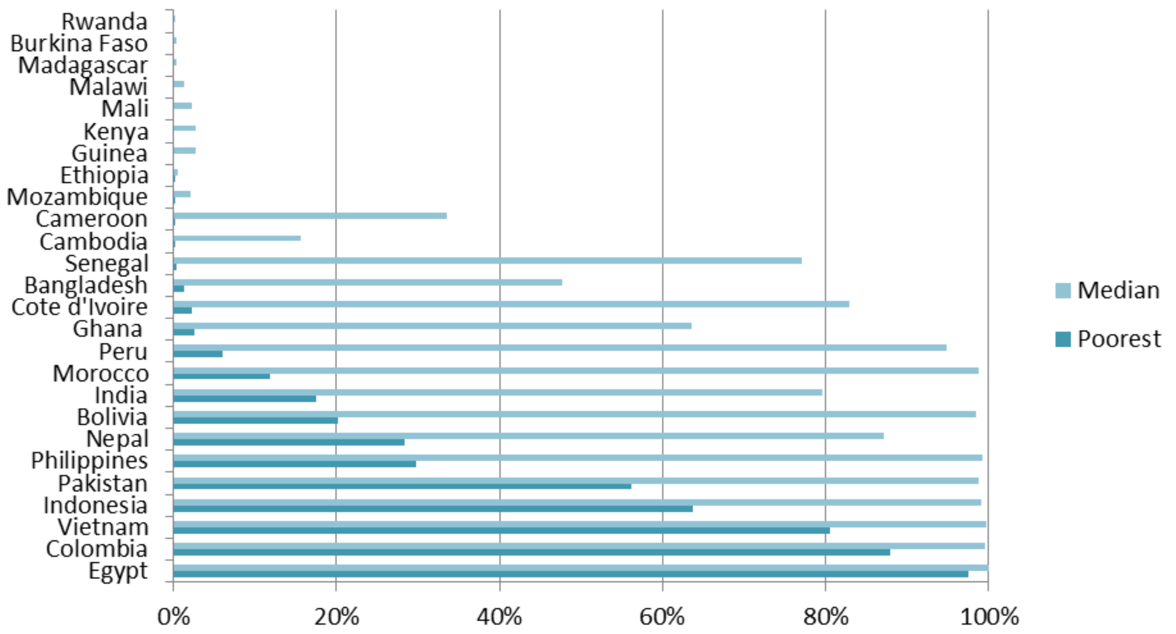
Lack of access to modern energy remains more severe in rural areas than in urban centres, though there are about 200 million urban inhabitants in sub-Saharan Africa and South Asia that remain unconnected to electricity and many more without access to clean-combusting fuels or stoves (mostly living in urban slums and informal settlements). While the percentage of population without electricity access is about twice as high in sub-Saharan Africa (around 70%) than in South Asia (about 33%), because of sheer population size in the latter region, around 600 million people in each region remain un-electrified. These regions correspond to those with the largest numbers of chronically poor people (CPRC 2008). While the share of population without access to electricity has been declining consistently over the last few decades in most regions, the rate of population growth still exceeds the

[3] Traditional practices include the incomplete burning of unprocessed biomass like firewood, crop and animal residues, as well as coal and charcoal in primitive stoves with low combustion efficiencies and high pollutant emissions.
[4] Estimates of the share of population without access to mechanical power, whether from electric or non-electric sources, do not allow even approximate quantification of a global proportion.

rate of new electricity connections in rural sub-Saharan Africa. Additionally, the share of rural populations dependent on traditional solid fuels has remained virtually unchanged over the last decade in sub-Saharan Africa and South and East Asia (IEA 2012). It is likely that chronically poor people have been left out of progress. For reasons of social cohesion it is important that policy makers, particularly those adhering to rights-based approaches, ensure that chronically poor people are included in efforts to increase access to modern energy.

Lack of access to modern energy is most acute for the poorest households. Figure 1 illustrates this in terms of access to electricity. In Peru and Côte d'Ivoire, for instance, households in the median wealth quintile are over ten times more likely to have access to electricity than those in the poorest quintile. However, in those countries with very low overall levels of electrification, including much of sub-Saharan Africa, there is little difference in access to electricity between households in the bottom and median wealth quintiles, due to limited electricity infrastructure availability. It is largely only households in the wealthiest quintile which have access to electricity in these countries.

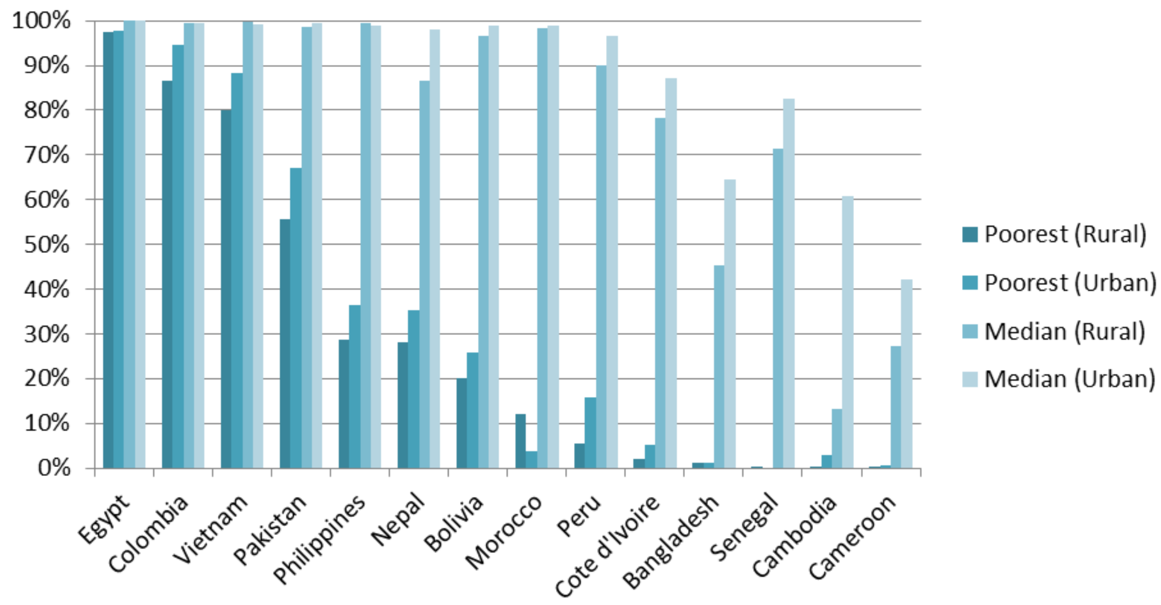
Figure 1 : Household access to electricity for the median and poorest wealth quintiles



Source: DHS data from the 2000s.

The poorest people are frequently concentrated in rural areas. This is a contributing factor to the gap in modern energy access between the poorest households and those in the median wealth quintile. However, as Figure 2 and Table 1 show, even within urban and rural areas, it is the poorest households that are less likely to have access to both electricity and clean-combusting fuels. In Pakistan, while almost 100% of households in the median wealth quintile have electricity in both rural and urban areas, this proportion is 67% for the poorest households in urban areas and 56% in rural areas. This suggests that, even where electricity is available, many of the poorest people are unable to connect possibly because of the high cost of connection or the poor quality or illegal status of their housing. This points to two policy priorities: one is expanding electricity coverage to areas currently not served and the other is enabling the poorest people to access electricity where it is already available.

Figure 2: Inequalities in electricity access between households in the poorest and medium wealth quintiles in rural and urban areas



Source: DHS data from the 2000s.

Energy for cooking remains the primary domestic end-use of energy in many developing nations, accounting for over 80% of the total energy used in many poor households. Yet cooking energy systems are still largely solid fuel dependent. Current cooking practices for many poor households involve solid fuels, for the most part, burnt on open fires or in stoves that are highly inefficient, and have poor combustion features. This has implications both for human health and the environment.

A global cost-benefit analysis estimates that there are potentially huge and multidimensional gains for chronically poor people from shifting from the current inefficient use of solid fuels to the use of advanced stoves and/or cleaner-combusting fuels such as liquefied petroleum gas (LPG) or biogas (WHO 2006). Successful interventions in household cooking systems can have very large economic and social paybacks, including through health and time savings. Inhalation of indoor smoke increases the risk of acute lower respiratory tract infections in children and the incidence of chronic bronchitis and emphysema in adults (WHO 2006). Specific analysis for Nepal, Kenya and Sudan shows that successful interventions, including a shift to LPG and to cleaner burning and more efficient stoves, have estimated internal rates of return ranging from 20% to 400% (Malla et al. 2011). However, vast disparities in the use of clean-combusting fuels exist both across rural and urban sectors as well as across expenditure quintiles within urban and rural regions, throughout the developing world (Heltberg 2003; Table 1). This suggests that policies need to address both the distribution of clean-combusting fuels and stoves supplies to rural areas, and the affordability of fuel and stoves for the poorest households.

Table 1: Percentage of the population using electricity and clean-combusting cooking fuels across rural and urban wealth quintiles

Nation	Energy Carrier	RQ1	RQ2	RQ3	RQ4	RQ5	UQ1	UQ2	UQ3	UQ4	UQ5
		%	%	%	%	%	%	%	%	%	%
Indonesia	Electricity	64	73	79	82	88	93	96	98	99	99
	Kerosene	90	91	91	93	93	93	94	93	86	62
	LPG	1	1	1	2	8	1	5	12	24	48
India	Electricity	31	44	53	63	79	75	90	94	97	98
	Kerosene	97	96	94	90	79	85	72	55	41	21
	LPG	1	2	6	12	38	19	46	68	83	90
Brazil	Electricity	50	57	63	69	78	84	91	93	95	96
	Kerosene	21	15	12	9	5	2	1	1	0	0
	LPG	42	61	75	85	90	91	98	98	96	85
Ghana	Electricity	2	5	7	9	19	28	27	34	43	61
	Kerosene	29	27	25	27	27	13	10	6	6	4
	LPG	0	0	0	0	2	0	2	4	8	10

Note: Estimates refer to the share of households reporting positive expenditure or consumption in the surveys. RQ1 and UQ1 are the poorest rural and urban quintiles, respectively, while RQ5 and UQ5 are the richest.

Source: compiled by Fuchs and Pachauri (2010) from nationally representative surveys - India NSSO 2004/05, Indonesia SUSENAS 2004, Brazil POF 2002/03 and Ghana GLSS 2004/05.

Given the potential multiple benefits from a transition to cleaner-combusting and more efficient cooking fuels and technologies, efforts are underway to accelerate such a transition globally (GACC 2011). In recent years, attention has also been devoted to assessing the co-benefits for the environment and climate change of interventions in household cooking systems. Measures including replacing inefficient cookstoves, can significantly contribute to reducing projected global warming (UNEP 2011). Unsustainable harvesting of fuel wood can also degrade local forest resources (Hofstad et al. 2009; Köhlin et al. 2011). New funds, especially those affiliated with international climate finance, can provide potential avenues for financing new initiatives for scaling up promising new cooking innovations.

Without access to the services that modern energy enables, poor people remain trapped in low-productivity subsistence tasks, continue to suffer from the severe health and social impacts associated with traditional energy use, and are unable to improve their living conditions. Often women and young children bear the brunt of these adverse impacts. In turn, this inability to improve livelihoods and living standards, results in poor people remaining unable to afford improved energy technologies and other critical assets and inputs that could enhance their incomes and welfare. Lack of access to modern energy contributes to chronic or persistent poverty.

The multiple benefits of access to modern energy at the individual and household levels include:

- Reduced drudgery of daily chores, particularly for women, including collecting water, gathering firewood and preparing food. In Bhutan, women spend 28 minutes per day less collecting fuel wood and men 21 minutes less, as a result of having electricity (ADB 2010).
- Improved health through reducing exposure to harmful pollutants emitted as by-products of traditional cooking practices. Between 0.6 and 1.8 million premature deaths could be averted in 2030, if universal access to clean-combusting cooking is achieved by then (Riahi et al. 2012).
- Increased opportunities for additional employment, to establish new enterprises and to improve the productivity of existing ones. Research in South Africa shows that, within five years, electrification significantly increases female employment outside the household (Dinkelman 2011). Meanwhile, rural electrification in Bangladesh increases total household income by around 12% through improving both farm and non-farm income (Khandker et al. 2009).
- Improved education. Electrification in rural India has increased school enrolment by about 6% for boys and 7.4% for girls, as well as extending weekly study time by more than an hour (Khandker et al. 2012).

Access to modern energy is also important for improving community services such as health care and street lighting. However, in some countries fewer than half of all health facilities have access to electricity, and access levels are lower in rural areas (Practical Action 2013). In sub-Saharan Africa, just 35% of primary schools have electricity access, compared with 48% in South Asia and 93% in Latin America.

Mechanical power is important for enhancing the productivity of labour in many activities that are fundamental to poor people's livelihoods, such as agro-processing and water pumping (Practical Action 2012). Yet there exists little data on mechanical power in developing countries. One estimate claims that 2.5 billion people without access to modern energy services still depend on unimproved versions of mechanical power equipment that inefficiently use human or animal power to meet their energy needs (UNDP and Practical Action 2009).

Complementary interventions, in sectors other than energy, are likely to be essential for access to modern energy to contribute to the reduction of chronic poverty. New initiatives such as the Energy Plus approach of the UNDP re-emphasize that energy access activities need to be mainstreamed within wider developmental efforts to maximize their welfare enhancing impacts on the poorest (UNDP 2012). This requires creating opportunities for poor households to shift away from using energy solely for consumptive purposes to using it for productive and income-enhancing applications as well.

Even for households that have a connection or physical access to a source of modern energy, irregular, unreliable, interrupted and at times adulterated supplies have a negative impact on their welfare. There is some evidence to suggest that poor energy reliability adversely impacts marginal and vulnerable groups disproportionately[5]. Suppliers, whether public or private, often tend to concentrate on meeting energy demands of large and industrial consumers at the cost of the poorest people whose demands remain unattractively low.

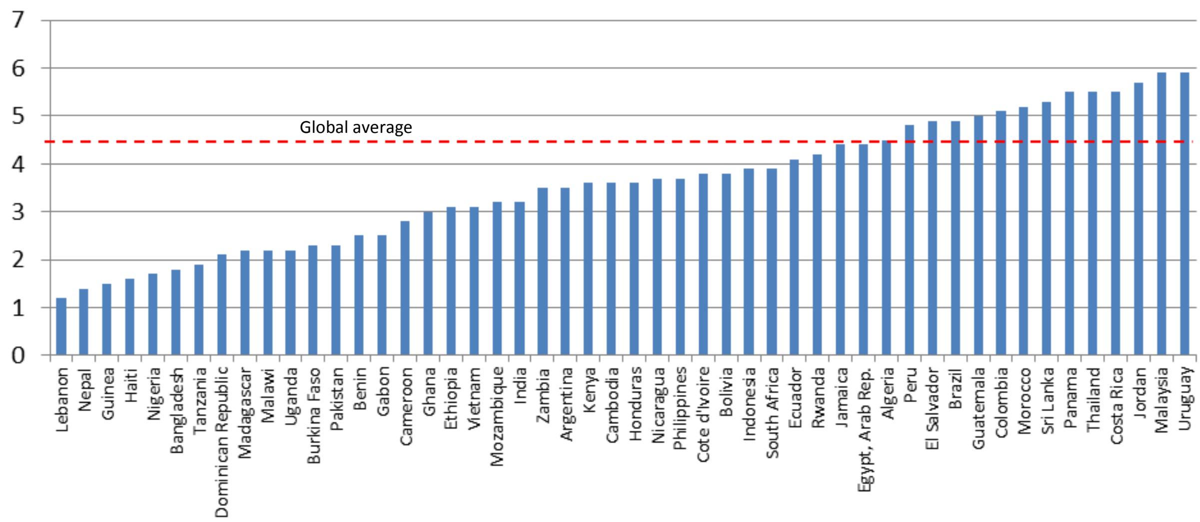
The energy insecurity of poor households tends to remain a neglected issue, because access is often thought of as a discrete state, with households considered as either having it or not. However, due to overall shortages, supplies to poor rural households and agricultural customers, even when officially connected, are often heavily rationed in many developing nations. Thus the availability - the actual hours of supply received in a given day for a given season - and reliability - total duration of

[5] Data and statistics on the reliability of energy supply and analysis of the importance of this for livelihoods remain scarce, particularly for the poorest population segments and regions.

interruptions during the scheduled hours of supply - is often inadequate and erratic. The quality of power supply, measured in terms of its voltage and the variability, also impacts customers.

According to a World Bank indicator on the quality of electricity supply (lack of interruptions and lack of voltage fluctuations), many of the poorest nations are ranked very low. Figure 3 presents the quality of electricity index[6] for a range of lower and middle income countries, showing differences between countries but the general low quality of supply by international standards.

Figure 3: The quality of electricity index



Source: Global Competitiveness Index 2012, World Economic Forum.

Most studies assessing the impacts of electricity supply interruptions focus on industrial and firm production losses, urban areas, or are at the macroeconomic level (Foster and Briceno-Garmendia 2010). An assessment for sub-Saharan Africa estimates that the average costs of electricity shortages are about 2% of the region's GDP. Losses for enterprises in forgone sales and damaged equipment amount to 6% of turnover for firms in the formal sector and as much as 16% of turnover for informal sector enterprises that lack their own backup generator (Eberhard et al. 2008). To the extent firms subject to such outages employ chronically poor people, these populations may be affected as well.[7] The IFC estimates, for instance, that a reliable power supply could increase annual job growth in low-income countries by 4% to 5%. Meanwhile, at the household-level increased electricity use and more regular and reliable supplies can raise entrepreneurial activity and living standards (Bensch et al. 2012; Rao 2013).

Existing evidence clearly suggests that inconveniences from outages and unreliable energy supply have costs for consumers. These costs, however, are likely to vary according to the type of consumer, incidences of outages, particularly with respect to time of day (working hours or evening), the time length of the outage and whether the outages are scheduled or not. However, impacts of the quality and reliability of modern energy supply on the poorest population groups and chronically poor households are largely unknown. This is because quality and reliability are relatively difficult to measure and assess and data for the poorest consumer segments remains scarce. Greater efforts at regular data collection and impact assessments for this segment of the population are needed.

[6] The quality of electricity is often reflection of a gap between generation capacity and demand.
[7] Most employed chronically poor people are informally employed. The informal sector is also an important vehicle which poor households make use of to escape from poverty.

A2: Poverty Dynamics and Energy

- *Chronically poor households are less likely to have electricity than households which have escaped poverty or fallen into poverty.*
- *Households which stay out of poverty are more likely to have access to electricity.*
- *As a proportion of household non-food expenditure, chronically poor households spend more on energy than other groups.*
- *Lack of access to electricity amongst the chronically poor is due to the unavailability of a supply and to its affordability.*
- *Solid biomass remains the dominant cooking fuel for chronically poor households.*
- *Gains from access to electricity for the chronically poor are constrained by the cost of acquiring appliances.*
- *Households with access to electricity are more likely to have income from a micro-business than those without electricity.*

This section presents an analysis of household poverty dynamics, examining if escapes from poverty are associated with having access to energy including electricity. This analysis, though, does not attempt to establish causation i.e. whether access to modern energy contributes to households escaping poverty, or whether it is after households attain a certain level of wealth that they then acquire access to modern energy. This section is based on analysis of three panel datasets with questions about access to, and use of, energy, including electricity: the nationally representative National Income Dynamics Survey (NIDS) from South Africa, a panel survey by Young Lives in Vietnam, and the AFRINT study which covers the rural areas of six sub-Saharan African countries. Box 2 gives more information about each of these surveys.

Box 2: The three panel datasets

National Income Dynamics Study (NIDS) implemented by the South Africa Labour and Development Research Unit and visited a nationally-representative set of South African residents for the first time in 2008. This visit collected baseline information on their situation and well-being. In 2010/11 these individuals were visited for a second time in order to investigate changes in their situation. Attrition from the sample means that wealthy, largely white South Africans, are under-represented in the second round.

The AFRINT project, led by Lund University, aims to investigate the possibilities for an Asian-style Green Revolution in sub-Saharan Africa. One component of the project is repeated household-level surveys of smallholder farmers. The AFRINT surveys collected in 2002 and 2008 cover the rural areas of Ethiopia, Ghana, Kenya, Malawi, Mozambique, Nigeria, Tanzania and Zambia and investigate changes among smallholder farmers, given international and national interest in smallholder-based agrarian development (Djurfeldt et al. 2011).

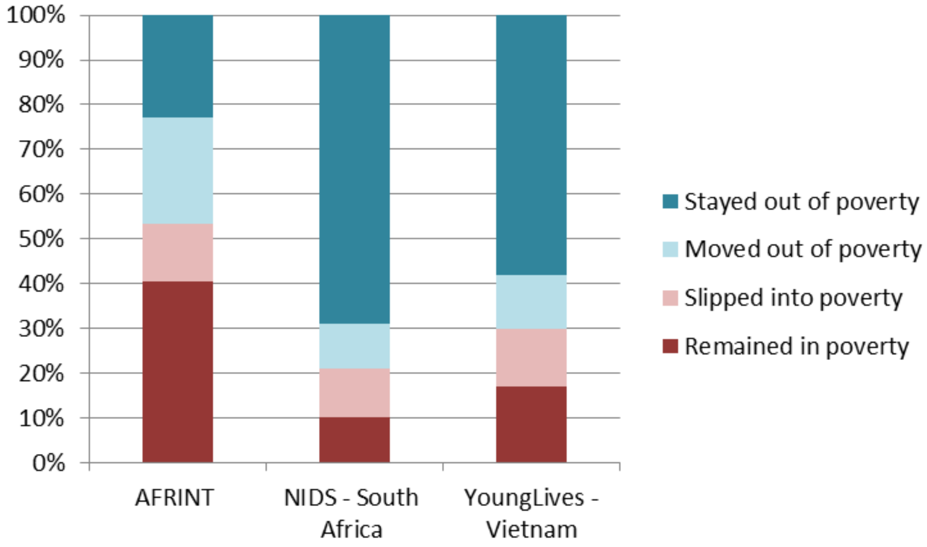
Young Lives is an international study of childhood poverty led by the University of Oxford. Through researching a range of aspects of children's lives, Young Lives aims to improve policies and programmes. One aspect of this research is the collection of panel data. The data collected in Vietnam is a purposive sample which includes both rural and urban areas but is deliberately biased towards poorer children and their families.

	Number of households in analysis	Date of 1st round	Date of 2nd round	% poor households in 1st round	% poor households in 2nd round
NIDS	5,171	2008	2010/11	20	20
AFRINT	5,690	2002	2008	64	53
Young Lives*	2,920	2006/07	2009	29	30

* This is a three-round panel survey. Because of a change in the questions between the rounds, this section presents analysis of round 2 and round 3.

For each of the datasets, households were grouped into four categories; those which remained in poverty for both of the rounds; households staying out of poverty in both rounds, those which slipped into poverty and those which moved out of poverty. Figure 4 presents an overview of poverty dynamics within the datasets, while Appendix 1 gives more information about how households were classified (using either household subjective poverty assessments or household per capita income).

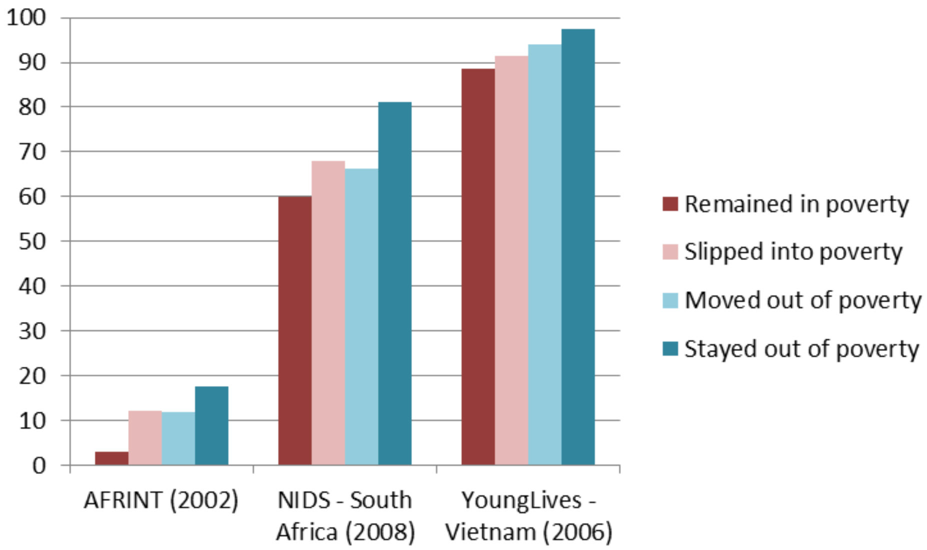
Figure 4: Poverty dynamics in the three panel datasets



Access to Electricity

As Figure 5 shows, the proportion of households with electricity varies across the datasets, largely reflecting national variations in electricity access. In 2005, for instance, 70% of households in South Africa had electricity while in Vietnam it was 84% (World Energy Outlook 2011). Meanwhile, national figures for electricity access in 2005 for Ethiopia and Kenya, two of the countries included in the AFRINT dataset, were 15% and 14% respectively. In addition, the AFRINT dataset focuses exclusively on rural areas, where electricity access tends to be less, as reflected in the findings from NIDS (Figure 6).

Figure 5: Percentage of households with electricity in round 1



For each dataset and in each round, households remaining in poverty were the least likely to have electricity (both on-grid and off-grid), while those staying out of poverty were the most likely (see Figure 5 for having electricity in round 1). In the case of South Africa and Vietnam, households staying out of poverty were significantly more likely to have electricity in both rounds than those households which remained in poverty, slipped into poverty or moved out of poverty. In the case of the AFRINT dataset, households remaining in poverty were significantly less likely to have electricity than households in the other three poverty dynamics groups.

In Vietnam, electricity access increased between the two survey rounds for households in all poverty dynamics groups, reflecting national figures on increased electricity access, from 84% in 2005 to 98% in 2009 (WEO 2011) and the success of the country's rural electrification strategy (See Box 3).

Box 3: The strategy of Vietnam to expand electricity access

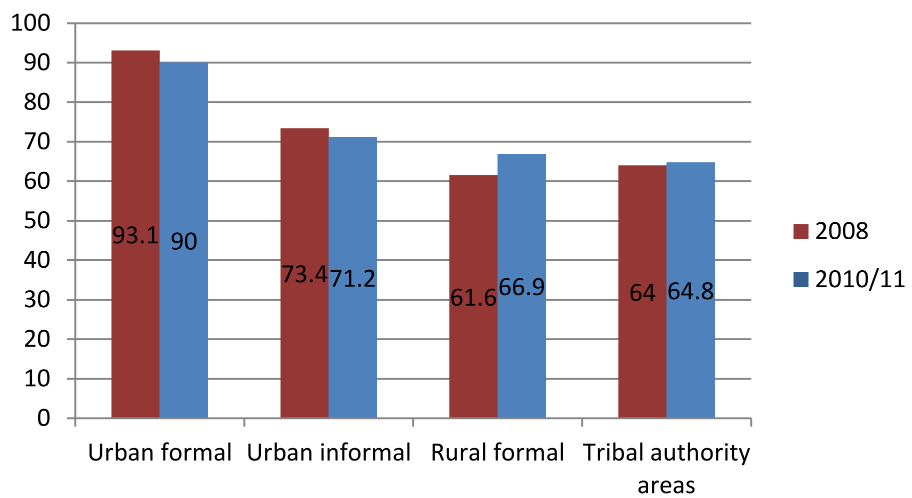
During the 1980s Vietnam's Rural Electrification Strategy focused on connecting agricultural and business areas to the grid, so providing a solid foundation for taxation. In the 1990s, these connections were expanded outwards from provincial capitals to district towns and then into surrounding communes. It became a political priority of the government to provide poor households with access to modern energy in order that they could climb the economic ladder. This was accompanied by the establishment of Vietnam Electricity (EVN) in 1995 which undertook widespread reform of the sector, including through encouraging private sector involvement. Since the early 2000s the government has increased the use of off-grid systems, particularly hydropower, to improve electricity access in remote rural areas. In 2005, 8.4% of households were using off-grid systems, though this had dropped from 18.4% in 2002 as grid extension led to a decline in the share of households using off-grid electricity.

Sources: ADB (2011), Bazilian et al. (2012) and Khandker et al. (2008).

For households in the AFRINT dataset, there was an overall increase in having electricity from 10% in round 1 to 12% in round 2 while households in all poverty dynamics categories, expect for those which slipped into poverty, saw an increase in their access. Households moving out of poverty meanwhile, saw a significant increase in having electricity, from 12% having electricity in 2002 to 19% having electricity in 2008. However, this association says nothing about causation.

There was no overall improvement in households with electricity between the two rounds of the South African (NIDS) dataset (Figure 6).

Figure 6: Households with electricity by rural/ urban location in the NIDS dataset



The Vietnam survey gives insights into why households did not have electricity/power in 2006. For households in all poverty dynamics categories the most frequent response was that electricity connections were not available in their area. However, for households remaining in poverty this was closely followed by not being able to afford power/electricity (for 44% it was not available, followed by 37% not being able to afford power/electricity). Certainly, it is well documented that the adoption of electricity is dependent on household incomes, while the high up-front costs of grid connection charges, can be as great a barrier to electricity access for the poorest households as the monthly tariff (Watson et al. 2012).

Energy for Primary Cooking and Heating Fuel

Electricity is not the only type of energy which households use. Households in each of the datasets also report using branches, wood, paraffin and charcoal, among others, as a main source of cooking energy.

In South Africa, the proportion of households in all poverty dynamics categories reporting electricity as their main source of fuel for heating and cooking increased. Table 2 illustrates this for the main cooking fuel used by households. Households remaining in poverty were the least likely to use electricity as either their main source of cooking fuel or for heating, presumably reflecting their lower access.

A similar situation is seen in Vietnam where the use of electricity/ gas as the main source of cooking fuel increased between rounds for all household groups, though wood remained the main source of cooking fuel for all but those households staying out of poverty.

Table 2: Percentage of households using electricity as their main source of cooking fuel in the NIDS dataset

	Round 1				Round 2			
	Remained in poverty	Moved out of poverty	Slipped into poverty	Stayed out of poverty	Remained in poverty	Moved out of poverty	Slipped into poverty	Stayed out of poverty
Rural formal	29.4	51.9	28.4	59.5	52.4	62.8	54.2	73.3
Tribal authority areas	27.6	37.8	35.4	44.7	40.1	49.5	55.5	61
Urban formal	78.1	75.8	83.1	88.2	82.4	81.3	88.9	93.4
Urban informal	40	57.9	55.6	65.2	52.4	71.9	71.4	71.8
Overall	37.7	50.3	49.1	69.1	49.5	62.9	65.5	79.4

Energy and Household Assets

One possible reason why the NIDS dataset shows an increase in households using electricity as their main source of cooking and heating fuel while there is no increase in households with electricity may be due to the lag-time between households getting electricity and subsequently obtaining expensive appliances, such as electric cooking rings (Box 4). The inability of the poorest households to afford expensive appliances is one of the reasons why they frequently benefit the least from an electricity connection (Khandker et al. 2012). Data analysis supports this hypothesis; between the two rounds, ownership of electric rings increased for households in each of the poverty dynamics categories, with the biggest increase being for those who remained in poverty. For these households the proportion owning an electric cooking ring increased from 35% in round 1 to 48% in round 2, though in both rounds households remaining in poverty were the least likely to own electric cooking appliances. This suggests that it is poverty and limited capability to acquire assets which is holding back real progress in energy use.

Box 4: Expanding electricity access in South Africa: The potential for lags between connection and usage

South Africa has seen recent impressive improvements in household access to electricity, with 5 million households connected between 1990 and 2007.

In 2003 the South African government launched the Free Basic Electricity Policy which provides 50kWh per household per month to poor households. Initially it was reported that its recipients did not understand how it worked and even more recently it is reported that some communities still remain unaware of the policy. Meanwhile, households applying for their free basic allowance have to be fitted with a pre-paid meter system and buy vouchers in order to activate it (Adam 2010), again potentially leading to a time delay between households obtaining a supply and using electricity for cooking and heating.

Sources: Adam (2010) and Bekker et al. (2008).

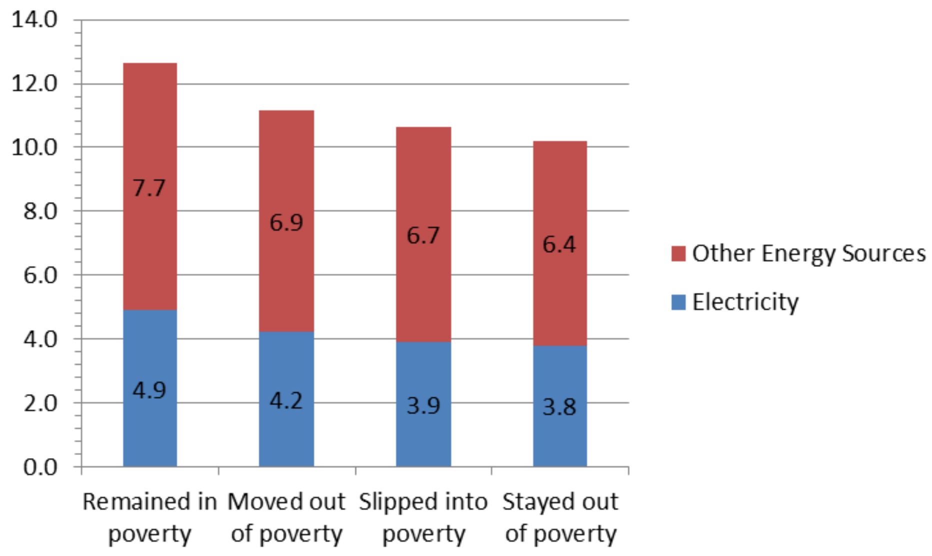
Households with electricity in both South Africa and Vietnam are more likely to own a fridge than those without, while, for both datasets in each round a greater proportion of households which stay out of poverty have a fridge than those in the other poverty dynamics groups.

Energy for Earning a Living

Analysis of the AFRINT survey reveals a relationship between electricity and a micro-business. Across all households, there is a significant relationship in the first round between a household gaining cash income from a micro-business and having electricity. This may point to the importance of electricity both for farm and non-farm enterprises. Meanwhile, for each of the poverty dynamics categories, households with electricity are more likely to have received cash income from microbusinesses than those without electricity access. Analysis of the effects of rural electrification in India has also highlighted the association between electricity and an increase in non-farm income as well as between electricity and having a home business (Khandker et al. 2012; Rao 2013).

The Vietnam survey also highlights the use of a motor or engine pump, with households remaining in poverty being significantly less likely to own one than those in the other three poverty dynamics groups. Certainly, households tend to use a mixture of different types of energy. Figure 7 highlights spending on energy in Vietnam, segregated into that on electricity and spending on other energy sources. Households staying out of poverty spend the most on both electricity and other sources of energy (a reflection of their greater ownership of expensive appliances), while those remaining in poverty spend the least. However, it is households which remain in poverty which spend the greatest proportion of their non-food expenditure on energy.

Figure 7: Energy spending as a proportion of non-food spending in Vietnam (2006/07)



B1: Making Energy Affordable

- *Universal access to modern energy services will only be achieved if there is some form of support for the poorest people.*
- *Energy subsidies are often regressive and need to be better targeted.*
- *Tariff structures can be used to target subsidies for poor electricity consumers.*
- *Finance to lower investment costs for the poorest consumers is as essential as price or tariff support on electricity and fuels.*
- *Subsidy reform or removal needs to contain measures to protect or compensate the poorest people for any negative impacts.*
- *Alternatives to subsidies, such as cash transfers, should also be considered to enable chronically poor people to access modern energy services.*

Chronically poor households spend a higher proportion of their non-food expenditure on energy than households which live in transitory poverty or are above the poverty line (Figure 7). Though the amount of energy consumed by the poorest households (measured in physical terms, e.g. kWh or KJ) is lower, the cost per unit of energy is often higher for them than for wealthier households. Poor households are willing to pay these higher prices because a certain quantity of energy is essential for survival (i.e. for cooking food) or because they place a high value on a minimum level of access (e.g. an electric light).

Despite the poorest households spending a significant proportion of their income on energy the affordability of modern energy services (electricity and improved cooking fuels and technologies) is often a barrier to access. Where an electricity service, for example, is physically available, poor households may not be able to access it because they cannot afford the connection charge or the monthly charges. Similarly, access to clean-combusting energy for cooking may be prevented because of the cost of purchasing the necessary cooking equipment (e.g. LPG stoves) and fuel (e.g. LPG bottles).

The social benefits of access to modern energy services and the links between access to energy and poverty reduction have led some governments to adopt measures to make it more affordable. These include financial mechanisms so poor households can pay energy costs (e.g. credit and pre-payment cards), action to lower costs through technological innovation or economies of scale (e.g. advance market commitments[8]), and subsidies for capital and recurrent costs. The goal of universal access to modern energy services will only be achieved if there is some form of support that makes energy affordable to the poorest consumers.

Subsidies are the most common mechanism[9]. Energy subsidies are adopted for a number of reasons, including to promote industrial and agricultural production, or the adoption of renewable energy technologies, but poverty reduction is a principal reason given for their introduction (Commander 2012). Subsidies can take different forms, summarised in Figure 8. In developing countries, most energy subsidies reduce the price paid by consumers for cooking, lighting, heating and other essential energy services (Commander 2012). They can also reduce the prices of other goods and services

[8] Advance market commitments (AMCs) are donor mechanisms which guarantee support for the delivery of goods or services. This support is disbursement after delivery, and can be used to provide an incentive to suppliers and a means to use economies of scale to reduce prices.

[9] The IEA definition of an energy subsidy includes any government action concerned primarily with the energy sector that lowers the cost of energy production, raises the price received by energy producers or lowers the price paid by energy consumers.

that have energy as a key input. Subsidies can be significant in enabling the poorest households to access modern energy services (Komives et al. 2007), and they can reduce the incidence of poverty[10] (World Bank 2006 in IEA et al. 2010).

Figure 8: Subsidy mechanisms

Government intervention	Example	Lowers cost of production	Raises cost of producer	Lowers price to consumer
Direct financial transfer	Grants to producers /service providers: Subsidy for bulk power supply Direct operating subsidy Capital subsidy	✓		
	Grants to consumers: Direct connection subsidy Connection subsidy through service provider Direct consumption subsidy to low power users (lifeline rate)			✓
	Low-interest or preferential loans: Financing subsidy for producers Consumer credit for new connections	✓		
Preferential tax treatment	Rebates or exemptions on royalties, sales taxes, producer levies and tariffs	✓		
	Tax credit	✓		✓
	Accelerated depreciation allowances on energy-supply equipment	✓		
Trade restrictions	Quotas, technical restrictions and trade embargoes		✓	
Energy-related services provided directly by government at less than full cost	Direct investment in energy infrastructure	✓		
	Public research and development	✓		
	Liability insurance and facility decommissioning costs	✓		
Regulation of the energy sector	Demand guarantees and mandated deployment rates: Cross-subsidy to low power users (lifeline rate)	✓	✓	
	Price controls		✓	✓
	Market-access restrictions		✓	

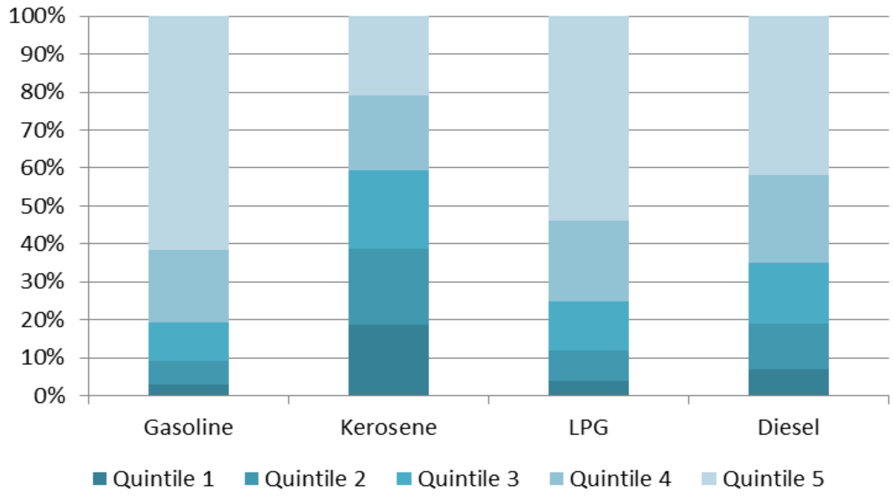
Source: adapted from UNEP (2008).

Fuel subsidies, however, do not only benefit poor households. Difficulties in targeting fuel subsidies mean that the poorest 40% of the population receives just 15-20% of the total fuel subsidy (IEA et al. 2010). Most benefits are received by wealthier households and businesses. For instance, the richest 20% of households in low and middle income countries receive six times the benefits of fuel subsidies than the poorest 20% of households (IMF 2013). As shown in Figure 9, globally, subsidies on gasoline, which is used mainly for vehicle transport, are more regressive in nature than subsidies for kerosene, which is often used by poor households for cooking and lighting. How regressive energy subsidies might be is context specific, however. In a study for Maharashtra in India, kerosene subsidies were found to have minimal financial value to poor rural households, in part because

[10] Fuel subsidies reduced the incidence of poverty by 8% in Yemen and 5% in Morocco (World Bank 2006 in IEA et al. 2010).

government quotas were based on cooking needs, but kerosene was used predominantly for lighting in rural areas (Rao 2012).

Figure 9: Distribution of petroleum product subsidies by income group



Source: del Granado et al. (2012)

Consumer subsidies for electricity face similar challenges, because wealthier households consume more electricity. In particular, universal subsidies are often regressive because benefits are conditional upon the quantity consumed, which increases with wealth. However, tariff structures can be used to target electricity subsidies more effectively than differential pricing for fuels. Lifeline tariffs do this by charging a lower, subsidised tariff for a monthly consumption of electricity below a specified level. This minimum level varies between countries[11], reflecting lack of consensus on the basic needs for energy as well as differences in the political and economic situation between countries. Incremental block tariffs, as used in Vietnam (Box 5), allow for a gradual reduction of subsidy as the quantity of electricity consumed increases. Subsidies for connection charges, often a critical barrier to access, can be well-targeted to the poor. Alternatively, customers can be allowed to pay the connection charge over a longer time period. Under the Second Rural Electrification Project in Morocco, for instance, rural consumers were allowed to pay the connection charge in monthly instalments of 40 dirhams (just less than $5) over a seven-year period (totalling 3,360 dirhams; World Bank 2008).

[11] In Vietnam and South Africa it is 50 kWh per month, in China 110 kWh, while in Uganda it is 15 kWh.

Box 5: Life-line tariffs in Vietnam

Vietnam's Incremental Block Tariff structure for residential consumers was reformed in March 2009, by reducing the consumption level which receives a preferential rate (lifeline tariff) from 100 KWh to 50 KWh per month, and increasing the price of electricity to all other users.

The new lifeline tariff (tariff for first block) was set at around 40% of the economic cost of supply to reach vulnerable people. At 50kWh/month, the size of the lifeline block is low in comparison to other countries which average 90 kWh per month.

The next block (51-100 kWh) was priced at the economic cost of supply, without profits for the power companies. Profits are covered by residential tariffs in higher blocks as well as cross-subsidies from other tariff categories, mainly industrial and commercial users.

The assistance is in cash and is given directly to poor households on a quarterly basis. Every payment is VND 30,000 (USD 1.5) per poor household per month. The assistance is sourced by the central budget and delivered by the Ministry of Labour, Invalids and Social Affairs, based on the list of poor households in each commune, which is updated every year. Poor and low-income households have to register with their electricity provider in order to get assistance for the first 50 kWh and 100% of poor households get assistance.

Source: Nguyen Thang (2012).

The high cost and weak targeting of fuel subsidies, and the poor financial performance of subsidised electricity services, have become drivers for their reform or removal. Better targeting of subsidies tends to entail higher administrative capacity and costs, for means-testing, categorising beneficiaries, and geographical or sectoral identification of recipients. Subsidy removal translates into changes in welfare through increases in the cost of living when higher fuel prices feed into other prices, as well as changes in the quantity of energy consumed by poor households resulting from higher prices[12]. The proportional impact of subsidy removal can be greatest for the poor, even though the rich receive most of the total value of the subsidy (Commander 2012).

Subsidy reform therefore needs to contain measures to protect or compensate the poorest people for negative impacts. For example, Kenya subsidised connection costs instead of electricity prices. The rural electrification programme contributed to increasing the number of connections from 650,000 in 2003 to 2 million by 2013, with a fund for connection fee payments financed by donors. Uganda meanwhile, retained a lifeline tariff for the lowest consumers and concentrated tariff increases on households with higher electricity consumption levels, and the Philippines retained subsidies for specified social groups (indigent families; IMF 2013).

Alternatives to subsidies, including cash and non-cash transfers, could also enable the poorest to access modern energy services, whether as part of wider social protection programmes or specifically for energy services. Social safety nets can be efficient and equitable, but their effects on energy consumption are not well known and energy services are not often considered an essential service to be delivered through safety nets.[13] Experience from Indonesia (Box 6) suggests that cash transfers can enable the poorest households to access energy. Another approach is the use of output-based aid (OBA) to ensure connection fees or equipment costs are subsidised after delivery to targeted households. To be effective and robust against corruption and leakage, energy subsidy programmes

[12] Given the high willingness to pay and low levels of consumption amongst poor households, it is possible there may be no change in the quantity consumed.
[13] For instance, access to energy is not mentioned at all in the Bachelet Report on a Social Protection Floor for a Fair and Inclusive Globalization (2011).

should aim to adopt simple and transparent targeting criteria consistent with those adopted by other social assistance programmes.

Box 6: Indonesia's use of cash transfers to mitigate fuel price increases

The Government of Indonesia sharply increased the consumer prices of gasoline, diesel and kerosene in 2005. To help the poor adjust to the effects of these higher prices, the Government distributed the equivalent of $11 a month to more than 19 million households over the period of a year. In 2008, after another price increase, the Government distributed $10 a month to 18.5 million households over a nine-month period.

These cash transfer programmes did not completely escape charges of unfairness, corruption and the provision of support to ineligible households, which can apply to subsidy schemes. However, almost two-thirds of the total distributed went to the poorest 40% of the population. A review of the 2005 programme found that the four main items purchased with the cash transfers were rice, kerosene, debt repayment and health (in that order). Recipients showed improvements in education, labour and health.

Source: Kojima (2013).

B2: Scaling up Promising Cooking Fuel and Technology Innovations

- *A transition to cleaner-combusting fuels and/or stoves is as important as access to electricity for reducing energy poverty.*
- *For the poorest population groups, improved or advanced biomass stoves are a feasible first step in a transition to cleaner cooking.*
- *Interventions in household cooking systems can have very large economic and social returns.*
- *The low success rates of interventions are due to several factors, including the gendered nature of cooking.*
- *Scaling up the dissemination, adoption and use of clean-combusting fuels and/or improved cookstoves requires multiple actions at different levels.*
- *The continued dependence on traditional cooking practices contributes to climate change, and climate funds can be used to improve the access to clean-combusting cooking fuels and equipment.*

A transition to cleaner-combusting fuels and/or stoves is important in most developing countries since electricity, even if it is available, is rarely used by the poorest people for household cooking or heating. While there are some successful cases where such a transition has been achieved within a relatively short period of time (e.g. Brazil and Indonesia, Box 7), in many developing nations progress to date has been slow, particularly in rural areas. Low incomes, irregular cash earnings, liquidity constraints and easy access to biomass sources, are some reasons why dependence on biomass fuels remains high, particularly in rural areas. A lack of understanding regarding the severe health consequences of inhaling the smoke emitted while burning biomass has also contributed to a slow transition away from these.

Box 7: Successful LPG scale-up in Brazil and Indonesia

In Brazil, LPG access was extended to 98% of all households between 1973 and 2001. This was achieved through a government policy that promoted the development of an LPG delivery infrastructure in all regions, including rural areas of the nation, and providing access to LPG at a uniform price across the country, which included a subsidy of about 18% of the retail price, on average. Although prices were liberalised in 2001, the poorest families continue to receive a subsidy via gas vouchers.

In 2007 Indonesia, in an effort to eliminate government subsidies on kerosene and provide a cleaner and more efficient fuel for cooking, launched an ambitious programme to convert its primary cooking fuel from kerosene to LPG in more than 50 million households within five years. Pertamina, the national oil company, and implementing agency conducted two pilot phases in Jakarta in 2006. Feedback from this test phase provided important lessons for the required planning and rapid infrastructure development needed subsequently. By the middle of 2012, the programme had been implemented in 23 provinces and benefitted close to 54 million households or other end-users. The programme continues to be rolled out in additional provinces of the country.

Sources: Brazil, Jannuzzi and Sanga (2004); Lucon et al. (2004). Indonesia, Budya and Arofat (2011); WLPGA and Pertamina (2012).

Gender inequalities also hinder a transition to cleaner-combusting fuels and improved stoves (Clancy et al. 2012). The opportunity costs of biomass collection are lower when female labour force participation is limited. Female roles in family decision-making often leave women with little say in household budgetary matters (e.g. purchase of new stoves or adoption of new fuels; Kishore and Spears 2012). Thus, despite fuel collection (for traditional solid fuels) and cooking being a predominately female concern in many developing countries, the male household head often has to perceive a need for change in existing cooking practices before a transition to using cleaner-combusting fuels or stoves occurs. A failure to address the gender dimensions of energy poverty, including the division of responsibilities and power relationships within households and societies, is one reason for the slow transition to clean-combusting energy services (Pachauri and Rao 2013).

In most cases, amongst the poorest population groups, improved or advanced biomass cookstoves are seen as a more feasible first step in a transition to cleaner cooking because clean-combusting fuels are affordable only at higher incomes. This is particularly true in rural areas, where many of the poorest people do not purchase cooking fuels, but rather gather them and distribution channels for clean-combusting fuels remain inadequate. However, options like biogas or ethanol gel fuels that are biomass based are already used in certain regions and might be suitable for others. Other immediate measures to improve the cooking experience in poor rural households include adding chimneys or room ventilation and changing home design or layout. In urban areas, a transition, even among the poorest, to clean-combusting cooking fuels has occurred in some nations such as Brazil. In either case, policies are required to address stove dissemination, adoption and use, as well as fuel supply and distribution chains.

Accelerating a transition to cleaner-combusting fuels and stoves globally requires scaling up and rolling out successful cooking innovations and programmes more widely and more rapidly than in the past. By examining successful transitions and some more recent innovative approaches, this section draws lessons on what has worked to help people from chronically poor backgrounds and regions shift to using cleaner fuels and/or improved stoves. Key principles and fundamental elements to scaling up promising cooking innovations are discussed below (GEA 2012; World Bank 2012; GACC 2011).

Dedicated national commitment with a vision for scale: Behavioural change takes time and therefore requires long-term vision, leadership, and investments, including those in crucial ancillary activities such as information campaigns, research and testing centres, and capacity development. The scale-up of decentralised rural energy services in Nepal (UNDP 2010) and the successful implementation of the clean cookstoves program in China illustrate this (Box 8).

Box 8: China's National Improved Cookstove Programme (NISP)

Between 1982 and 1992 the NISP introduced 129 million stoves, mostly biomass cookstoves, into rural areas. Initially the programme focused on pilot counties which applied to be included through provincial and national competitions and were selected on the basis of biofuel shortages and their capacity to implement. The programme therefore worked in the easiest areas first.

More than two-thirds of these stoves remained in use in 1993 and around 100 million were still in use fifteen years later. The role of government in the NISP has changed over time. While the first phase involved the government subsidising and distributing low-cost stoves, the second phase saw it focus on research development and push for commercialisation. The third phase meanwhile, saw government emphasis on extension, promotion and increased standardisation of the most popular models.

Essential to the success of the NISP has been the systematic independent monitoring and evaluation of cookstove use. Evaluations picked-up that initially the stoves were not sufficiently durable and that customised household installation frequently led to their dimensions being altered, making stoves inefficient. Government investment in research and development, in collaboration with stove retailers and customers, lead to the development of long-lived standardised inserts produced in factories to ensure quality, that stoves were built according to specifications and to reduce costs. Most Chinese users now pay the full cost of stove materials and construction labour.

Today, the programme is no longer government-financed and the private sector still produces the stove components, producing more efficient and less polluting models.

Sources: Barnes et al. (2012) and Smith et al. (1993).

Policy coordination and coherence: Household energy remains a fragmented field with multiple actors, lacking a cohesive strategy to address the range of adverse impacts of traditional fuel use. Strong alignment across policy domains is important to accelerate the adoption of cleaner fuels and stoves at scale. This involves ministries dealing with separate portfolios such as energy, environment, rural development, agriculture, education and health, working in tandem to create awareness about the negative impacts of using traditional fuels on human health and the environment and educating the public about the need for and benefits of switching to cleaner and more efficient fuels and stoves. Also, it is important that institutions in different sectors take a proactive approach, and plan and implement innovative measures at regular intervals for addressing relevant challenges.

Engaging local actors: Tailoring stove design to local requirements is essential. Early cookstove projects may have adopted good designs from an engineering and design perspective, but sought little feedback from end users. This resulted in products that were seemingly effective, but could not withstand harsh conditions on the ground (e.g. dust, wind, wood of varying size, etc.) or were incompatible with cooking practices and food preparation by users (Mukhopadhyay et al. 2012). Impractical stove designs were partially responsible for the widespread Indian Improved Cookstove initiative failing. The Indian government reached their target to distribute 1.9 million stoves, but these stoves were not designed with local cooking preferences in mind; stoves sat idle and women continued cooking with the traditional three-stone method (Staton and Harding 2003). More recently, stoves developed by Prakti in the South of India have experienced success on a small-scale as a consequence of redesigning stoves based on feedback from end-users regarding size and design. In Maharashtra local potters are involved from the outset (Box 9).

Box 9: Involvement of local potters in Maharastra

India's national programme experience in Maharashtra provides example of a successful improved cookstove programme. The ARTI, the state's technical back-up unit, initiated an entrepreneurship training and development programme for traditional potters to participate in the design, promotion and sale of stoves. This programme focused on the development of easy-to-assemble portable moulds for making improved stoves, set up an entrepreneurship development programme for traditional potters and trained potters in stove installation. Because of their familiarity with local markets, traditional potters could apply sales techniques that rural households found more convincing than those of government officials or NGOs. The entrepreneurs sold their products both in the open market and through the national programme. With modest investments they earned reasonable profits and were keen to expand their business.

Source: Barnes et al. (2012).

Affordability, targeted subsidies and consumer financing: One of the major policy challenges is to make new fuels and stoves affordable for all. The poorest people have insufficient working capital to invest in a large cylinder of LPG or buy a new cookstove in one go. One option is to introduce smaller sized cylinders (e.g. in Senegal), especially for rural and low-income households. Furthermore, there are new initiatives, such as that of the Delhi Government, to provide all Below Poverty Line (BPL) households with a free stove and security deposit on the first LPG cylinder. Regular monitoring and evaluation of the scheme will be needed to determine its impacts on the poorest households.

Several new initiatives are also underway which use creative ways of targeting subsidies to the poorest households, including direct finance options, leasing and rental models, fee for service models and third party financing (Zerriffi 2011). While the impacts of these new business models have been modest so far, they provide a potential means for scaling up efforts in the future.

Access to microfinance and other financial institutions that can provide affordable loans for stove purchases at a reasonable rate of interest may also be important for scaling-up the use of clean-combusting fuels for cooking. However, it may be that the poorest people need grants and other forms of support rather than credit. Most of the poorest households also find it difficult to accumulate financial savings without easy access to safe institutions that provide deposit services. Developing and regulating financial services that can address the insurance, credit and savings deposit needs of the poor can be crucial to the success of achieving this transition.

Business models and creative cross-subsidisation: That commercial enterprises can profitably serve those at the 'bottom of the pyramid' is a view that is gaining hold (Prahalad et al. 2004). Many recent efforts to introduce improved stoves at scale have called for greater private sector involvement and the development of commercial markets for new stoves. While some of these private sector initiatives have been successful (Shrimali et al. 2011), in most instances the commercial stove players have targeted commercial customers or more wealthy households. For the poorest households, subsidies on clean-combusting fuels and grants or cheap credit for new stoves remain necessary. Governments could introduce regulations and provide incentives, such as tax incentives, to encourage private companies to cross-subsidise households with low purchasing power by larger commercial customers or richer households.

Quality assurance, monitoring, standards, testing and safety: Successful scale-up of cookstove programmes requires building consumer confidence to ensure their adoption and sustained use. This, in turn, means ensuring quality controls and standards are met and regular monitoring occurs. Government authorities need to put in place a regulatory framework and mechanisms to ensure that adequate standards (for safety, performance i.e. efficiency and emissions, and design) for new stove technologies are set, safeguarded and enforced. An emerging generation of tools is enabling continuous and objective monitoring of the stove adoption process (from acceptance to sustained use or dis-adoption; Ruiz-Mercado et al. 2011). Monitoring is also needed for measuring greenhouse gas and aerosol emissions (Rehman et al. 2011) and can provide a means for transparent verification in carbon projects.

Constant monitoring and evaluation with the help of the Rural Energy Offices at the county level was a fundamental component of the success of the Chinese National Improved Stove Program. Developing credible monitoring and evaluation systems is vital. This includes careful testing, certification, and field performance monitoring — 'you don't get what you expect, but what you inspect' (Smith et al. 2007).

Capacity building for regular maintenance and repairs: Training and extension programmes that build the capacity of local communities to undertake regular maintenance and repairs of new stoves are critical. Reliable after-sales support and services are also important for building consumer confidence. Successful stove programmes in China and Nepal involved local communities and community-based organizations assisting with stove installation, and being trained on stove use and maintenance (WB, ESMAP 2010). Involving women in after-sales services can also serve as a means to empower them and obtain their buy-in for the sustained use of new stoves (Slaski and Thurber 2009). Recent efforts to involve women in the innovation, development, dissemination and maintenance of modern energy services (Box 10), have shown positive impacts on women's well-being and status in society (IRENA 2012).

Public education: Many stove programmes are failing because of a lack of understanding regarding the health implications of solid fuel use (Lewis and Pattanayak 2012). Public education needs to highlight the adverse health and environmental impacts associated with solid fuel use in unimproved stoves, particularly among the poorest populations and regions.

Box 10: Involving women in energy value chains

GERES (Group for the Environment, Renewable Energy and Solidarity), a French non-profit NGO, has been very conscious of the roles that women play in improved cookstove projects. In its New Lao Stove (NLS) project in Cambodia, it has aimed to strengthen women as owners in the process by providing production training to women, providing them access to finance and allowing them the flexibility of production from home so they can take care of their children. The project finds it more effective to work with women because women entrepreneurs run more efficient production, produce better stoves, and save more money. Van Tola is a model of entrepreneurial spirit and runs three of the 42 NLS production centres that have been established across nine of Cambodia's provinces. She saw the training that GERES provided as a way to escape the cycle of poverty and dependency in which many rural women find themselves. Within a period of five years, Tola was employing over 40 villagers and family members to produce over 4000 NLS stoves a month.

Source: http://www.cambodia.geres.eu/our_projects/new_lao_stove

GenteGas, a Guatemalan social enterprise, aims to reduce the entry costs for low-income communities to purchase clean burning stoves and fuels in rural areas by providing income-generating opportunities to women. By partnering with a local micro-lender, it is building a woman-to-woman sales network to build microenterprises and extend the value chain of the basic cookstove product. GenteGas provides household education and awareness regarding toxic cooking smoke, LPG safety and handling, entrepreneurship and financial literacy training, and loan processing assistance to women. Women entrepreneurs receive a sales commission based on monthly sales. GenteGas is currently undertaking a pilot phase, but hopes to scale-up operations in the future.

Source: GenteGas (2013). GenteGas Pilot Request for Proposal. Retrieved by email correspondence.

Marketing and distribution: Marketing strategies can also play an influential role in acceptance levels for stove projects. Well-targeted product promotion is critical to reaching poor communities as has been clearly demonstrated in the case of the ENVIROFIT stoves in India (Shrimali et al. 2011). Targeted marketing is also an effective strategy to achieve success in regions facing biomass scarcity or high costs of purchased wood. This requires comprehensive market analyses, surveys and market intelligence to determine consumer demand and for effective customer segmentation. Rural and social marketing for other products and services (e.g. health) might provide lessons for how to build awareness and share information regarding new cooking solutions.

Fuel supply chains: Ensuring adequate supplies of clean-combusting fuels and stoves as well as distribution infrastructure that reaches into the remotest rural areas remains a challenge. In many instances, advanced stoves also require processed biomass (e.g. pellets) and their production and distribution entails logistical challenges. In such instances, entirely new value chains need to be created. As women often have a central role in existing cooking and fuel collection strategies, involving them in new energy value chains can be an effective way of scaling up access (Box 10).

B3: Providing Electricity for Local Businesses and Employment

- *Lack of electricity is a constraint on production and enterprise growth.*
- *Access to electricity can reduce the costs of energy for enterprises and increase productivity, which can have a positive net employment effect.*
- *Electricity alone is not enough to stimulate business investment, but business development support services which may accompany electrification can increase enterprise and employment growth.*
- *Access to electricity can lead to increased participation in the labour market, especially for women.*
- *The impacts of electrification upon household enterprises are unevenly distributed and felt by wealthier households more than the poorest.*

Increasing access to quality jobs is an important component of poverty reduction. Improving wages and working conditions in labour markets, as well as improving productivity in self-employment, are important to improve the living conditions of the poorest people.

The overall availability of jobs is related to economic growth, which is closely correlated with total energy and electricity consumption. Access to electricity can enlarge the range of employment options, particularly in rural areas, through enabling the expansion of a range of services for manufacturing, communications, mechanical power and lighting (GEA 2012). Estimating the job creating effects of electricity supply at the macro-level involves analysis of: (a) indirect jobs (jobs created in suppliers and distributors); (b) induced jobs (jobs resulting from direct and indirect employees spending more); (c) second-order “growth” effects such as more reliable power allowing enterprises to produce more, and more efficiently; and (d) net job creation (accounting for job losses in competitors; IFC 2013).

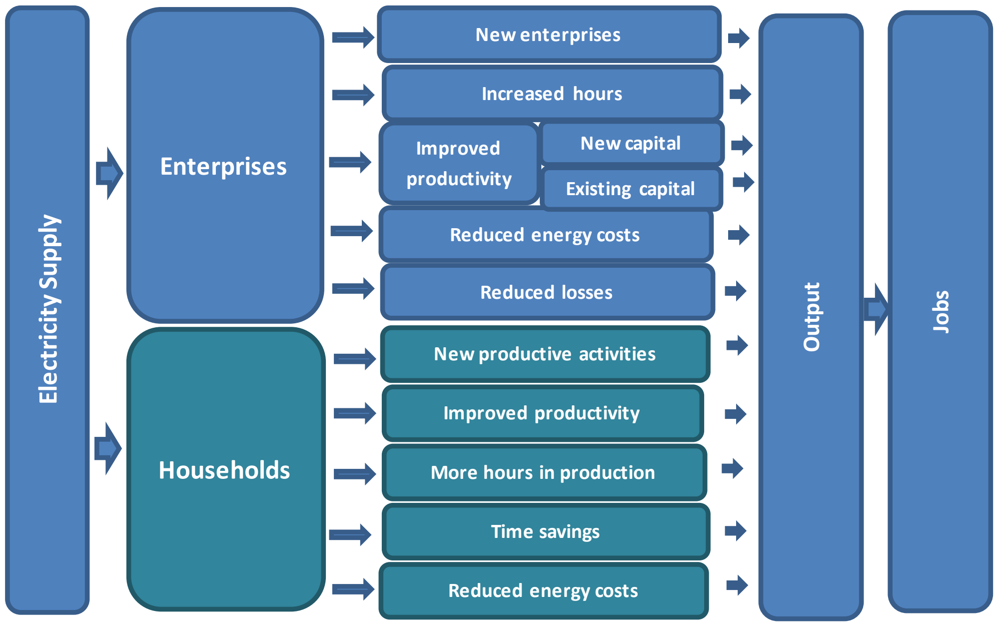
Data from India shows that a 1% increase in electricity consumption results in a 0.53% increase in employment, through additional power consumption increasing output (IFC 2012). Specifically in northern India, for every job created directly in the construction and operation of an electricity transmission system, an additional 4.8 jobs are created through indirect and induced effects over the life of the scheme (IFC 2012). While investments in electricity infrastructure and the operation of electricity services provide some employment, the indirect and induced employment from an electricity supply is much greater (IFC 2013).

While access to modern energy can increase employment by raising demand for enterprise products, it can also decrease employment by substitution of labour by machinery or appliances. Overall, however, the impacts on employment appear to be positive. Increased labour productivity does not necessarily equal job losses. Analysis by the IFC shows that higher productivity is associated with faster employment growth in subsequent years (a 1.8% growth in number of jobs for each 1% gain in productivity; IFC n.d.).

Figure 10 presents an overview of the different mechanisms through which electricity supply can contribute to increasing the quantity of jobs and improving the quality of income generating activities in which the poorest people are involved. This distinguishes between electricity consumed by businesses and electricity used for productive purposes by households.

In addition, electricity also has a broader impact on production than the direct, indirect and induced employment effects of electricity consumption. There are also indirect and more long-term impacts on productivity through education and health effects, and access to information and communications services.

Figure 10: Electricity and employment causal chain



Electricity and Enterprises

Access to electricity can help existing businesses to:

- Improve their productivity, including through increasing labour productivity (Box 11). For agricultural enterprises, electric machinery and farm equipment, such as water pumps, threshers, grinders and dryers, can help to improve yields and reduce labour time. Electricity can also contribute indirectly to agricultural mechanisation by allowing timely local repair and maintenance of tractors and other machinery (Kirubi et al. 2009).

Box 11: Mpeketoni electricity project, Kenya

A community-owned and managed diesel-powered mini-grid, Mpeketoni Electricity Project, in combination with access to markets and road and communication infrastructure, has contributed to the robust growth of microenterprises in Mpeketoni village. The introduction of electricity-driven machinery and tools has increased labour productivity, both in the quantity and quality of output, leading to higher sales. In particular, productivity per worker and gross revenues per day increased by the order of over 200% for both carpentry and tailoring microenterprises. With labour paid on a piece basis this has resulted in increased incomes.

Despite tariffs being nearly three times that of the national grid, the project demonstrates that there is an unmet demand for electricity in rural areas. In Kenya a revised Electricity Power Act could permit small-scale power generation projects to operate license-free in rural areas, as is the case in India and Nepal, in order to meet this demand.

Source: Kirubi (2006) and Kirubi et al. (2009).

- Increase hours of production - electric lighting leads to extension of working hours, allowing shops and other businesses to open during hours of darkness. In Bangladesh, tailors worked 4 more hours a day following electrification, and increased their revenue by 30% (Khan 2001).
- Reduce energy costs in production - in Vietnam, electrically powered tea crushing and drying machines reduced labour and fuel costs. In many countries, electric grain milling reduces the cost of most common agro-processing activities (Kooijman-van-Dijk and Clancy 2010).

Electrification can also contribute to the uptake of different kinds of enterprises and the creation of new businesses. After electrification in Bolivia, while most businesses continued to engage in a limited number of activities (shops, bars, tailoring), new enterprises in metalworking and communication services also opened. After electrification in Tanzania, metalworking, cycle repair, electric repair and mineral processing activities emerged. Enhancing the quality of electricity supply can also contribute to existing non-farm enterprises creating new jobs which benefit the poorest people, though who is impacted by the introduction (Box 12). Measures to increase the quality of supply include the introduction of meters to reduce demand, though who is impacted, and how, by the introduction of meters needs to be carefully assessed to ensure that chronically poor people are not disproportionately negatively affected.

Box 12: Enhancing the quality of electricity supply to generate new employment

One study from rural Gujarat in India provides evidence of the enormous positive social and economic impacts of a pioneering scheme named Jyoti Gram. The scheme involved laying a parallel rural transmission network across the state and a bifurcation of the feeders supplying agricultural vis-à-vis residential and commercial connections. Villages were provided with 24 hour power for domestic use and farmers began getting eight hours of daily power supply but of full voltage and on a pre-announced schedule. Meters on the agricultural feeders identified areas of higher than expected demand.

Jyoti Gram resulted in an enhanced quality of supply of electricity for all consumers; an end to endemic power cuts within the state and voltage fluctuations. The biggest benefits were valued to be those to non-farm economic enterprises, which generated new jobs and livelihoods.

However, the brunt of rationed power supply for agricultural uses has fallen, not on more wealthy tubewell owners, but on marginal farmers. Tubewell owners have made good their loss from the reduced volume of pump irrigation sales by a 30-60 per cent increase in pump irrigation price, reduced the cost of wear and tear and enhanced bargaining power to make favourable deals with marginal farmers and sharecroppers.

Source: Shah and Verma (2008).

Though access to electricity can increase the range of business opportunities, this is subject to market access and the establishment of new businesses does not necessarily immediately follow electrification. The employment effect of electrification is greater when it is accompanied by complementary interventions. Business development support services and road construction to accompany electrification can increase enterprise and employment growth (Gibson and Olivia 2010). In rural Tanzania better access to finance, infrastructure, and cell phone communication is critical to higher enterprise and employment growth (Kinda and Loening 2010). Thus, when a key objective of electrification is employment and income generation from the use of electricity, it is not enough to rely on electrification itself to stimulate enterprise growth and employment (section B5 discusses inter-sectorally co-ordinated approaches to electricity provision).

The effects of electrification upon employment also tend not to be immediate. There may be a lag of several years between access to electricity and investment in new enterprises or electrically-driven equipment. Where the viability of investment in electrification relies upon expanded production from the use of electricity, interventions to facilitate investment in production therefore need to be simultaneous and co-ordinated.

Electricity, Household Production and Incomes

A large body of literature argues that rural electrification makes a significant contribution to the welfare of rural households through reducing energy expenditure, increasing hours in productive activities and productivity in existing activities, and allowing the uptake of new income-generating activities. The cumulative effects can result in substantial income growth for households (Khandker et al. 2012).

Households with new connections, however, do not take up new income-generating activities immediately, and a study in South Africa concluded that a rise in the number of household-based enterprises among connected households occurred due to factors other than just having an electricity connection (Prasad and Dieden 2007). Some studies also suggest that household-based productive activities undertaken by women tend to use process heat, (Clancy et al. 2003) and so the stimulus provided by electricity to women's entrepreneurial activity may be insufficient or may require complementary inputs (Kooijman-van Dijk and Clancy 2010). Skills development can be important to promote household uptake of new activities after acquiring an electricity connection (Box 13).

Box 13: Combining access to electricity with skills development in Nepal

The Rural Energy Development Programme (REDP) aims to expand access to energy services into remote rural areas, through focusing on decentralised, off-grid approaches. Access to electricity is an 'entry point' for REDP programmes, but other initiatives are also implemented to enhance rural development benefits in remote villages. Training and skills development are important components. Community organisations focus on interests including income generating activities, forestry, biogas and poultry farming.

The cumulative development benefits far outweigh the investment costs of a micro-hydropower system. The introduction of electricity is strongly associated with higher revenues for rural households due to the use of new equipment for improved productivity in existing agro-processing activities, longer working hours made possible by electric lights, and better access to market information and weather forecast. However, very few households surveyed (only 3.4%) created a new income generating activity after electrification. This reflects the fact that a number of barriers including poor market access, lack of available capital, and low skill levels can constrain their development.

Source: Legros et al. (2011).

However, the impacts of electrification on household enterprises tend to be unevenly distributed. Mvondo (2010) found that 66% of families did not make additional income from the use of electricity. In India the impact of electricity access on per capita expenditure in the richest households is almost double that for middle-income households (Khandker et al. 2012). The use of electricity for productive purposes amongst wealthier households may lead to employment opportunities for women and men from poorer households, but there is an absence of data which could demonstrate this. In Bangladesh, while household incomes increased overall by 12.2% due to electrification, the impact on the poorest households was insignificant (Khandker et al. 2009). This again suggests the importance of interventions to build the assets, including appliances, of the poorest households so that they can take advantage of the opportunities which an electricity connection can provide. Meanwhile, decisions to acquire certain appliances depend partly on the relative bargaining power of men and women, with the impacts of different appliances varying by gender. In India, women have some influence on cookstove purchase decisions, but much less over the purchase of expensive electric appliances. Food processing appliances, for instance, benefit women in most contexts while 'shared' goods such as lighting have differential benefits for women and men (Clancy et al. 2012). Interventions to increase appliance ownership among the poorest households therefore need to have a gendered-perspective (Pachauri and Rao 2013).

There is some evidence that freed up time following electrification leads to increased participation in the labour market outside the household, particularly for women. In South Africa electrification has resulted in a 9% increase in female wage-employment, but no comparable increase amongst men (Dinkelman 2011). Similar conclusions emerge from Nicaragua where electrification increases the tendency for women to work outside the home by 23%, due to the reduced time which they spend on firewood collection and on family agricultural activities. Again though, there is no impact on male employment (Grogan and Sadanand 2013). However, the context-specificity of these findings makes generalisations about these impacts difficult and there is limited understanding about if, and how, the benefits of modern energy access in freeing-up women's time translate into more employment, income generating opportunities or other benefits for women (Pachauri and Rao 2013).

B4: Supplying Electricity to Remote Rural Regions

- *Remote rural areas lack energy infrastructure, are weakly connected to markets for commercial fuels and energy equipment, and have limited energy demand because of low income levels.*
- *In rural areas with poor and dispersed populations the cost of extending access to electricity through a centralised grid can be greater than decentralised alternatives.*
- *The least-cost decentralised option depends on the local context and the demand for electricity, as well as local energy supply options.*
- *Most of the additional power required in remote rural areas is likely to be supplied by mini-grids or stand-alone systems.*
- *Decentralisation of responsibility for the promotion and regulation of electricity could enable uptake of decentralised energy systems for rural areas.*
- *Stand-alone systems provide a limited amount of power but can be appropriate for isolated off-grid households, businesses and public services. Access to such systems for the poorest households requires subsidies and end-user financing.*

Across the developing world, levels of energy poverty are consistently higher in rural areas than urban settlements with 80% of households without access to modern energy services living in rural areas. Individuals, households and groups in remote rural areas and regions, which have low resource endowments, poor infrastructure and communications and ineffective government, are more likely to experience chronic poverty (Bird et al. 2003). Almost by definition these areas lack energy infrastructure, are weakly connected to markets for commercial fuels and energy-related equipment, and have limited energy demand because of low average incomes. In this section we consider the challenges of providing modern energy services to poor populations in remote rural areas. The focus is on electricity.

Extending the Existing Grid

The conventional approach to providing electricity services is to develop large power stations and transmit the centrally-generated electricity to consumers across the country, by means of (high-voltage) transmission and (low-voltage) distribution lines. The investment costs of long-distance transmission can be high ($ 15-17,000 per km; NRECA 2000) and in many developing countries transmission and distribution losses are significant (up to 15% of power generated). In rural areas with poor and dispersed populations the cost of centralised grid extension can be greater than decentralised alternatives with grid extension being cost effective for urban settlements and just 30% of rural areas (IEA 2011).[14] Decisions about whether, and when, to extend the existing grid or to promote off-grid sources require governments to have knowledge of village demand and proximity to the existing grid network (Box 14).

[14] The marginal cost of distribution lines for mini-grids should be compared with the costs of a stand-alone system when comparing mini-grid and stand-alone systems of a given capacity.

Box 14: Choosing between grid expansion and off-grid electrification in Laos

Laos quadrupled its electrification rate from 16% in 1995 to 63% in 2009. Under the Rural Electrification Project the government increased access to electricity through extending the existing grid and using off-grid measures. A priority from the start was to draw-up a rural electrification master plan. Using GIS technology a database was developed which mapped both on- and off-grid areas along with the socio-economic status of villages which had yet to gain access to electricity. This enabled the government to decide which areas the grid could be expanded to efficiently and to select off-grid areas. In particular, the information ensured that the grid would not be technically overstretched, formed the basis for a cost-benefit analysis of on- and off-grid options, and increased the understanding of the time period over which particular areas could get grid access in the future. Within off-grid areas, through providing information on an area's topography, the database provided information on which technologies (e.g. solar, hydro or biomass) would be most appropriate.

Source: Bambawale et al. (2011).

Off-grid or decentralised rural electrification can be through stand-alone systems or mini-grids. The extension of national grids will deliver less than half (45%) of the additional power required to achieve universal access to electricity. Most of the additional power required will be delivered through mini-grids and stand-alone systems, 36% and 20% respectively (IEA 2011). In Nepal almost 30% of electricity supplied in the rural areas is currently through the off-grid route (Palit and Chaudrey 2011).

Decentralised Rural Electrification: Mini-grids

Around 65% of rural areas not served by a national grid will have their electricity needs met by mini-grids, which are generally defined as district or village networks up to 3 MW in capacity,[15] isolated from the central or national electricity grid (IEA 2011).

Decentralised electricity systems comprise generation, localised distribution, energy storage and a load/demand management system. A variety of sources are used for the generation of electricity in decentralised systems, including diesel, biomass, wind, solar PV and small hydro. Hybrid systems generate power from a combination of sources. Mines and agro-processing plants located in remote rural areas can also be a means to supply electricity to the local community. More recently mobile phone stations, which require a power supply, are seen as potential providers of electricity to remote rural areas.

The resource used for generating electricity will vary according to village load profile, availability of renewable resources, and fuel transportation costs. The least-cost option for decentralised electricity (calculated as the levelised cost[16]) depends on the local context and specific use (load profile), as well as local supply options. Local, renewable sources of energy for generation can give a cost advantage to renewables and avoid dependence on long supply chains. The capacity of a mini-grid is sized according to estimated electricity consumption, including peak levels, as well as assessment of the local energy resource and viability of the load factor. Mini-grids have the potential to manage the fluctuating levels of consumption by individual users across the network and through storage.

A variety of institutional and financial models can be found for mini-grids. The majority are government operated (Palit and Chaudrey 2011), but there are also private sector, co-operative and community schemes as well as hybrid models. Successful mini-grid development requires regulatory systems which enable decentralised solutions, including through the promotion of local energy plans

[15] Mini-grids were defined by ESMAP (2007) as 5kW to 500kW in capacity. The higher capacity limit mentioned here, however, reflects the actual capacity of existing mini-grids.
[16] The levelised cost is used to reflect both fixed and variable costs over the life of the investment. It is defined as the constant price per unit of energy (or installed capacity) that allows the investment to break even.

(Box 15). A combination of institutions may then operate or own different parts of the system (generation, distribution, management and revenue collection). Similarly, a variety of financial models can be found, covering investment and operating costs, and influenced by the structure of incentives and regulations (GVEP 2011). Successful mini-grid schemes have carefully considered local economic, social and environmental conditions and developed a viable financial model. These factors can be very context specific (GVEP 2011).

Box 15: Linking the national with the local: Small scale hydropower in sub-Saharan Africa

In sub-Saharan Africa just 5% of the potential for hydropower generation is currently tapped. However, some countries, including Rwanda, Kenya, Ethiopia and South Africa are making progress in promoting micro-hydro schemes (MHP) which are suitable for isolated grids providing electricity to rural villages and also to feed into public grids. In these countries decentralised renewable technologies have been mainstreamed into regional and national policy documents.

Due to the small-scale character of MHP projects, MHP sector development relies not only on good national-level policies, regulations, capacities and financing schemes, but also needs to incorporate the local level effectively.

It is important to give local governments a mandate and budget for energy development as they are more likely to experiment with small-scale solutions like MHP than planners at the national level. This linkage between rural electrification and decentralisation is often not acknowledged. Currently, most energy regulatory systems are inadequate to promote decentralised solutions such as MHP. In many countries, regulation was established to regulate one or more large (state) utilities and therefore needs to be adjusted to regulate a large number of different entities, including small private power producers and community-based cooperatives.

One good practice of how to increase governance capacity and co-ordination between different government institutions is to support the set-up of local energy plans, as has happened in Madagascar. By including the local governments in the energy infrastructure planning process, awareness, capacities, and accountability for successful implementation of energy policies can be strengthened. In Uganda, energy officers are being trained for 5 pilot provinces. Their mandate will be to be the focal point of the local government for energy issues, including energy demand and supply planning for their area.

Source: GTZ and EUEI (2010).

While community approaches for mini-grid development can be successful, governance structures need to be clearly established, which involves an extensive preparation period. When local leaders are not included, this may be viewed as a threat to their position in the community and can result in improper maintenance and even disconnection of the system (USAID/ARE 2011). However, giving the elite too much control over the mini-grid may lead to the exclusion of the poorest households if the situation is not carefully managed. One way to minimize this is to stipulate that 100% of households be involved in programme activities, as in the Rural Energy Development Programme (REDP) in Nepal (Box 16). It is important to understand how the different abilities of end-users to pay for electricity shape the incentives for collective action, patterns of electricity consumption, equity in access to electricity, and mechanisms for conflict resolution (Kirubi et al. 2009). Community approaches require technical and social capacity building to compensate for the lack of skills to maintain the mini-grid and the potential for community disputes. The introduction of another partner – either private or public – to take over some aspects of managing the mini-grid is therefore preferable (USAID/ARE 2011).

Box 16: The Rural Energy Development Programme (REDP) Nepal: Community mobilisation and off-grid approaches

REDP is expanding electricity into remote areas using off-grid approaches, both mini-grids and stand-alone systems. By December 2009, REDP had installed 267 micro-hydropower systems in addition to 5,440 toilet-attached biogas plants, 2,410 solar PV home systems, and 11,757 improved cooking stoves. The programme has enabled the benefits of electricity access to reach even the poorest households, as opposed to the elite and already privileged families within the community.

Community mobilisation is a key component of the programme. REDP works to ensure that micro-hydropower systems are installed by community members, in close co-operation with District Development Committees and Village Development Committees. Local NGOs carry out the process of community mobilisation. This is guided by six principles, including organisational development, skills enhancement, capital formation, technology promotion, environmental management, and empowerment of vulnerable groups and communities.

Multiple community organisations form a wide range of functional groups based on common interests, including, for instance, training on poultry farming or raising awareness of sanitation practices. At least one male and one female from each household are members of a community organisation. The micro-hydropower functional group is the key body at the village level for establishment, operation and management of MHSs. Once this group has been running successfully for at least six months, group members are encouraged to convert it into a legal entity to encourage sustainability.

Source: Legros et al. (2011).

In many places mini-grids are perceived as an interim measure or transition stage, with connection to a centralised grid being the eventual objective, and they may be designed with this mind. Between 2002 and 2005, the proportion of households in Vietnam served by off-grid systems fell from 18.4% to 8.4% as a result of grid extension (Khandker et al. 2008). Differences in tariffs and service standards between mini-grids and centralised grids may become a barrier to connecting them, meaning that consistency of tariff structures needs to be considered.

Decentralised Rural Electrification: Stand-alone systems

It is expected that about one-third (35%) of rural areas not served by a national grid will obtain electricity from stand-alone systems, which are isolated off-grid options with limited capacity, usually serving one household or business (IEA 2011). Many of these are diesel powered, but solar, wind, hydro and biomass systems are also used. The first are dependent on reliable market chains reaching remote areas, while renewable energy systems depend on local resource availability.

Solar home systems (SHS) have become particularly popular for household use. A SHS typically includes a photovoltaic (PV) module, a battery, a charge controller, wiring, fluorescent DC (direct current) lights, and outlets for other DC appliances. A typical small SHS, with 35 Wp capacity,[17] can operate several lights and a radio or television.

SHS, then, have the limitation that they can only be used for lighting and powering low-voltage appliances and are unable to support high-capacity income generating activities. This poses a challenge for the poorest households to finance the capital costs of these systems and raises questions about whether consumer credit, either through commercial banks or microfinance institutions, is suitable for the poorest households to gain access to SHS (Wong 2012; Box 17). Other market-driven financing arrangements which may be appropriate for the poorest households include

[17] Most solar home systems are between 10 Wp and 100 Wp (peak capacity in watts).

fee-for-service schemes where the equipment remains the property of the service provider, and public sector-operated revolving fund credit schemes (Glemarec 2012).

Box 17: Solar home systems combined with microcredit in Sri Lanka

In remote rural areas of Sri Lanka, Solar Home Systems (SHS) are combined with micro-loans for potential users to purchase the systems.

The majority of households with SHS highlight improved quality of life due to the availability of electricity, using it to charge mobile phones, lighting, radios and TVs. However, the income of the poorest households is insufficient to pay monthly loan installments on time and the early wearing out of batteries often leads to a breakdown of the whole system.

A microfinance institution administers the financing part of the programme and solar firms are responsible for technical implementation and after-sales services. This division of responsibilities is confusing for the clients and leads to high costs, as both institutions have to travel long distances to visit the households. It also leads to incompatibilities: a two-year warranty for the battery is not acceptable if the users have to pay back their credit within a period of 3 years.

Ownership of a SHS does not guarantee income generation. Because of this it is crucial to evaluate the use of microfinance to provide access to energy for the poorest households. For the poorest households, a “fee for service” system whereby households pay a small monthly fee for access to energy, rather than household purchase of the SHS is more appropriate.

Source: Laufer and Schafer (2011).

Improving Quality of Supply

As mentioned earlier, poor quality and unreliable modern energy supplies seem to disproportionately affect the poorest people and regions. Decentralised energy provision can be one way to address these quality issues by making use of local resources and capacities. However, improving the reliability of energy supplies remains a big challenge that will require focused attention, additional investments to expand infrastructure and delivery capacity and broader developments that strengthen the voice of poor consumers and communities. Further actions that can contribute to improving the quality of supply include:

- Improving the effectiveness of regulation in the energy sector. Increasing the accountability of different actors in the energy supply chain (e.g. power providers, transmission companies and distribution companies) to regulatory bodies helps to ensure that their individual actions (or lack of actions) do not impact the reliability of the wider energy system. The ability of regulators to penalise actors or to prescribe action can contribute to improving the reliability of energy supply.
- Building capacity for local energy planning and solutions. Poor reliability is often caused by a gap between energy demand and capacity to meet that demand (e.g. installed electricity generation capacity being lower than peak demand). For decentralised systems, future demand needs to be carefully assessed and demand management measures built into the system. Planners for centralised, grid-based systems must also forecast demand, but the long lead time for the installation of large-scale infrastructure means that forecasting demand many years into the future is necessary. This calls for specific expertise.
- Diversifying sources of supply. Energy security, for individual consumers and at the national level, can be enhanced through diversifying supplies, reducing dependence on specific sources of energy. In an electricity system, for instance, this can mean investment in several power stations

rather than one or two large ones, or that different power stations use different energy sources (e.g. hydro, wind, and gas).

- Strengthening transmission and distribution systems. The reliability and quality of grid electricity can be affected by poor maintenance and under-investment in transmission and distribution, even when there is adequate generation capacity. Technical losses reduce the power available to consumers, while technical faults give rise to supply interruptions and voltage fluctuations. Adequate resources for operation and maintenance, as well as investment in new infrastructure, need to be provided. These costs can be entirely, or partially, funded by building them into tariff structures and ensuring the collection of revenue from consumers.
- Promoting energy efficiency. This reduces energy demand for particular users and can help reduce gaps between supply and demand which lead to supply interruptions. Regulations for energy efficient product and appliance standards combined with financial mechanisms to facilitate investment in energy efficiency measures can be effective to increase energy efficiency.

B5: Following Co-ordinated Approaches

- *Ensuring energy access to meet only essential energy needs will not be enough to enable the poorest households to escape poverty sustainably.*
- *For energy services to contribute to raising the incomes of chronically poor households, complementary interventions are necessary.*
- *Governments should adopt and pursue energy access targets specifically for the poorest populations and regions.*
- *Co-ordination and inter-sectoral collaboration is required to ensure that the expansion of energy services contributes to poverty reduction.*

Conventional approaches to energy planning are supply-side oriented. Planners forecast the demand for energy services and plan to deliver the estimated amounts of different forms of energy. When it comes to providing access to modern energy services for people living in poverty, the focus is on providing energy services to meet the basic energy needs, which are mainly for domestic consumption (i.e. lighting, cooking, and heating).

Some definitions of the minimum acceptable level of access to modern energy services include energy for productive or income-generating purposes (Practical Action, IEA). However, these also tend to be minimum quantities of energy. This ‘minimalist’ approach to energy access, in most cases, will not be enough to enable poor households to escape poverty. The amounts of energy supplied through energy access interventions and their focus only on the supply of basic energy services are unlikely by themselves to transform the lives and livelihoods of the poorest families.

For the poorest people to be able to use energy services to raise their incomes and improve their livelihoods, complementary interventions are necessary. These include grants and subsidies and employment opportunities as well as investments to improve access to information, access to markets, business development services and capital (finance). The co-ordination or co-investment in energy access with other interventions has been called the ‘Energy Plus’ approach (UNDP). An integrated approach of this kind has been demonstrated at the project level as effective for poverty reduction (UNDP 2012), improving household incomes and their capacity to pay for energy and other services. However, there is limited systematic evidence.

Public services which are critical for poverty reduction, such as health and education, also require access to modern energy services. There is a correlation between human development outcomes (e.g. maternal mortality) and access by such facilities to modern energy services (Practical Action 2013). Investment in these social sectors (e.g. building clinics and schools) can include an energy supply (usually a stand-alone system) when there is no alternative energy supply available, such as the electricity grid.

Investment in modern energy services, whether through energy access interventions or programmes in other sectors, involve choices about energy sources and technologies. An integrated approach to energy development should seek to exploit the interconnections with other sectors to maximise the human development and poverty reduction impact. The development of energy services based on local natural resources (e.g. water and forests) needs to take account of competing uses of the resource and be undertaken in a way that ensures their sustainability. Investment to exploit renewable natural resources can similarly affect the options for the development of local energy services.

The conventional sectoral approach to energy services and to development in other sectors can be a constraint to an effective integrated approach. When investment in, for example, sustainable forestry is critical for improving energy services for the poor this may not be recognised by those responsible for forestry development, and investment in forests may not be seen as a responsibility of an energy ministry. Similarly, improved cooking technologies are important for improving overall health status in most developing countries but are not regarded as an area for action by health ministries.

The following measures could help to maximise the role which modern energy services can play in contributing to poverty reduction:

- Governments could include energy access targets in national development strategies and investments to deliver on these in expenditure plans.
- Energy access interventions can include objectives to contribute to increasing the incomes of poor households through the use of modern energy services, and developing the support services and institutions for this (policy, market development, training and employment opportunities).
- Mechanisms should be introduced or strengthened to ensure effective co-ordination and inter-sectoral collaboration for expanding energy services which contribute to poverty reduction. Ministries involved in energy, should work alongside those concerned with education and health to promote the transition to improved stoves and clean-combusting fuels. Ministries with portfolios in agriculture and rural development could also be involved in delivery of modern energy services to rural areas.

C1: Country Energy Poverty Categories

- *The appropriate policies and priorities for addressing energy poverty will vary depending on country context, including socio-economic circumstances and energy mix. Lower and middle income countries can be divided into five categories for this purpose.*
- *Policy lessons can be learned from countries which have made rapid progress in increasing modern energy access for the lowest wealth quintile.*

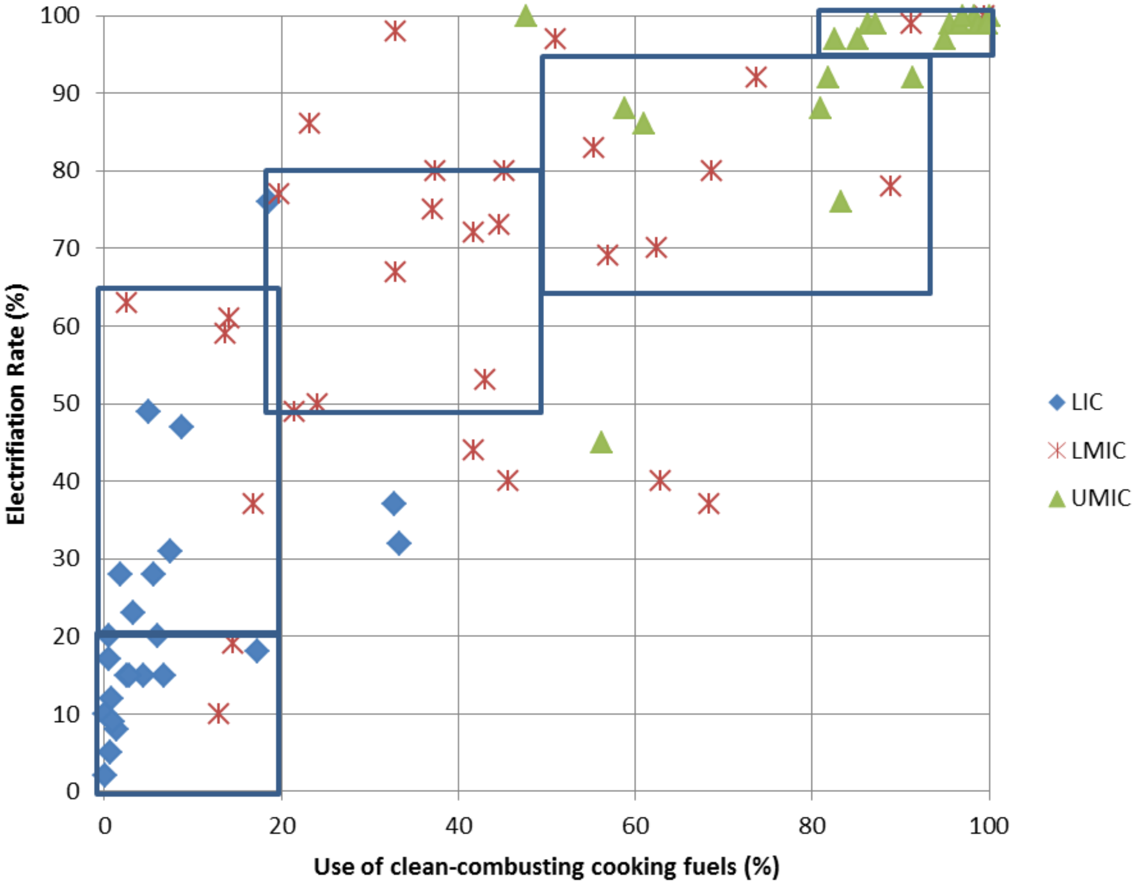
Countries have different rates of energy access, for both electrification and use of clean-combusting cooking fuels (Figure 11). The general pattern is that low income countries have made the least progress towards these goals, followed by lower-middle income countries, while upper-middle income countries have progressed the most. Countries at different stages of electrification and access to clean-combusting fuel will have different priorities for achieving the objective of universal access to energy, and for balancing this objective with the other objectives of energy policy – the 'energy trilemma'. For low income countries, particularly in sub-Saharan Africa, where overall levels of electrification and use of clean-combusting cooking fuels are very low, there is a real need to make energy access a political priority.

To assist policy prioritisation and the monitoring of implementation, and as a means to compare countries, several measures of energy development have been proposed. Two of note are the IEA's Energy Development Index (EDI) and the Multidimensional Energy Poverty Index (MEPI), developed by the Oxford Poverty and Human Development Initiative. The former measures the level of development of a country's energy system, including household level and 'community' level indicators. The MEPI, which measures the incidence of energy poverty and its intensity, and includes indicators for a range of energy services (e.g. cooking, lighting, and communications; Nussbaumer et al. 2011), is more relevant to discussion of energy poverty and the chronically poor.

The most commonly used indicators of energy access are the electrification rate and the use of clean-combusting fuels and stoves, though data for these are still not routinely collected in all countries. These two indicators are both included in the EDI and MEPI. Using the most recent data for these two key indicators, countries can very roughly be grouped into 5 categories (Figure 11).

1. Countries with extremely limited electrification and use of clean-combusting fuels (under 20% for each). These are low income countries (LICs) in sub-Saharan Africa and Papua New Guinea in the Asia-Pacific Region. These countries are also ranked in the lowest two categories of the MEPI, indicating acute and slightly less acute multidimensional energy poverty.
2. Countries with moderate electrification rates (between 20-65%) but a low level of clean-combusting fuel use (under 20% of the population use them). These include both low income and lower-middle income countries (LMICs), predominantly in sub-Saharan Africa, but also including Bangladesh, Cambodia, Myanmar and Laos. These countries also rank in the lowest two categories of the MEPI.
3. Countries with moderate to good electrification rates (50-80%) but moderate access to clean-combusting fuels (between 20% and 50% of the population). These are predominantly lower-middle income countries, with MEPI scores in the middle two ranks.
4. Countries with good access to electricity (more than 65% of the population) with over half the population using clean-combusting fuels. These countries are in the lower- and upper-middle income categories (UMICs).
5. Countries with near universal access to electricity and good access (more than 80%) to clean-combusting fuels. These countries have the highest ranking in the MEPI.

Figure 11: Use of clean-combusting fuels and electrification rate by country



Sources: Electrification Rate – IEA (2012), use of clean cooking fuels WHO database (2010).

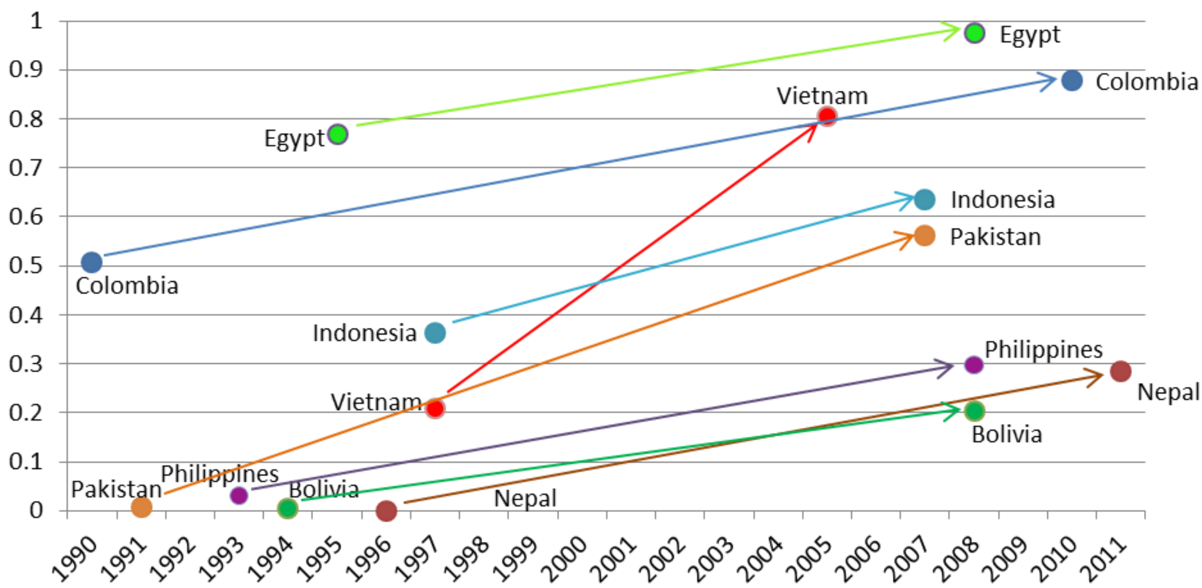
Table 3 presents the country energy poverty categories, breaking them down by region. Outliers to this classification include Vietnam, which, particularly for a lower middle income country, has impressive levels of electrification (of 98%) but low levels of use of clean-combusting fuels (33%), and China, where all the population has access to electricity but use of clean-combusting fuels is under 50%. The two low-income countries which have the highest levels of clean-combusting fuel use and so do not fall into any of the country energy categories, are Zimbabwe and Eritrea.

Table 3: Country energy categories by region

Category		Asia	Latin America	Sub-Saharan Africa	Middle East and N Africa
1	Extremely limited electrification and use of clean-combusting fuels (under 20% for each)	Papua New Guinea		Rwanda Guinea Burkina Faso Kenya Uganda Malawi Madagascar Tanzania Mozambique Zambia Liberia Sierra Leone Central African Republic Democratic Republic of Congo	
2	20-65% electrification rates but less than 20% of population use clean-combusting fuels	Bangladesh Cambodia Myanmar Laos	Haiti	Cote D'Ivoire Nigeria Congo Benin Togo Ethiopia Guinea Ghana	
3	Electrification rates of 50-80% but under half population uses clean-combusting fuel	Nepal Sri Lanka Pakistan India Indonesia	Honduras Guatemala Nicaragua	Senegal	
4	Lower and upper middle income countries with over 65% electrification and over 50% clean-combusting fuel use	Philippines Thailand Bhutan	El Salvador Bolivia Peru Jamaica Panama Ecuador Guyana	South Africa Cape Verde	
5	Middle income countries with almost 100% electrification and over 80% clean-combusting fuel use.	Malaysia	Argentina Brazil Costa Rica Columbia Dominican Republic Uruguay		Algeria Libya Morocco Egypt Lebanon Jordan Tunisia

Aggregate statistics however, overlook disparities in access to electricity and use of clean-combusting fuels within countries. For households in the poorest wealth quintile, electrification rates and use of clean cooking fuels are always lower than national average figures (Figure 1 and Table 1). Some countries, however, have seen greater progress than others at increasing electricity access for households in the poorest wealth quintile. Figure 12 illustrates this, showing the impressive improvements made by Vietnam, in particular, at increasing electricity access for the poorest people. Egypt, another lower-middle income country, has just less than 100% electricity access for households in the poorest quintile. Nepal meanwhile, not only shows a national electrification rate higher than other low income countries (of 76%) in Figure 11, but has also succeeded in increasing electricity access for the poorest people, albeit starting from a low base. The experiences of Nepal and Vietnam have been highlighted throughout this guide.

Figure 12: Changes in electricity access for households in the poorest quintile 1990-2011



Source: Analysis of DHS data.

The different country categories identified in this section suggest different policy priorities and measures to ensure the delivery of energy services to chronically poor people. The policy framework for each country needs to reflect their particular context, including level of development and institutional architecture. However, the key policy issues discussed in previous sections – making energy affordable, scaling up access to clean-combusting cooking fuels and technologies, electricity for businesses and employment creation, supplying energy for remote rural regions and co-ordinated approaches to energy service development – are likely to be faced in efforts to deliver energy services for the chronically poor in most developing countries. Given this, Table 4 presents recommended policy priorities according to country circumstances.

Table 4: Policy priorities by country categories

Country Category		Recommendations on electricity access for the poorest	Recommendations on improved cooking for the poorest
1	Extremely limited electrification and use of clean-combusting fuels (under 20% for each)	Focus on extension of electricity (grid and off-grid) to population without access. Establish financial mechanisms (e.g. credit and savings) to enable poor to access electricity, including for productive uses.	Develop and implement strategy to deliver improved cooking technologies and cleaner-combusting fuels to poor. Public awareness and social marketing actions on harmful effects of traditional cooking practices, to promote demand.
2	20-65% electrification rates but less than 20% of population use clean-combusting fuels	Extension of electricity (grid and off-grid) to population without access. Establish financial mechanisms (e.g. consumer credit) to enable poor to access electricity, including for productive uses. Use subsidy or social protection measures to reach poorest quintiles.	Develop and implement strategy to deliver improved cooking technologies and cleaner-combusting fuels to poor. Public awareness and social marketing actions on harmful effects of traditional cooking practices, to promote demand. Establish financial mechanisms (credit and savings) to enable poor to acquire improved cookstoves.
3	Electrification rates of 50-80% but under half population uses clean-combusting fuel	Focus on extension of electricity off-grid to reach rural and remote populations. Establish financial mechanisms (e.g. consumer credit) to enable poor to access electricity, including for productive uses and for domestic appliances. Use subsidy or social protection measures to reach poorest quintiles.	Public awareness and social marketing actions on harmful effects of traditional cooking practices, to promote demand. Establish financial mechanisms (credit and savings) to enable poor to acquire improved cookstoves.
4	Lower and upper middle income countries with over 65% electrification and over 50% clean-combusting fuel use	Focus on extension of electricity off-grid to reach rural and remote populations. Establish financial mechanisms (e.g. consumer credit) to enable poor to access electricity, including for productive uses and for domestic appliances. Use subsidy or social protection measures to reach poorest quintiles.	Establish financial mechanisms (credit and savings) to enable poor to acquire improved cookstoves. Support establishment of market chains for cleaner-combusting fuels and cooking appliances.
5	Middle income countries with almost 100% electrification and over 80% clean-combusting fuel use.	Deploy financial mechanisms (e.g. consumer credit) to enable poor to access electricity, including for productive uses and for domestic appliances. Link electricity supply to business development and technical advice services. Ensure quality of electricity supply. Use subsidy or social protection measures to reach poorest quintiles.	Establish financial mechanisms (credit and savings) to enable poor to acquire improved cookstoves. Support establishment of market chains for cleaner-combusting fuels and cooking appliances. Use subsidy or social protection measures to reach poorest quintiles.

C2: Conclusions and Summary Recommendations

Achieving Sustainable Energy for All

There are huge challenges in ensuring sustainable energy for all. National statistics on the rate of electrification and the use of clean-combusting fuels illustrate the vast progress needed in many low and lower-middle income countries to make this goal a reality (Figure 11). For some countries, predominantly in sub-Saharan Africa, energy access needs to become a political priority to achieve the substantial progress which is needed.

Recent analysis highlights the causal link between a household having access to electricity and escaping poverty (Khandker et al. 2012). Meanwhile, the analysis of panel data carried out for this Policy Guide shows that chronically poor households are less likely to have electricity and more likely to use biomass as their main source of cooking fuel than households moving out of poverty, slipping into poverty, or staying out of poverty. We can conclude that amongst the poor and vulnerable there is a group which is particularly energy deficit, and therefore worthy of special policy measures.

Aggregate statistics hide large disparities in access to modern energy at the household level, particularly between households at different levels of income and wealth. In both rural and urban contexts, analysis of household-level data reveals that households in the bottom income quintile have less access to electricity and clean-combusting cooking fuels than wealthier households.

Governments and providers face a challenge in having enough information about the status of access to modern energy by the poorest households. In India, for instance, a village is classified as electrified if at least 50% of its inhabitants have electricity. However, this says little about the status of access of the other 50% and the timespan within which it is expected that they will gain access. Energy access definitions vary by nation. Governments are frequently committed to expanding access, but with little effort to monitor the quality of access or supply, or even what purposes electricity is being used for.

Ensuring that the poorest households obtain electricity and clean-combusting fuels requires two sets of policies; one to intensify access within areas where it is currently available, and another set to extend access into new areas. The suggestion is that this be done in a targeted way. For electricity, the former set of policies requires using a range of innovative mechanisms to reduce the up-front connection costs as well as the costs of usage. This can include allowing the connection charge to be paid in monthly instalments over several years or introducing connection subsidies for particular rural areas. Social protection is another potential demand-side approach, though to-date the impacts of social protection on energy access are unknown. In urban areas legal connections to the electricity grid are tied-in with issues of tenure and housing quality.

The latter set of policies to extend access into new areas can be achieved either through expanding existing grid and supply networks or using decentralised approaches, including promoting mini-grids or stand-alone systems. It can be cost effective to connect rurally remote households through decentralised approaches, and they have been used successfully to provide an interim connection to households before they are reached by the central electricity grid. However, this poses challenges for local energy planning. While current energy regulatory systems were usually established to regulate one large utility, promoting off-grid energy requires giving local governments and sometimes other agencies a mandate and budget for energy issues. Important when promoting mini-grids are managing community dynamics in contexts where users have varied abilities to pay and different usage demands. Meanwhile, particular challenges for the poorest households to access stand-alone systems include the up-front costs. Research suggests that pay-to-use arrangements or daily rental rather than outright ownership, or longer-term rental of these systems, are more appropriate.

Even if they do have electricity though, the poorest households frequently rely on traditional cooking practices, being unable to afford either a clean-combusting stove or other fuels, such as LPG. In the short term, policies could promote cleaner burning and more efficient stoves while also encouraging sustainable use of biomass resources. Key principles for scaling-up promising cooking interventions to reach the poorest people include end-user financing or credit to acquire the stove, constant monitoring and evaluation of programmes to make sure they are serving poor people's goals and are feasible for them, as well as ensuring stoves are durable and designed with inputs from users and building local capacity for regular maintenance and repairs. In the longer term policies can encourage households to adopt clean-combusting fuels, including through expanding and deepening the LPG, natural gas or biogas delivery infrastructure. For the poorest households subsidies on clean-combusting fuels and grants or cheap credit for new stoves remain necessary.

Harnessing the Power of Energy Access for Chronic Poverty Reduction: From Minimalism to Sustainable Livelihoods

The multiple benefits that access to clean energy can secure are widely acknowledged and include time savings, improved health, new opportunities for employment/microbusinesses and the improved productivity of existing income generating activities. However, particularly for the poorest people these benefits can neither be taken-for-granted nor will they necessarily contribute to poverty escapes.

To date, the focus has largely been on securing minimalist energy access for poor households, such as through promoting solar lanterns in rural areas. However, this minimalist energy access, while it may improve the situation of households through extending studying and working hours into the evening, is insufficient to sustain poverty escapes. Solar home systems, for instance, are more suited for 'consumptive' uses of electricity than 'productive' ones, including supporting a microenterprise. The energy access that poor people obtain needs to be sufficient to enable them to pursue new or higher productivity enhancing and income generating activities.

There are several ways in which access to electricity and modern energy can affect employment and job creation, though the existing evidence base on this remains weak. Recent efforts at combining efforts to expand energy access with skills development and improved market access have had wider livelihood benefits (UNDP 2012). Decentralised energy approaches that involve local communities can also be beneficial. In particular, recent evidence suggests that energy access through renewable energy technologies can generate significant employment and improve rural livelihoods especially when such projects are integrated with local commercial activities (IRENA 2012). Deeper analyses of the circumstances under which improvements in energy access lead to job creation are needed.

Energy services are needed in a quantity and of a quality and reliability to enable people's lives to be transformed. Empirical studies highlight how limitations in energy reliability can constrain household earnings and possibilities of starting new enterprises (Bensch et al. 2012; Rao 2013). Overall however, information on the impacts of unreliable energy supplies on household income remains limited. Other areas for investigation include the types, and quality, of jobs, which electrification can generate in an area, as well as who gets those jobs. Combined with this, there is a lack of data on acquisition and use of mechanical power, which constrains the inclusion of productive uses of energy in an index such as the MEPI (Nussbaumer et al. 2011).

Frequently, though, even if they have access to modern energy the poorest households face constraints to make the most out of this access, with poverty constraining their ability to purchase new appliances, clean-combusting stoves, farm tools or equipment for a microenterprise. For instance, a range of bottlenecks, including lack of market access and limited access to capital can constrain households from establishing new enterprises even after electrification (Legros et al. 2011). The UNDP Energy Plus Approach recognises the need to integrate energy access initiatives with those which address other barriers to poverty escape (UNDP 2012).

Existing social inequities can act as barriers to the acquisition and use of new energy technologies in ways that enhance wellbeing and livelihoods, particularly for women. Some recent evidence points to the fact that actively involving women as energy entrepreneurs or within energy value chains can improve their agency in effecting changes regarding energy and technology choices and use. An evaluation of recent initiatives such as the Barefoot College and SEWA in India, Grameen Shakti in Bangladesh, and Solar Sisters in Africa, should be able to provide additional insights into ways to involve women and raise their status.

Addressing Energy Poverty in the Post-2015 Framework

There is widespread recognition that people living in poverty need access to adequate, reliable and affordable energy if they are to escape chronic poverty. The post-2015 development agenda, which is likely to include an objective to eradicate absolute poverty, must reflect the essential role that the use of energy plays in people's survival and prosperity. Including an energy related goal in the post-2015 framework could go some way towards remedying the failure of having excluded it from the earlier MDGs. A goal of universal access to modern energy has already been endorsed by many governments under the Sustainable Energy for All Initiative, and the United Nation's declaration of 2014-2024 as the International Decade for Sustainable Energy for All should help ensure that access to energy will continue to be advanced post-2015. There is also some indication that there may be an openness and willingness for a more progressive approach at defining an energy related goal that goes beyond the minimalistic definitions of access considered in the past. However, whether there will be an energy goal in the post-2015 framework, and what form it will take, is still uncertain. The process to formulate and agree post-2015 development goals will continue until 2015.

National governments will need to define their own energy targets (e.g. for access to electricity, improved cooking technologies and mechanical power) and strategies to deliver these. Governments will also have to determine the minimum levels of energy access appropriate to their country situation and a set of indicators to measure progress. These should recognise that to enable the chronically poor to escape poverty, access to adequate energy includes access to energy for productive uses.

The post-2015 development agenda will, in all likelihood, call for energy to be increasingly supplied from sustainable, renewable sources. Most of the energy consumed by the poor today comes from renewable sources, but access to electricity and cleaner fuels for cooking could lead to an increase in their consumption of fossil-fuel based energy. We have noted above that in rural and remote areas, where decentralised electricity generation is the practical option, renewable sources are often the most viable option. The costs of large, grid-connected renewable electricity generation are becoming competitive with fossil fuels under existing market conditions, increasing the prospects for using sustainable energy to supply electricity for all.

For cooking energy, improvements in access to cleaner technologies will in many places mean using natural gas or LPG. However, these options offer safer and cleaner cooking and at the same time could reduce greenhouse gas emissions from cooking compared to traditional cooking practices. The use of advanced or improved cookstoves could also reduce emissions from incomplete biomass combustion. The provision of universal access to energy, even in the unlikely event of it being entirely from fossil fuels, would not have substantial effect on global greenhouse gas emissions and would be consistent with any Sustainable Development Goals included in the post-2015 framework.

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Annex 1: Setting the Poverty Lines for Panel Data Analysis

AFRINT Dataset

- Households interviewed in 2002 and 2008.
- Covers rural areas of 8 countries in sub-Saharan Africa; Ethiopia, Ghana, Kenya, Malawi, Nigeria, Tanzania, Zambia, Mozambique.
- For this analysis subjective data of household self-reported poverty and wealth status is used to categorise the households into poverty dynamics groups.
- At each round the interviewer was asked through; 'looking at this household by way of its capital assets and appearance, how would you rank its wealth in comparison with other households in the village'. The interviewer then placed the hh on a 5-point scale of; very poor; below average wealth; average wealth; above average wealth; very wealthy.
- 2348 hh have this subjective poverty data present for both rounds.
- Cross-checked these subjective poverty categories against 'total reported income[18]' in 2008 and it seems to be a reasonable fit.
- Poverty line set between below average wealth and average wealth – which is close to where the $1 a day poverty line would be (this is chosen in preference to the World Bank's $1.25 as $1 is closer to the poverty lines of the 50 countries with the largest number of poor people - see Deaton, 2010).
- This means that in 2002, 64% of households lived in poverty while in 2008, this proportion was 53%.

National Income Dynamics Study – South Africa

- Households interviewed in 2008 and 2010/2011.
- Nationally representative sample.
- The adult questionnaire asked about membership of subjective poverty categories – this subjective poverty data therefore relates to the individual rather than hh level.
- In-depth income data was collected in the questionnaire and households were grouped into poverty dynamics categories on the basis of household income per capita.
- To assign a poverty line hh were grouped into income quintiles on the basis of hh income per capita[19]. The poverty line was set between the richest four quintiles and the poorest quintile.
- 5690 hh have income data present in each round.

Young Lives Dataset – Vietnam

- Analysed round 2 (undertaken in 2006/7) and round 3 (undertaken in 2009).
- Data collected from 20 communities from 5 regions; covering rural/ urban areas and areas with different levels of development. For this analysis, households were grouped into poverty dynamics categories on the basis of their self-reported subjective wealth assessment.
- HH were asked to which of 7 groups did they belong compared to other hh in their village; the richest; among the richest; richer than most hh; about average; a little poorer than most hh; among the poorest; the poorest[20].
- 2920 hh have this subjective poverty data present in both round 2 and round 3.

[18] This analysis did not use income to set the poverty line as the data is missing for many hh and it doesn't involve an in-depth collection of all the different aspects of hh income.
[19] NIDS provides a composite income variable.
[20] R1 did not ask this question which is why that round is not analysed here.

- Cross-checked these subjective poverty categories against per capita total real consumption data from round 2 and for the purposes of setting the poverty line they are a reasonable proxy. Poverty line set between the ‘about average’ and ‘a little poorer than most’ categories.
- This meant that in round 2, 29% of hh lived in poverty and in round 3 30% of hh lived in poverty. WB data has the $1.25 poverty headcount in Vietnam at 17% for 2008. Young Lives technical note (Nguyen 2008) compares their sample with the nationally representative Vietnam Household Living Standard Survey (VLSS) and notes that hh in their sample are three times more likely to be categorised as poor than hh from the VLSS sample – reason why for this analysis the poverty line is set relatively high.