Poor people's energy outlook 2013

Praise for this book

'The *Poor people's energy outlook* series has already made a significant contribution to the global efforts and dialogue on the issues surrounding energy poverty. Its well-selected focus areas, including community services, have informed both policy and investment decision-making. This year's effort again helps refine our understanding and the direction of our collective efforts.'
Morgan Bazilian, Deputy Director, Joint Institute for Strategic Energy Analysis

'Having been neglected for too long, energy access is finally where it belongs – at the centre of attention of the development community. Now we need to understand better exactly how to mobilize the resources and investment needed to make substantial progress. The *PPEO* is a vital source of knowledge towards this cause.'
Michael Franz, Project Manager, EU Energy Initiative Partnership Dialogue Facility

'Since its first edition, the *PPEO* has become a reference publication for practitioners in the area of energy access. The new *PPEO* report is extremely important, for it provides very useful insights into the linkages between energy access and community services – an area which has been largely overlooked by existing literature.'
Dr Marlis Kees, Programme Manager, 'Poverty Oriented Basic Energy Services (HERA)', GIZ

'The *Poor people's energy outlook 2013* provides clear evidence and frameworks that would assist developing nations to move from darkness to light. It empowers poverty advocates to pursue the call for greater investment and proposes practical actions that would move nations from poverty to prosperity. Energy remains the driving factor for survival, better life and inclusive sustainable development; and should form a key area of focus in the post-2015 global agenda.

'Life without energy is death. This book is a "must read" for all development partners, individuals, governments, and NGOs that want a better and safer world.'
Dr Sam Agbo, Head of Health and HIV, Save the Children

'With a focus on delivering energy for health and education, Practical Action's *PPEO 2013* has once again effectively demonstrated that energy access is essential for achieving development goals. This report should not just be read by people working on energy in developing countries but by people interested in reducing poverty.'
Alison Doig, Senior Advisor – Climate Change and Sustainable Development, Christian Aid

'The *Poor people's energy outlook 2013* is a true and realistic reflection of the current energy challenges we face to ensure everyone's right to effective and modern education, health and other community services. The report has well-documented facts and provides ideas and action plans for the way forward. This global report by Practical Action is very commendable and deserves the support of all stakeholders at all levels.'
Amsalu Negussie, Eastern and Southern Africa Water, Sanitation and Climate Change Advisor, Plan International

Poor people's energy outlook 2013

Energy for community services

PRACTICAL ACTION
Technology challenging poverty

About Practical Action

Practical Action is a development charity with a difference. We use technology to challenge poverty by building the capabilities of poor people, improving their access to technical options and knowledge. We work internationally from regional offices in Latin America, Africa, Asia, and the UK. Our vision is of a sustainable world free of poverty and injustice in which technology is used for the benefit of all.

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Cover photo: Uganda Arua, West Nile Province. Eight-year-old Peace Dratery (middle) and her classmates do their homework under the light of a Philips Solar Light System in the village of Offaka (Credit: Sven Torfinn / Panos)

Back cover, left: Boarding pupils from Nyafaru school in Zimbabwe using electric light in the evening to study by. A micro-hydro system provides enough electricity for the school to power 200 light bulbs, a fridge, a radio and television – used for educational purposes (Practical Action / Crispin Hughes)

Back cover, right: School children benefit from hand washing facilities in western Nepal (Practical Action Nepal)

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Acronyms and abbreviations

DHS	demographic and health survey
EA	energy access
EFA	Education for All
EnDev	Energizing Development
ESI	energy supply index
ESMAP	Energy Sector Management Assistance Programme
HDI	Human Development Index
ICT	information and communication technology
IGO	inter-governmental organization
LPG	liquefied petroleum gas
LSMS	living standards measurement survey
NGO	non-governmental organization
OFID	OPEC Fund for International Development
PPEO	*Poor people's energy outlook*
PV	photovoltaic
SARA	Service Ability and Readiness Assessment
SE4ALL	Sustainable Energy for All
SPA	Service Provision Assessment
TBA	traditional birth attendant

Foreword

Achieving Universal Energy Access has risen to the top of the international agenda as a result of the UN Secretary General's groundbreaking Sustainable Energy for All initiative.

From lighting in streets and in the home, to power for water pumping, cooking, and basic processing and communications, access to energy enables people to live better lives. It also transforms health-care provision – enabling vaccines to be refrigerated, implements to be sterilized, and diagnostic equipment to be powered.

Ensuring that energy is integrated into the development, planning, and delivery of health and education services, and into public institutions, will directly drive inclusive human development, community by community.

Energy is fundamental to poverty reduction, sustainable development, and the achievement of the Millennium Development Goals. It must be given careful consideration in the follow-up to the outcomes of Rio+20 and as the post-2015 global development agenda is defined.

Expanding sustainable and affordable energy access for all is an overarching priority for UNDP. We are fully committed to playing our part in the international drive to achieve that.

Poor people's energy outlook 2013 is a welcome contribution to discussion about energy access. It addresses the core challenges of achieving inclusive development and overcoming unequal access to energy services. As with earlier editions of the report, *Poor people's energy outlook 2013* encourages us to consider energy access in different ways – ways that help chart a path out of poverty to greater prosperity.

For all these reasons I warmly welcome this third edition of *Poor people's energy outlook*.

Helen Clark
Administrator
United Nations Development Programme

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Executive summary

A life without access to energy is a life of drudgery. Despite the availability of technical solutions, two in every five people still rely on wood, charcoal, or animal waste to cook their food, and one in five people lack electricity (IEA, 2012). This is a global technology injustice.

Energy is vital for human, social and economic development. The public health and environmental situation in developing countries is sobering: each year, 2 million people die from diseases caused by indoor smoke – more than deaths from malaria (UNDP/WHO, 2009). We urgently need a paradigm shift to deliver the energy services that poor people need, want, and have a right to.

Poor people's energy outlook (*PPEO*) focuses on the important role energy plays in transforming poor people's lives. It prioritizes their perspectives and provides concrete tools and approaches to contribute to improving access to energy.

The focus of the first report (Practical Action, 2010) was household energy. It analysed how people access and use energy in the home. The second (Practical Action, 2012) highlighted the critical role energy plays for earning a living. The theme of this third *PPEO* report is energy for community services: health, education, public institutions, and infrastructure. Without access to modern energy supplies there is little prospect of delivering key community services. In turn, international development goals will not be achieved if health, education and other local facilities are not effective.

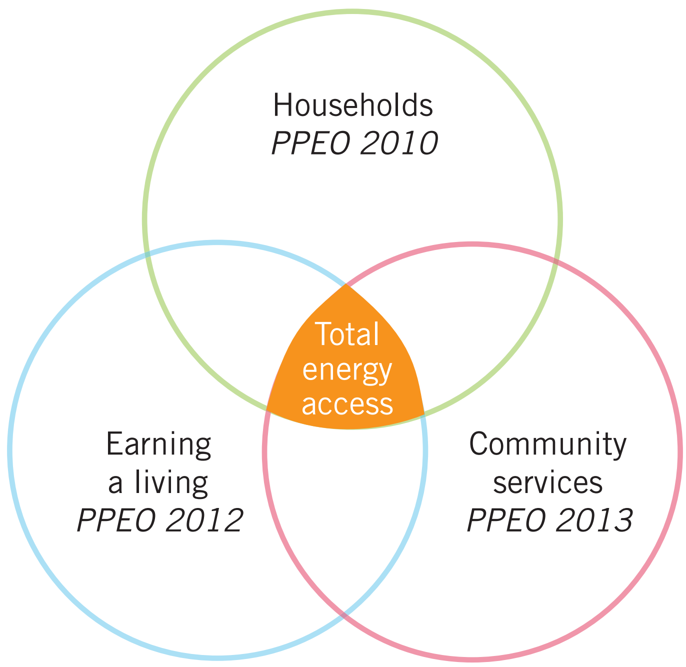


Figure 0.1 Total Energy Access: for households, earning a living, and community services

Practical Action champions a Total Energy Access approach, defined as when:

Households, enterprises and community services have sufficient access to the full range of energy supplies and services that are required to support human social and economic development.

Community services need energy

Energy is an enabler. It improves the quality of existing services and paves the way for new services to be made accessible to poor people. Energy reduces opportunity costs, drudgery and wasted effort. It plays a transformative role in increasing the effectiveness and quality of the following community services:

- **health care**: hospitals, clinics, and health posts;
- **education**: schools and training centres;
- **public institutions**: government offices, police stations, and religious buildings;
- **infrastructure services**: water and street lighting.

An estimated 1 billion people are served by health facilities without electricity. This is technology injustice

It is estimated that 1 billion people are served by health facilities without electricity.[1] The rates are lowest in South Asia: in India 46 per cent of health facilities, serving an estimated 580 million people, are without electricity. In sub-Saharan Africa more than 30 per cent of health facilities, serving an estimated 255 million people, are without electricity.

Ensuring accessible, affordable and clean energy access is critical for delivering adequate health services. It needs to be considered alongside investments in infrastructure, as well as staff, equipment, and medicines. People cannot, for example, receive adequate health care if the lack of energy supply means the facility they visit has no electric lighting, refrigeration, or sterilization equipment, and is not able to attract skilled staff.

Over 291 million children go to primary schools without electricity

In the education sector, it is estimated that more than 50 per cent of children in the developing world go to primary schools without access to any electricity; this affects more than 291 million children worldwide.[2] Lack of electricity is equally problematic for students and teachers in secondary and tertiary facilities. It has an impact on:

- teaching and learning (vocational tools and equipment and use of information computer technologies);
- physical infrastructure (lighting, cooking facilities, space heating and cooling, water pumping, and purification);
- human resources and governance (improved conditions for staff through use of modern technology, training, management of records).

This report provides a multi-tiered framework to measure access to energy for both health and education facilities. The framework enables practitioners and policymakers to assess, plan and budget for improved energy access in ways which are, most critically, based on poor people's energy needs and priorities.

Lastly, public institutions and infrastructure services are another important pillar of community services. This includes institutions such as government administrative offices, religious buildings, community centres and services including street lighting and water pumping. Compared to health and education sectors the above are under-resourced and undervalued in terms of their contribution to community well-being.

However, within the context of decentralization and an increasing recognition of the importance of good governance, the provision of community, district and provincial services is essential. Greater emphasis must be placed on their adequate resourcing in order to ensure the delivery of services that are critical to poor people.

Experts from health, education, and other key sectors suggest that energy is too often neglected, and needs to be integrated more effectively to deliver broader benefits. Increased focus on energy for community services is crucial and will be transformational in terms of achieving Millennium Development Goals, in particular goal 2 (achieve universal primary education), goal 3, (promote gender equality and empower women), goal 4 (reduce child mortality), and goal 5 (improve maternal health) (UNDP, 2011).

Towards Universal Energy Access: defining and measuring progress

Momentum is gathering behind the United Nations (UN) goal of Universal Energy Access by 2030. The UN Secretary General's Sustainable Energy for All (SE4ALL) initiative provides global leadership and sets forth three objectives to be achieved by 2030:

- universal access to modern energy services;[3]
- double the share of renewable energy in the global energy mix;
- double the rate of improvement of energy efficiency.

SE4ALL has galvanized support and progress is being made. In terms of national political commitments, as of August 2012, 55 (out of 140) developing countries had opted in to SE4ALL. This is a promising start, yet it leaves more than 4 billion people in developing countries outside the initiative (using classifications from UNDP/WHO, 2009).

This report analyses the 138 formal commitments made to SE4ALL to assess their scale, focus, and additionality. Currently, the focus of commitments does not reflect the multitude of poor people's needs. Most of the commitments are to household energy and very few tackle productive uses or community services. For example, household cooking receives far less attention than electricity provision, despite being an equally pressing concern for poor people.

Given the scale of the challenge, all resources must be targeted effectively. Levels of investment are still far below what will be required. In 2009, around US$9 billion was spent on energy access, considerably short of the estimated $48 billion per year needed to achieve universal access by 2030 (IEA, 2012).

A common understanding of energy access is imperative

Furthermore, the development of a common definition of energy access is imperative and will guide the creation of an agreed monitoring framework. Without a comprehensive definition, the multi-faceted energy needs of poor people will continue to be neglected. Measurement and definitions need to move away from a binary position, where a person either has or doesn't have energy access based only on whether they have a grid electricity connection. Institutional capacity needs to be developed to enable the relevant institutions to apply the new framework.

To advance this, Practical Action is working closely with the World Bank on the Defining and Measuring Access to Energy for Socio-Economic Development project. One outcome of this collaboration to date is the indicative framework for defining and measuring access to energy as presented in this edition. Previous *PPEO* reports have played a critical role in reviewing and widening the definition, which has now influenced the World Bank and partner agencies, and initiatives including SE4ALL. This is a breakthrough as the framework will shape the definition and delivery of energy access globally and nationally for the foreseeable future.

The emerging change in approach reflects real progress and promises to ensure that resources are better targeted in future. The proposed framework is critical because:

- households, livelihoods and community services are represented;
- it promotes modern energy services alongside modern energy supply;
- electricity, cooking fuels, and mechanical power are included.

Countries opting in to SE4ALL are encouraged to adopt this framework, in order to ensure consistent monitoring, evaluation and delivery of interventions in the coming years.

For SE4ALL to truly succeed, there is a need for a new energy narrative

The value of an ecosystems approach

At the national level an enabling environment which is geared towards meeting pro-poor energy access goals is essential. Practical Action's revised Energy Access Ecosystem Index, featured in this report, offers a workable means of analysing this environment. It focuses on nine indicators, three each in the areas of policy, finance and capacity.

This report analyses the Energy Access Ecosystem in Bangladesh, Bolivia, and Rwanda. Although levels of energy access in Rwanda are currently very low, it has the most favourable environment in terms of ecosystem scores. This offers the potential for rapid improvements in energy access in the coming years. In contrast, levels of energy access in Bolivia are far better, but a low ecosystem score indicates that progress towards reaching the remainder of the population may be slow.

The report recommends that the ecosystems approach to evaluating the enabling environment be adopted more widely; for example, as part of the SE4ALL gaps analyses and national action plans. Civil society is encouraged to use this tool to track national progress and to call for changes that will support genuine energy access.

Framework for action

For SE4ALL to truly succeed there is a need to establish and follow a new energy narrative; one which recognizes the full range of services that poor people want, need, and have a right to.

Practical Action, as a civil society organization committed to realizing Universal Energy Access, makes the following recommendations:

1. **Promote a service-based rather than supply-based approach to energy definition and delivery**
   A definition of access which is based on household connections to the grid will not end energy poverty. Achievement of Universal Energy Access by 2030 will require recognition of the full range of people's energy needs, not just at household but also at enterprise and community services levels. We urge SE4ALL opt-in countries to adopt the tracking framework and encourage public and private investment and activity to reflect the full range of energy needs, supplies, and services defined in the framework.

2. **Increase financing for decentralized solutions**
   To reach Universal Energy Access by 2030, 55 per cent of additional electricity generated for households will need to be through mini- and off-grid solutions. In order to deliver this, national plans and the portfolios of donors, multilaterals and the private sector now need to embrace appropriate decentralized solutions.

3. **Encourage an ecosystems understanding of the energy landscape**
   Countries that have opted into the SE4ALL initiative will be developing gaps analyses and national action plans to scope out the ways in which they will work towards their 2030 targets. Successful delivery of these national plans will depend on assessing and addressing the deficit in policy, finance and capacity, made possible through applying the ecosystems index.

4. **Create the space and support civil society to engage with SE4ALL**
   Internationally, SE4ALL now rightly recognizes civil society as the 'third pillar' of the initiative, alongside business and government. Given the appetite and expertise of civil society, both North and South, real engagement could make a difference towards SE4ALL genuinely delivering for poor people. Therefore, a clear and considered programme of engagement with civil society at national and international levels is fundamental. This needs to be supported by the finance to operationalize these plans in both the short and long term.

Introduction

The objective of *Poor people's energy outlook* (*PPEO*) is to ensure that the experiences and perspectives of poor people are reflected in efforts to improve energy access.

In *PPEO 2010* (Practical Action, 2010), the focus was on household energy: how people get and use energy in the home. This is the most widely recognized and discussed part of energy access.

PPEO 2012 (Practical Action, 2012) then looked at energy for earning a living, an essential part of reducing drudgery and increasing incomes. This is widely recognized in the energy sector as important, but has less widespread support in terms of appropriate policies and programmes. This edition brought to life how poor people use energy to earn from activities such as farming or running a small-scale enterprise.

The theme for *PPEO 2013*, the third in the series, is energy for community services: health, education, public institutions, and infrastructure. The report has been informed and guided by discussions with people in Bolivia, Bangladesh, and Rwanda. Practical Action has engaged with community members, civil society organizations, and government officials to hear their perspectives on how energy – or the lack of it – affects their lives.

PPEO 2013 focuses on the vital area of energy for community services

Among the countries where Practical Action works, Bolivia, Bangladesh, and Rwanda were selected for *PPEO 2013* research in order to represent different geographical, environmental, and development contexts:

- With a population of 10 million, Bolivia is the most developed of the three countries in terms of both the UN Human Development Index (HDI)[4] and energy access. Overall, four out of five people have electricity, but in rural areas over half are still without access. A relatively high 70 per cent of the rural population are still cooking with traditional fuels (IEA, 2011). There is limited data on energy access for health centres and schools. Although there are policies to improve rural energy access, little progress has been seen during the last few years. Bolivia has formally joined the Sustainable Energy for All (SE4ALL) initiative.
- Bangladesh (population 161 million) is ranked 146 out of 185 countries according to the HDI. Less than half the population have access to electricity and only 9 per cent cook with modern fuels (IEA, 2011). Seventy-seven per cent of health centres have electricity, but there is no national data on electricity for schools (Saha, 2002). Ambitious and targeted policies to improve energy access are being challenged by demographic growth and rural poverty. Bangladesh has also opted in to the SE4ALL initiative.
- With a population of 11 million, Rwanda is ranked 166 by the HDI and has very low electricity access (5 per cent) and less than 1 per cent of the population cook with modern fuels (UNDP/WHO, 2009). Although

School children benefit from hand washing facilities in western Nepal. Water is provided from two types of storage tank, one which stores ground water pumped using grid electricity and another which stores water directly from a centrally piped distribution system (Practical Action Nepal)

four out of five schools are reported to have electricity, only 36 per cent of health centres have access (UNESCO, 2011; MOH [Uganda] and Macro International, 2008). In response to such high needs there are strong policies in place, with clear targets for energy access. Rwanda has also opted in to the SE4ALL initiative.

As well as in-country research, this report has benefited from the growing literature on the subject of energy access – evidence which can support the drive towards sustainable energy for all. This report has been informed by national statistics, project level data, case studies, and research studies. It aims to illustrate how energy changes people's lives and to this end it provides evidence from community and practitioners' perspectives.

Chapter 1 is dedicated to Energy for Community Services. Firstly, we look at why energy access is important in this context and the scale of the challenge. Then we explore how energy is used in the community, the practicalities of energy supplies, and how to go about monitoring progress.

Chapter 2 presents the emerging framework for defining and measuring access to energy. This chapter reflects the joint work between the World Bank, the Energy Sector Management Assistance Programme (ESMAP), Practical Action, and other agencies on the Defining and Measuring Access to Energy for Socio-Economic

Development project.[5] The ambition is to create a framework that is widely accepted by the development community and adopted by the SE4ALL initiative.

The SE4ALL initiative has focused international attention on energy access. Many countries have 'opted in', with a wide range of commitments made by governments, the private sector and civil society during 2012. Chapter 3 includes an analysis of the commitments made to the SE4ALL energy access objective, exploring the extent to which they respond to household, enterprise and community energy needs.

In Chapter 4, we have refined the Energy Access Ecosystem Index first proposed in *PPEO 2012*. The ecosystem approach looks at different aspects of policy, finance and capacity to draw conclusions on the conditions for achieving progress. With Total Energy Access as the goal, an improved energy access ecosystem is a prerequisite. In this chapter we present results from national assessments in Bangladesh, Bolivia, and Rwanda and rank their ecosystem 'health'.

2013 is a crucial year in moving from commitment to delivery on the path towards Universal Energy Access. There are important principles at stake. Chapter 5 presents a civil society agenda – a framework for action, and a series of recommendations to ensure the full potential of SE4ALL is realized. Now is the time for a new narrative that recognizes the full range of energy services that people need, want, and have a right to.

Now is the time for a new narrative that recognizes the energy services people need, want, and have a right to

1

Energy for community services

Energy is crucial to community services, which in turn are fundamental to improving the lives of poor people and the achievement of the Millennium Development Goals, in particular goal 2 (achieve universal primary education), goal 3 (promote gender equality and empower women), goal 4 (reduce child mortality), and goal 5 (improve maternal health) (UNDP, 2011). This chapter focuses on the obstacles and opportunities for energy provision in the following areas:

- **health care**: hospitals, clinics and health posts;
- **education**: schools, universities, and training centres;
- **public institutions**: government offices, police stations, religious buildings, etc.;
- **infrastructure services**: water and street lighting.

These four categories provide a useful way of analysing community services in order to define and measure access to energy.

Health care

Supporting improvements in health-care systems is a cornerstone of development and central to improving people's lives. The World Health Organization (WHO) states that the right to health can be understood as the right to an effective and integrated health system (WHO, 2007a).

The health sector includes a broad range of institutions from rural health posts to specialist hospitals which tend to be in large cities. Each country has a unique way of organizing and administering its health sector, through a variety of public, private and faith-based service providers. In sub-Saharan Africa, for example, religious entities provide 25–70 per cent of health provision (Schmid et al., 2008).

Energy is crucial to community services, which are fundamental to improving poor people's lives

Alongside buildings, staff, equipment, and medicines, a critical component of an effective health-care facility is access to energy. People have little chance of receiving adequate health care if the facility they visit has no electric lighting, refrigerator or sterilization equipment, and is not able to attract skilled staff. Yet an estimated 1 billion people in the world are served by health facilities that are completely without electricity.[6] Some 800 women die every day during pregnancy and childbirth due to preventable complications and 99 per cent of these deaths take place in developing countries with poor health facilities (WHO, 2012a).

The following problems have been specifically highlighted from lack of access to energy in health facilities (EC, 2006):

- inability to provide clinical services after sunset;
- poor lighting conditions for performing operations;
- poor storage facilities for vaccines and medicines requiring refrigeration;
- poor facilities for sterilization of medical tools;
- inability to power laboratory equipment to diagnose patients' diseases;
- poor ability to communicate with medical specialists or to call for transport to a health facility with a higher degree of specialization;
- limitation to traditional cooking facilities, resulting in inefficiencies, poor air quality, and possible inadequate food intake by patients;
- difficulty in deploying health officers in remote rural areas.

Mothers bring their babies for vaccinations in Nyafaru, Nyanga, in the Eastern highlands of Zimbabwe. A community micro-hydro system provides electricity for lighting, a sterilization unit, and incubator at the Medical Centre (Practical Action / Crispin Hughes)

Box 1.1 Pregnancy and childbirth

'After 25 minutes the technician and nurse both gave up. The surgeon later explained that the baby had suffocated *in utero*. If only they had had enough power to use the ultrasound machine for each pregnancy, he would have detected the problem earlier and been able to plan the C-section. Without early detection, the C-section became an emergency; moreover, the surgery had to wait for the generator to be powered on. The loss of precious minutes meant the loss of a precious life.'

Kathryn Hall, Founder and President, Power up Gambia, Harvard Medical School

The relationship between energy access rates in health facilities and people's health status is subject to many factors. At a most basic level, however, energy can be a vital component in the quest for improving health services. For example, electricity access rates in Kenyan health facilities increased from 62 per cent in 2004 to 74 per cent in 2010. In the same period the number of facilities with incubators for newborn babies increased from 38 to 62 (NCAPD et al., 2005, 2011), and the neonatal mortality rate (probability of the baby dying in the first 28 days after birth) dropped from 40 to 28 per 1000 births (WHO, 2004, 2012b). While many factors will have contributed to these improvements, energy access is central.

The following section provides a more detailed description of how energy is used to improve health-care provision.

Energy use in health-care facilities

A broad range of energy equipment is required for diagnosis, treatment and surgery. Table 1.1 outlines a number of health facilities and equipment that are supported by modern energy services, including: vaccinations, sterilized equipment, incubators for premature babies, ultrasound, X-ray machines, and ELISA equipment for HIV/AIDS diagnosis. Improved equipment can be electrical or use thermal energy from solid, liquid and gas fuels.

Facilities without electric lighting have to depend on paraffin lamps, candles or torches that provide low-quality light, give off harmful fumes, and in some cases present a fire hazard. They are also more expensive per unit of energy than electric lighting (Practical Action, 2010). For critical and urgent health services such as emergency treatments and childbirth, staff have no option but to cope as well as possible in low lighting or in the dark, increasing the risk for all patients, including mothers and babies.

Another, often less considered, aspect of health-care services is communication. For example, mobile phones and VHF radios are critical to ensure there is sufficient support during emergency situations and enable better treatment decisions by connecting to specialists from referral hospitals (Musoke, 2002). Communications technologies can also ensure the timely supply of materials such as essential medicines and vaccines – the alternative to a mobile phone call may be a long journey for a staff member which results in time not spent delivering services.

This also applies in contexts where traditional birth attendants (TBAs) or midwives are often the only link women have to health-care services during their pregnancy and childbirth. A project in Uganda used solar-powered VHF radios to link TBAs with the formal health system. The VHF radio is used to relay advice to the TBA or, if they cannot manage the case, transport is dispatched from the health unit with a midwife to collect the patient. This led to a reduction in maternal mortality from 500 per 100,000 to 271 in just three years (Musoke, 2002).

Table 1.1 Energy services required for general-service readiness and specific health services

Purpose/service	*Energy service/equipment*
General amenities/infrastructure	
Basic amenities and equipment	Lighting – clinical/theatre, ward, offices/administrative, public/security Mobile phone charger, VHF radio, office appliances (computer, printer, internet router, etc.) Cooking, water heating and space heating Refrigerators, air circulation (electric fans) Sterilization equipment (dry heat sterilizer or an autoclave) Space heating
Potable water for consumption, cleaning and sanitation	Water pump (when gravity-fed water not available) and purification
Health-care waste management[1]	Waste autoclave and grinder
Service specific medical devices	
Cold chain and Expanded Program on Immunization (EPI) refrigeration	Vaccine refrigerator
Maternity and mother/child health	Suction apparatus, incubator, other equipment
HIV diagnostic capacity	ELISA test equipment (washer, reader, incubator)
Outpatient department (OPD)	Portable X-ray, other equipment
Laboratory and diagnostic equipment	Centrifuge, haematology mixer, microscope, blood storage, blood typing equipment (37°C incubator and centrifuge), blood glucose meter, X-ray, ECG, ultrasound, CT scan, peak respiratory flow meter
Surgical equipment	Equipment and facilities for: tracheostomy; tubal ligation; vasectomy; dilatation and curettage; obstetric fistula repair; episiotomy; appendectomy; neonatal surgery; skin grafting; open treatment of fracture; amputation; cataract surgery
Additional infrastructure	
External lighting	Security lights at front gate, main doors and around buildings, outside toilet block, walkway lights
Staff housing	Lighting, TV, AM/FM stereo Other appliances (mobile phone charger, electric fan, etc.) Cooking and water heating
Emergency transportation	Vehicle or motorbike

1 While the current SARA facility survey tool relates only to incineration, the most recent WHO advice on health-care waste management recommends use of an electric-powered autoclave and grinder, therefore power demand for this equipment is cited here.

Source: extracted from USAID/WHO, 2012, by Practical Action and World Bank / ESMAP, Defining and Measuring Access to Energy for Socio-Economic Development project

A further important facet of energy provision relates to diseases – preventable by vaccines and immunizations – that kill around 1.7 million children each year, predominantly in developing countries (GAVI, 2012). Vaccines lose their potency permanently when exposed to temperatures outside their storage range, so they need to be stored in a powered refrigerator. The permissible range varies, but nearly all vaccines should be kept between 0 and 10°C.

Health centres with functioning refrigeration facilities help build vaccinations into routine service delivery, as well as treatment of diseases such as HIV and AIDS, measles, and polio. Refrigeration also enables storage of blood, medicines and testing reagents. On average, cold chain logistics increases vaccine costs by an estimated 14–20 per cent and prevents access to vast areas of the developing world (Vaxess, 2012).

Unreliable electricity connections with frequent power shortages contribute massively to wastage; it is estimated that almost half of all vaccines delivered to developing countries are ruined due to poor cold chain services (Vaxess, 2012).

Almost 50% of vaccines in developing countries are ruined due to poor cold chain services

Box 1.2 Powerless to deliver health care in the Bangladesh chars

North Channel health and family planning day centre is a government facility in the remote and chronically poor char lands of Bangladesh. The three full-time staff serve 50–60 patients daily, providing basic/emergency treatments and all family planning services. The facility has no electricity supply or vehicle support. With no cooling devices, staff struggle to work during hot seasons and patients become dehydrated. Without lighting, the facility does not operate in the evening.

A patient recalls her experience: 'Without any treatment my baby Nargis died, but death spared me for longer sufferings. If there were electricity, we could get health care at night as the doctor would reside in the centre premises. So many political regimes have ruled but none ensured electricity for our hospital. No one values a poor's life.'

Even during the day, the natural light indoors is not sufficient for many tasks; doctors need to use torches for IUD insertion. The IUD device, like all other equipment and apparatus, is sterilized in boiling water using a kerosene stove. Despite having some electrical medical equipment such as suction apparatus, they cannot use it without a power source. Without a TV or radio the staff and patients do not receive health-related news, visual information, or awareness programmes. Lack of a computer makes it difficult to share data with the district hospital.

In the absence of a grid connection, or where grid connectivity is unreliable, paraffin- and LPG-powered fridges can be effective, although they require more attention and maintenance than electric fridges. For example, the Laime Toro Health Centre in Bolivia does not have electricity and uses an LPG fridge to store vaccines and medicines. The doctor says the fridge performs well but they face difficulties with gas supplies: 'If the gas for the fridge runs out, we need to travel 32 kilometres to get a gas cylinder from the market, and sometimes there are none to buy. It would be better if the cold chain used electricity, because if we do not find gas, we're in big trouble.'

Infections from unsterilized equipment pose a real hazard. Given that every year 50–60 million people in the developing world suffer wounds, and one in five of these patients suffer from post-operation infection (WHO, 2012b), sterilization of

Refrigeration keeps vaccines cool at the health centre in Tamborapa, Peru. Power is supplied to this remote community via a micro-hydro system (Practical Action) equipment is crucial. Boiling water to clean instruments is a common method of sterilization, although it is not endorsed by the WHO as a reliable method of sterilization as it does not kill 100 per cent of the microbes present on surgical devices. Satisfactory sterilization can be achieved with dry heat sterilizers and autoclaves that can be solar thermal, paraffin or electric powered (USAID/WHO, 2012).

The above section highlights some of the most critical barriers to health-care delivery. In addition, from a Total Energy Access perspective, lack of access to energy in other spheres can further exacerbate an individual's poor health status.

- **Household**: cooking on open fires and kerosene lighting causes indoor air pollution which is recognized as one of the largest global public health issues (Practical Action, 2010).
- **Earning a living**: traditional labour practices can all have detrimental health effects. Activities such as grinding staples, carrying wood to sell it directly or to make charcoal, and cooking as part of a small business increase exposure to smoke and add to physical strain.
- **Community services**: lack of clean water has detrimental effects on health. Lack of street lighting causes accidents.

Electrification rates in health-care facilities

There is too little data to provide an accurate picture of electrification rates in developing countries. Figure 1.1 illustrates that electricity access rates are lowest in

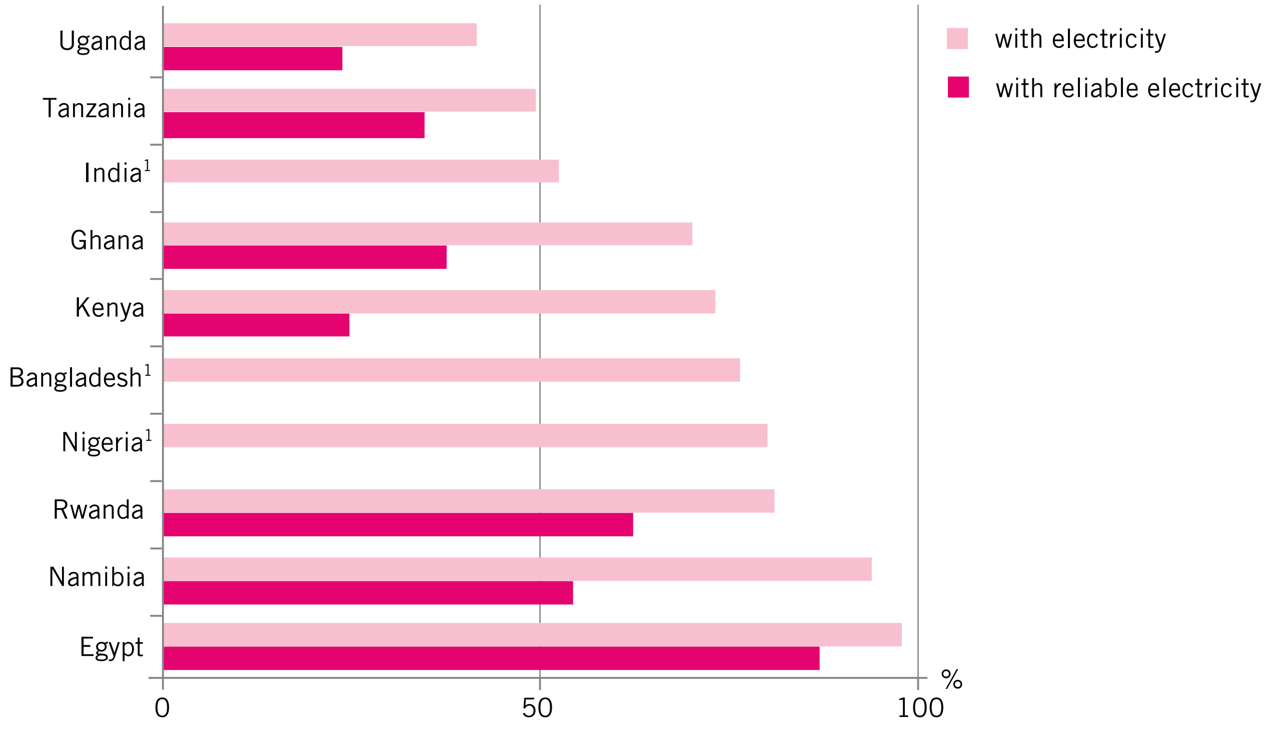


Figure 1.1 Electricity access rates in health facilities for the few developing countries with available data

Note: Definitions of 'reliable' vary, usually either an uninterrupted supply during working hours or having a backup system, or not unavailable for more than two hours at a time.
1 No data is available on the regularity of supply in Bangladesh, India and Nigeria.

Source: all data taken from the USAID Demographic Health Survey's Service Provision Assessments in each country (USAID, 2012), expect for India (IIPS, 2011).

South Asia: in India 46 per cent of the health facilities, serving an estimated 580 million people, are without electricity. In sub-Saharan Africa more than 30 per cent of health facilities, serving an estimated 255 million people, are without electricity. Of the countries for which data is available, the situation is particularly concerning in Uganda and Tanzania where only 42 per cent and 50 per cent respectively have electricity.

Higher household electrification rates in different countries are roughly correlated with higher electrification rates in health centres. However, there are significant anomalies in data that make useful comparisons and analysis very challenging.

What is more certain is that rural areas are most affected by a lack of energy services: many facilities wait in vain for connection to a grid or struggle with the high cost of diesel and its limited availability for their generators. In Uganda, for instance, only 1 per cent of rural outpatient clinics are connected to the electricity grid (Harsdorff and Bamanyaki, 2009). Table 1.2 shows that in Rwanda hospitals which are located in urban areas have a much higher electrification rate than rural-based health centres and clinics.

Table 1.2 Electricity indicators for health facilities in Rwanda's Service Provision Assessment survey

Electricity indicators	*Hospital (%)*	*Health centre/ polyclinic (%)*	*Dispensary/clinic/ health post (%)*	*Total (%)*
No electricity or generator	2	18	25	*18*
Generator observed with fuel	95	22	32	*29*
Regular[1] electricity or generator	95	59	67	*63*

1 'Regular' is defined as electricity routinely available during service hours, or backup generator with fuel available

Source: NIS, 2008

Only 25% of health facilities in Kenya have a reliable electricity supply

Alongside the lack of access to energy is the problem of unreliability in energy supply. In Kenya for instance, only 25 per cent of facilities have a reliable supply and blackouts happen at least six times a month, for an average of 4.5 hours at a time (NCAPD et al., 2011; World Bank, 2007). An unreliable supply directly affects services such as childbirth and emergency treatment, and limits night time services. It can also lead to wasted vaccines, blood, and medicines that require constant storage temperatures. Backup generators can be extremely expensive and severely constrain the finances of a facility.

While stand-alone electrical devices, such as solar lanterns or VHF radios, and thermal applications, including paraffin refrigerators, sterilizers, incinerators or cooking facilities, make a significant contribution to health-care service delivery, very little data exists to assess their impact.

Having energy at a health centre does not necessarily mean you are able to provide a particular kind of service. Regular electricity is required for storing vaccines – and while 63 per cent of Rwanda's health facilities have regular electricity, 61 per cent are storing vaccines (see Table 1.3). On the other hand, only 30 per cent have autoclaves and 29 per cent use dry heat sterilization. Four out of five health facilities in Rwanda offer antenatal care, but only 17 per cent of those have examination lights which would allow for a proper pelvic examination. Resourcing of the health service in terms of equipment will need to go hand in hand with improving access to electricity.

Table 1.3 Energy equipment indicators in health facilities in Rwanda

Health services at facility	*Medical equipment*	*Facilities with equipment (%)*
Delivery services (childbirth)	Examination lights	42
Antenatal care services	Examination lights	17
Family planning services	Examination lights	15
Physical examinations for sexually transmitted infections	Examination lights	11
HIV/AIDS testing	Incubator	7
Antenatal related testing	Incubator	5
Newborn care	Incubator or heat source	15
Stored vaccines observed	Refrigerator (functioning at temperatures between 0 and 8°C)	61
Malaria diagnosis	Microscope	36
Tuberculosis (TB) diagnosis	TB diagnosis kit (incubator, microscope or rapid TB diagnostic test kit) X-ray machines	38 8
All health services	Autoclaves Dry heat sterilization Boil/steam sterilization	30 29 41

Source: NIS, 2008

Energy supply options for health-care facilities

Energy supply options vary greatly in rural and urban areas. In most instances, the full range of energy services required by health facilities cannot be met by electricity alone. Solid, liquid and/or gas fuels are a necessary complement.

One key issue is that the supply of energy for thermal needs – cooking, water heating, space heating and incineration – can represent a large proportion of a health facility's energy consumption and expenditure. As with households, a range of traditional biomass and modern fuels are typically used. Improved fuels and stoves reduce indoor air pollution and mitigate health problems for the cook. Energy-efficient stoves and boilers can help manage the cost or collection burden of fuel consumption.

Facilities connecting to the grid are not constrained by the amount of power they can draw, but are subject to the reliability of the grid and often experience periods without power. Backup systems such as diesel generators or battery-inverter systems are common, but are expensive and often inadequate to meet even priority energy needs.

For facilities that are remote from the electricity grid a range of decentralized technologies are available, including renewable energy, diesel engine generators,

Box 1.3 Marie Stopes Clinic, Bangladesh

The Marie Stopes Clinic for sexual and reproductive health in Bangladesh experiences at least two hours of power outages every day – increasing waiting time for patients and requiring the staff to work longer hours to accomplish their tasks. The backup generator can only power the operating theatre and training rooms. The diesel costs, coupled with the staff overtime bills, make the unreliable grid electricity supply a major financial burden on the facility.

The amount spent on diesel in a year could fund a skilled nurse for six months

Table 1.4 Comparison of electricity supply options to provide a reliable 25 kWh/day supply

Technology	*System size*	*Capital (US$)*	*Operating cost (US$/year)*	*Operation and maintenance assumptions*
Solar PV system with batteries	6000 W panels 100 kWh batteries	$55,000 system $10,000 batteries	$2,550	1% system cost per year (includes maintenance and component replacement, does not include security); amortized cost of replacing the batteries every five years (20% of battery cost)
Wind turbine with batteries	8750 W turbine 100 kWh batteries	$44,000 system $10,000 batteries	$2,900	2% system cost per year; amortized cost of replacing the batteries every five years
Diesel engine generator	2.5 kW	$2,000	$6,400	$0.0075/kWh maintenance, $0.67/kWh fuel ($1/litre for fuel used), operating at 15 kWh per day at 67% capacity, and replacement of engine every ten years
Hybrid system	6000 W panels 50 kWh batteries 2.5 kW engine	$55,000 system $5,000 batteries $2,000 generator	$2,200	1% PV system cost per year; battery replacement every five years; 200 hours of engine operation per year; replacement of engine every ten years
Grid extension	n/a	$10,000+ per mile	$900	$0.10/kWh power

Source: USAID, n.d.

or hybrid systems. Well-designed and maintained off-grid systems can provide an affordable, adequate and reliable electricity supply.

Small stand-alone systems, while unable to meet all energy service needs, can provide essential energy services for facilities. For example, use of solar lanterns in clinic delivery rooms and at night, solar refrigerators for vaccine and blood storage, wind-powered water pumps, and biogas for cooking can bring large benefits.

Table 1.4 shows some of the main options for providing electricity to a rural health clinic. The affordability of options is analysed according to the capital cost of the system and the operation and maintenance costs. The scenario is based on a rural clinic assuming approximately 120 beds and equipment for general service readiness, and some service-specific equipment such as diagnostic devices (with an electricity consumption of 25 kWh/day).

Data on the use of different energy supply options in rural health facilities is very sparse, but the use of stand-alone electricity supply systems, especially solar PV systems with batteries, has been promoted in many developing countries. This trend has been driven by higher fuel prices since around 2004 as well as the declining cost and increasing availability of solar technology. Solar PV systems with storage are now usually cheaper than diesel generators for the provision of off-grid electricity (IRENA, 2012).

Most pressing for decision-makers are issues of cost and reliability. Where there is no grid electricity, or supply is intermittent, diesel generation is often a reliable and easily available option. But, as Table 1.4 shows, careful consideration should be given to all technology choices and the integration of different systems. Institutional aspects of policy, planning, management, financing, service infrastructure, community participation, and user interface are critical to the successful use of any chosen technology (Jimenez and Olson, 1998).

A framework for measuring access to energy for health

Given all the constraints highlighted above, this section provides a framework on how to measure energy access for health-care provision at primary, secondary and tertiary levels. Most importantly, it offers a service-focused perspective reflective of the full scope of poor people's energy needs.

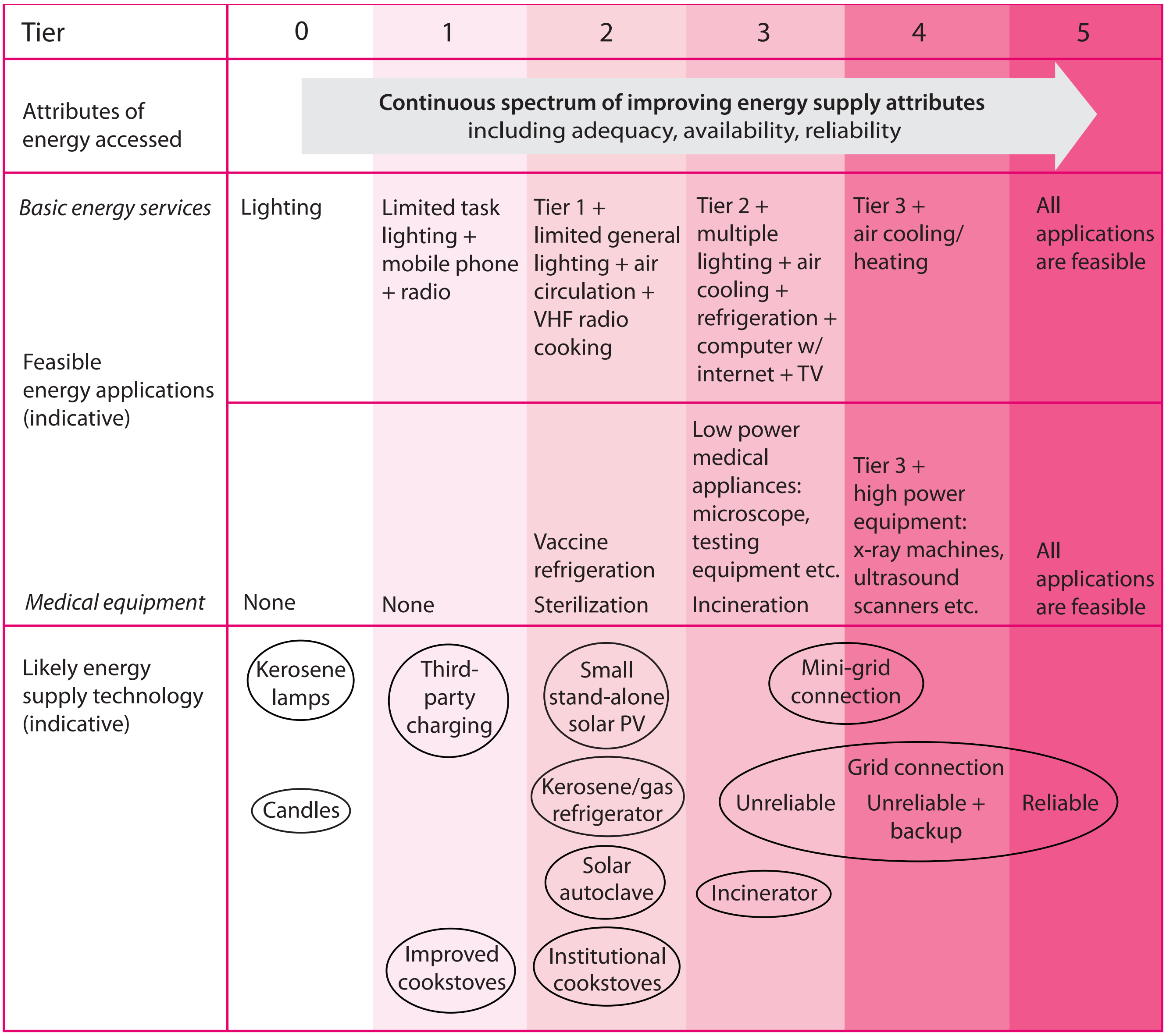


Figure 1.2 An indicative framework for defining and measuring access to energy for health centres

Source: Practical Action and World Bank / ESMAP, Defining and Measuring Access to Energy for Socio-Economic Development project

Figure 1.2 has been developed by Practical Action in partnership with the World Bank / ESMAP, and World Health Organization.[7] The tool can be used at several levels: for an individual facility, or aggregated for a district, country or region. However, the framework and methodologies need to be developed and piloted further, before they can be applied more widely.

The framework is intended to build on existing national data collection initiatives to provide comprehensive tracking at the country and global levels. The Service Provision Assessment (SPA) survey and Service Ability and Readiness Assessment (SARA) are two initiatives that are already looking at this. SARA is a health facility assessment tool developed through coordination between WHO and USAID that incorporates questions relating to the electricity supply and associated equipment.

Education

Access to quality education is proven to play a crucial role in increasing incomes and economic activity, improved health and social development and well-being. Not only does energy access improve children's experience in schools, it is widely acknowledged to be the foundation of future earning potential. An individual's expected income, and level of economic activity, is strongly related to the number of years they spend in education. For example, data from India shows that the yearly income is 1.6 times greater for someone who spends 12 years in education compared to someone who spends only six years (Cabraal et al., 2005).

The UNESCO Education for All (EFA) initiative describes five enabling inputs for quality education (UNESCO, 2005):

- teaching and learning (learning time, teaching methods, assessment/feedback/incentives, class size);
- teaching and learning materials;
- physical infrastructure and facilities;
- human resources: teachers, principals, inspectors, supervisors, administrators;
- school governance.

Table 1.5 How energy technologies contribute to the enabling inputs of a good education

Energy service	*Potential activity/outcome*
Teaching and learning (learning time, teaching methods, assessment/feedback/incentives, class size)	
Lighting	Extend learning hours in the evening Extend working hours for preparing lessons and administrative duties Improve indoor light for reading, writing and other tasks
ICTs (computers, mobile phones, music player, etc.)	Allow students to learn computer skills Enable more interesting and engaging lessons Enable staff training through distance learning Remove need for teachers to miss classes to travel for assessment, feedback, materials, and salary
Materials for teaching and learning	
Vocational tools and equipment	Enable training for vocational trades (e.g. carpentry, mechanics, electrics) and professional and technical skills (e.g. computer literacy).
ICTs	Teachers can access the latest information, and produce and prepare learning materials (printing, photocopying etc.) Teachers can use effective audiovisual teaching aids Increased motivation of students to learn and teachers to teach
Physical infrastructure and facilities	
Cooking facilities	Provision of midday meals and boiling water for drinks
Space heating and cooling	Comfortable and healthy environments for students and staff
Outdoor lighting	Increased convenience, security and safety outdoors in the evening
Water pump	Increased access to clean water and improved sanitation
Water purification	Access to clean water for drinking and cooking
ICTs	Communications with support services for facility management
Human resources: teachers, principals, inspectors, supervisors, administrators	
ICTs, lighting, heating etc.	Enhance living conditions for teachers and ability for them to communicate with family and friends Facilitate training for staff Attract and retain qualified teachers
School governance	
ICTs	Speed up communication with education authorities Facilitate management of student and staff records, school accounts, etc. Improve decision-making by school heads and staff

Each enabling input for a quality education is facilitated or improved to some degree by access to energy. Yet it is estimated that more than 50 per cent of children in the developing world go to primary schools without access to electricity; this affects more than 291 million children worldwide.[8] Table 1.5 summarizes the technologies, activities, and impacts of improved energy services in the school.

Energy use in schools

Electric lighting allows schools to operate outside daylight hours, extending the working hours for students, adults, and teachers. For schools with too many pupils, longer classroom hours can allow additional classes to accommodate more students and/or reduce class sizes. Students without electric lighting at home can stay at school to study and complete homework, leading to better grades. In the Philippines, 85 per cent of children with electric lighting said it is easy to read in the evening, compared to only 41 per cent of children without electric lighting (Cabraal et al., 2005). Evening classes can also be run for other members of the community. Teachers can prepare for lessons, mark homework, conduct staff meetings and carry out administrative tasks.

Electric lighting allows schools to operate outside daylight hours for evening classes and homework

Reading and writing in low light is extremely difficult. Mr Mollah, a school-teacher in Bangladesh, reports that low light sometimes makes conducting lessons near impossible. Classroom windows and shutters are forced to stay open during the cold season in order to maximize the natural light entering the room.

Given the importance of balanced nutrition for child development and concentration, some governments and NGOs in developing countries run programmes to provide meals in schools. In the absence of modern cooking solutions, many schools that provide meals have to rely on wood burnt in open fires or rudimentary stoves for cooking and heating. Collection of wood is carried out by students and staff, decreasing time available for teaching and learning. Challa Chico is a small school in rural Bolivia that educates 25 students. Firewood is collected by the schoolchildren for cooking their midday meal on an inefficient stove. Ms Reque, a teacher at the school, reported: 'We would like to use LPG but access is not easy due to the distance from the capital city, and it is difficult for us to afford.'

In India, the midday meal scheme aims to avoid classroom hunger and increase school enrolment and attendance, as well as addressing malnutrition, empowering women through employment, and improving socializing between castes (TERI, 2011).

Box 1.4 Extending learning beyond the classroom in Bolivia

The Cristo Redentor School is located in the town of Cochabamba, Bolivia. The school has 260 primary and early secondary students. The school caters for poor and middle-income families, including special needs children. The local utility supplies reliable electricity. Mrs Delgado, the school's director, reports that electric lighting is necessary, particularly during winter, because the school is surrounded by tall buildings that block natural light. Lighting has enabled the teachers' working day to be extended for planning and training. Children now stay and do homework in the evening, and teachers and parents can meet at night. Outdoor lighting alleviates the fear of theft. The school now has 24 computers with an internet connection, as well as radio, TV, and DVD player.

Mrs Delgado explains: 'Teaching becomes more dynamic, more interesting and more motivating for students. With these technologies they can improve their learning and stay informed beyond what the school can give them.'

Electric fans keep the computer rooms cool and create a pleasant working environment, where students do not become fatigued from the heat.

Before a new kitchen block with fuel-efficient stoves was built at Onwards and Upwards Secondary School in Uganda, school cook Lubega used to feed 500 children each day using open fires (Promoting Equality in African Schools)

In cold climates, in addition to nutrition, concentration and comfort can be helped by space heating of classrooms. Cold, damp, and poorly ventilated rooms provide an unhealthy environment and can exacerbate health problems for the unwell.[9] Heating is required not only in the temperate regions of the world, but also in high altitude areas, particularly during their cold seasons (Practical Action, 2010).

Extremely warm conditions can also exacerbate illnesses such as dehydration, fatigue, and heat stroke. Space cooling can be important to keep rooms and offices at a comfortable temperature for staff and students – low-power electric fans can make all the difference. The head teacher at Arkandi primary school in Bangladesh complained that: 'When temperatures reach 38°C in the summer months, both the teachers and students quickly become tired and absent-minded without any form of cooling.'

Energy access is not only critical at primary school levels. It is widely accepted that for secondary schools, higher education institutes, and vocational centres, access to energy is fundamental to provision of relevant education services. For example, experience and confidence with computers is increasingly important in jobs markets; computer classes not only interest school students but also attract adults looking to gain extra skills. Access to internet is essential for higher education institutes to conduct research and communicate with international colleagues. Vocational training centres teaching carpentry, welding and manufacturing require a good quality energy supply and high-power machinery.

As is the case with the link between energy access and health-care performance, the relationship between energy access and education is relevant beyond the scope of educational institutions. For example, at household level, access to improved cooking solutions such as gas or kerosene prevents children, especially girls, from spending hours collecting firewood. Lighting at home can also give children the opportunity to study and do homework.

Electrification rates in schools

Given the fundamental nature of electrification for educational purposes, the dearth of data shows that the issue lacks the attention it requires. The limited data that does exist shows that sub-Saharan Africa has the lowest rate of primary school access to electricity at 35 per cent, compared to 48 per cent in South Asia, and 93 per cent in Latin America. This represents 90 million, 94 million and 4 million pupils who attend school without electricity in the respective regions.[10] In some countries in sub-Saharan Africa, such as Burundi, only 2 per cent of primary schools have electricity; in India the figure is 48 per cent (see Figure 1.3).

As with the health sector, rural areas are disproportionally affected. Data from four states in India shows 27 per cent of village schools have electricity, compared with 76 per cent of schools in towns and cities. In Peru fewer than half of village schools have electricity, whereas nearly all urban schools have electricity (World Bank, 2010).

Data and analysis on availability of electrical equipment are also included in some surveys. The figures in Table 1.6 show that where electricity availability for schools is low, so is access to computers. For example, only 48 per cent of Indian schools have electricity and only 13 per cent have a computer for administrative purposes. On the other hand, the presence of electricity does not necessarily mean electrical equipment such as computers will be available. In Chile 99 per cent of schools are electrified and 90 per cent have computers connected to the internet for student use, while in Paraguay, 97 per cent of schools have electricity, but only 7 per cent have computers for student use. Clearly, having electricity is a prerequisite for using different kinds of electrical equipment, but whether the equipment is available depends on how well resourced the education sector is as a whole.

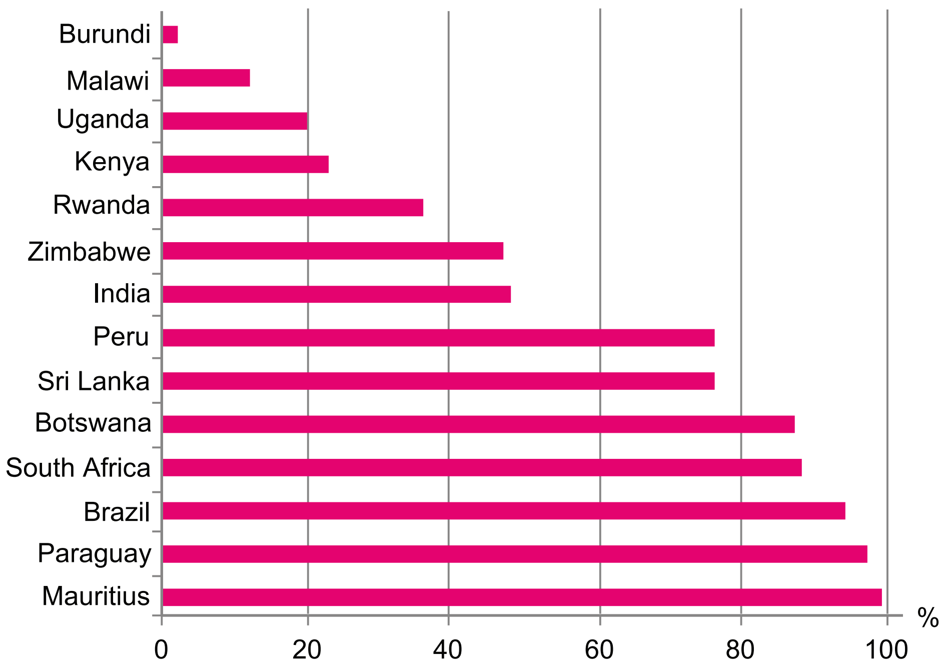


Figure 1.3 Percentage of primary schools with access to electricity in selected countries

Source: UNESCO, 2007, 2008, 2011

Table 1.6 Percentage of schools with electricity and computer access

Country	*Schools with access to electricity (%)*	*Computers for administrative use (%)*	*Computers for students to use with access to the internet (%)*
India	47.6	12.8	8.8
Peru	76.4	52.7	22.1
Sri Lanka	79.1	21.3	3.1
Philippines	89.0	47.8	5.8
Brazil	94.5	70.4	22.8
Paraguay	96.6	29.0	6.5
Tunisia	98.3	21.9	23.1
Malaysia	98.4	95.2	59.4
Argentina	98.7	75.3	22.9
Chile	99.4	93.4	90.2
Uruguay	100.0	93.4	36.8

Source: UNESCO, 2008

Energy supply options for schools

The electricity supply options for a school are comparable to those of a health centre (see earlier section, 'Energy supply options for health-care facilities'). The system size and cost depends upon the size of the school and the specific energy needs. Table 1.7 presents an example scenario for a primary school with approximately 100 students, four classrooms, lighting, electric fans, a stereo and a computer for administrative purposes.

As with health-care supply options, stand-alone systems can provide essential energy services for rural schools. Their use, particularly solar PV systems, is growing due to falling costs and better availability of products and services. Micro systems are now much more widely available and can benefit teachers with night lighting from solar lanterns or with mobile phone charging.

Table 1.7 Comparison of electricity supply options to provide a reliable 5 kWh/day supply

Technology	*System size*	*Capital (US$)*	*Operating cost (US$/year)*	*Operation and maintenance assumptions*
Solar PV system with batteries	1200 W panels 20 kWh batteries	$12,000 system $2,000 batteries	$500	1% of system cost per year (includes maintenance and component replacement, does not include security); amortized cost of replacing the batteries every five years (20% of battery cost)
Wind turbine with batteries	1750 W turbine 20 kWh batteries	$10,000 system $2,000 batteries	$600	2% of system cost per year; amortized cost of replacing the batteries every five years
Diesel engine generator	2.5 kW	$2,000	$1,400	$0.0075/kWh maintenance, $0.67/kWh fuel ($1/litre for fuel used), operating at 15 kWh per day at 67% capacity, and replacement of engine every 10 years
Hybrid system	1200 W panels 10 kWh batteries 500 W engine	$12,000 system $1,000 batteries $500 generator	$450	1% of PV system cost per year; battery replacement every five years; 200 hours of engine operation per year; replacement of engine every 10 years
Grid extension	n/a	$10,000+ per mile	$200	$0.10/kWh power

Source: USAID, n.d.

The supply of energy for thermal needs – cooking, water heating and space heating – can represent a large portion of a school's energy consumption and expenditure. As with households, a range of traditional biomass and modern fuels are typically used. Improved fuels and stoves reduce indoor air pollution and mitigate health problems for the cook. Energy efficient stoves and boilers can help manage the cost or collection burden of fuel consumption.

A framework for measuring access to energy for education

Figure 1.4 provides a framework for measuring energy access for education services similar to that in Figure 1.2 in the health section. Again it is important to highlight that the framework provides an alternative approach to measuring access to energy, prioritizing services as well as supply-side perspectives.

Tier	0	1	2	3	4	5
Attributes of electricity accessed	**Continuous spectrum of improving energy supply attributes** including adequacy, availability, reliability					
Basic energy services Feasible energy applications (indicative)	Lighting	Limited task lighting + mobile phone + radio cooking	Tier 1 + limited general lighting + air circulation + VHF radio cooking space heating	Tier 2 + multiple lighting + air cooling + refrigeration +	Tier 3 + air cooling/ heating	All applications are feasible
Teaching equipment	None	None	Limited computer use	Projector + Laboratory equipment + Multiple computers w/internet	Tier 3	All applications are feasible
Likely energy supply technology (indicative)	Kerosene lamps Candles	Third-party charging Improved cookstoves	Small stand-alone solar PV Kerosene/gas refrigerator Institutional cookstoves Biomass heater	Mini-grid connection Grid connection: Unreliable Incinerator	Mini-grid connection Grid connection: Unreliable + backup	Grid connection: Reliable

Figure 1.4 Indicative framework for defining and measuring access to energy for schools

Source: Practical Action and World Bank / ESMAP, Defining and Measuring Access to Energy for Socio-Economic Development project

Public institutions

Services of all public institutions can be improved and expanded through access to energy

As well as health centres and schools, there are many other institutions that contribute to the functioning of a community and the well-being of its people. They provide a broad range of functions: organization and administration of government services and operations; promotion of security and safety for individuals and property; promotion of social, cultural and spiritual health; and social care. Local public institutions may include:

- government administrative offices;
- police stations;
- religious buildings;
- prisons;
- community centres;
- public libraries;
- orphanages;
- sports facilities.

The presence and importance of the various institutions vary greatly between communities and countries. The number of facilities without access to modern energy services is unknown. Little data exists on the number and coverage of facilities, let alone their energy status. This is exacerbated by the fact that administration of institutions may be public, private, NGO- or faith-based.

Services of all public institutions can be improved and expanded through access to energy. For example, electricity is needed for lighting, cooling and ICTs. Social events tend to take place after dark when people are free to attend; lighting and entertainment equipment can extend the duration and transform the vibrancy of such gatherings. Microphones and loudspeakers are used for making political announcements, social gatherings and prayer sessions. Clean cooking water and heating are required in institutions where people live such as prisons, orphanages, and rehabilitation centres.

Local government offices and police stations are often responsible for keeping public records such as demographic data, tax information and legal registrations, and sometimes they coordinate development work. These tasks can be made much more efficient through use of computers, photocopiers, and printers. Increased

Box 1.5 Union Information Service Centre, Madhukhali, Faridpur District, Bangladesh

The Union Parishad (UP), or local government, in Bangladesh is tasked with providing many services, from birth certificates to trade licences and tax collection. It also houses the Union Information Service Centre (UISC) that provides agricultural information, for example, farming techniques and weather forecasts. In Madhukhali, Faridpur District, the UP is fortunate to have a grid electricity connection. With computers, internet, printer and photocopiers, their 26 staff provide a full suite of up-to-date knowledge and information services to local people.

Mr Mujibor, a sugarcane farmer, obtained a farmers' certificate from the UP, which helped him arrange a loan from the local agricultural bank. One of the service providers at the UP also helped him to investigate alternative crops. With this service and the seed capital from the bank, Mr Mujibor started growing other crops such as aubergine (eggplant) and chilli. This has increased his earnings by Tk4000 (around US$50) in the first cropping alone. Mr Mujibor believes that it would not have been possible for him to increase his family's income without the support and service he received from the UISC.

information and communication can also facilitate improved governance, human resource management, training delivery, and support infrastructure such as renewable energy systems.

The development impacts of community institutions can be hard to define and attribute, and even harder to quantify. They offer important benefits that are commonly undervalued for their role in human development and are often more important to local people than development activities (Bigg and Satterthwaite, 2005).

In Liberia, for instance, solar PV systems were installed in police offices in areas where grid connections were not available. This has increased police presence, improving the image and trust of the Liberian national police among local populations and the security in these rural areas (GIZ, 2012).

Energy supply options for public institutions

As with health centres and schools, electrical and thermal energy supplies are important for public institutions, and both centralized and decentralized technologies have an important role to play in ensuring universal access to energy. For rural areas, off-grid electrical systems are often the most appropriate option. Tables 1.4 and 1.7 outline the various supply options and analyse the capital and operating cost considerations.

A multi-tier framework similar to Figures 1.2 and 1.4 is being developed as part of the ongoing joint work between Practical Action and World Bank / ESMAP on the Defining and Measuring Access to Energy for Socio-Economic Development project.

Infrastructure services

Infrastructure services are one of the foundations on which economic and social life is built. A safe and healthy community typically enjoys clean water, sanitation facilities, proper drainage, roads, waste disposal, public transport, communications services, and street lighting. Access to energy is a key enabler of some infrastructure services. In particular it is crucial for water pumping and street lighting

Street lighting

Street lighting promotes safety, encourages school attendance, and enables economic activity

Street lighting helps promote safety and security, encourages attendance at school, enables economic activity, and brightens social occasions. Many people, particularly women, avoid going outside at night for fear of being robbed or attacked, and from the threat of dangerous animals such as poisonous snakes (DFID, 2011). Lighting can enable markets and food stalls to function more effectively after dark and boost evening activity. Street lights make it easier for health workers and police to respond to emergencies. Midwives, who often need to visit villages at short notice for a childbirth, may be able to reach the birthing mother more quickly and safely.

It is not known how many communities are without street lighting. However, the majority of the 1.3 billion people without electricity in their homes are unlikely to have electricity in the streets outside. The presence of street lighting is of course greater in urban areas than rural, although there are many cities and towns with little and unreliable street lighting, particularly in low-income or informal settlements.

Box 1.6 Lighting up the barrios, Bolivia

Barrios such as Villa Israel in Cochabamba, Bolivia, have street lighting but only in the main square or streets. Liane Maite, a Villa Israel resident, explains: 'There are more robberies in the dark. There is street lighting, but only in the main streets. Further in town, there isn't any lighting; it's all dark. You have no choice but to be careful. It's very dangerous here. The robbers have gotten used to taking advantage of the dark and robbing the businesses and the houses. It's common to be robbed or to be hit because of a cell phone. We file complaints, but nothing happens. We're forgotten. Not even schools have lighting.' (Los Tiempos, 2012)

The roads in many developing countries are notoriously dangerous for drivers, passengers and pedestrians alike. Potholes and patchy surfaces encourage drivers to swerve dramatically and drive on the verges. Poor enforcement of speed limits and other important regulations can serve to make road use even more risky. An unreliable power supply will cut street lights and can play havoc with road junctions controlled by traffic lights.

By 2020, an estimated 2.3 million people will die each year in road traffic accidents, 90 per cent of them in low- and middle-income countries. The risk of accidents is higher in the dark than in daylight; street lighting is a relatively low-cost intervention that can contribute to accident prevention (Beyer and Ker, 2009).

In areas where there is no street lighting, many people carry hand-held lights or avoid going outside at night. Others carry flame torches that are made using biomass such as coconut leaves or kerosene. These inefficient flame torches can be extremely dangerous and cause burns. They are also ineffective during windy and rainy weather conditions. Battery-powered torches are also common but these require regular battery purchase or charging and illuminate only a small area.

Tall poles and distribution lines can make street lighting expensive to install and the long hours of operation can make them expensive to run. A typical efficient outdoor bulb is 80 watts; to provide light for 12 hours at night would require nearly 1 kWh of electricity (GEF/UNEP, 2012).

In areas where grid electricity is not available, solar PV has proven to be an alternative solution for stand-alone street lights (DFID, 2011). It is important to consider issues around management, battery maintenance, and even theft of batteries. There is some evidence that community approaches, including local ownership and maintenance, have proved more sustainable (Frame et al., 2011).

Water pumping

More than 780 million people still lack access to improved sources of drinking water and 2.5 billion people lack improved sanitation facilities (UNICEF/WHO, 2012). This contributes to more than 3.4 million deaths each year from water, sanitation, and hygiene-related causes, nearly all (99 per cent) of which occur in the developing world (WHO, 2008).

Sub-Saharan Africa remains the worst affected region, with 40 per cent of people using unimproved water sources, compared with 13 per cent in South Asia, and 7 per cent in Latin America and the Caribbean. Urban areas are generally better served worldwide; 84 per cent of people without an improved water source live in rural areas. In cities, however, rapidly growing populations are outpacing the rate at which people gain access to improved supplies (WHO/UNICEF, 2010). In schools, lack of access to water for sanitation facilities has a large impact on girls' attendance; research shows that about one in 10 school-age African girls do not attend school during menstruation or drop out at puberty because of the lack of clean and private sanitation facilities in schools (UNICEF, 2005).

Water access is determined in great part by geography. In hilly regions, where surface or spring water is present, gravity-fed water systems are the cheapest and lowest maintenance option – in these cases access to water is not constrained by lack of energy. In areas where the only clean water is underground or very distant, a pump and associated energy supply is required, as well as pipes and taps. In some areas, water is not suitably clean for drinking and requires filtering or cleaning which is commonly done using electric-powered devices.

In areas where the only clean water is underground or very distant, a pump and associated energy supply is required

It is difficult to estimate the total number of people in the world that need a pump or other device to access water. It is certainly necessary for the 2 billion people who currently get their water from a borehole and dug well (UNICEF/WHO, 2012).

A range of pumping technologies exists; they can be powered by human effort, renewable energy resources, diesel or electricity. The amount of energy required depends on the volume of water to be pumped, the height through which it will be delivered, and the efficiency of the pump. A water supply system may provide for a large settlement or village, a smaller cluster of households or individual premises. The pump may represent only a small proportion of total installation costs, but ongoing costs for maintenance and fuel or electricity can be significant, especially with high local fuel costs.

Box 1.7 Health centre water supply, Nkombo Island, Rwanda

The health centre and school on Nkombo Island have recently been connected to the national electricity grid that has been extended from the mainland. The facilities previously used a diesel generator for their electricity needs, including a water pump. Mr Narcisse, the pump assistant, reports: 'Now we can assure the supply of water to the health centre and schools on a daily basis. The generator often used to break down and it would take weeks before we could get it repaired. Even if the electricity is cut, it is for less than 24 hours and the tanks can store enough to cover this.'

Diesel is very expensive on the island and the pump was often not operational for weeks at a time while the administration waited for funds. Staff, students, and patients' carers had to collect water from the well by hand, and carry it on their heads to where it was needed. With tap water now available, water-borne disease has decreased significantly, as has the time and labour used for water collection. The health centre can provide hygienic services and schoolchildren have freely available drinking water and better sanitation. The nearby households also benefit from the water system through shared taps.

Attracting and retaining professionals – the role of energy

Capable and motivated staff are at the heart of effective service delivery in the community. Health centres, schools, and public institutions in rural areas typically suffer from a dearth of qualified and experienced personnel. In Zambia, for example, there are seven times as many doctors, and two-and-a-half times as many nurses, per head of population in urban compared with rural areas (World Bank, 2010).

This can be partly explained by greater density of health facilities in urban areas, but employers also often have to provide financial and non-financial incentives to attract staff to rural areas.

Professionals are often unwilling to live and work in areas without modern housing, communications, and energy

The reasons that rural areas struggle to retain sufficient numbers of qualified staff are not well documented. Standard of living is a major consideration in any individual's choice of where to live and work. Frustration among rural workers often stems from the lack of infrastructure, support staff, and supplies. Issues such as lack of water, electricity, education facilities for children, and connectivity increase dissatisfaction (Rao et al., 2010). Professionals are often unwilling to live and work in areas without adequate infrastructure including decent housing, communications, and modern energy services.[11] Rural economies are also weak and dispersed, therefore private practice is often more attractive in urban markets where concentration of potential clients is an advantage.

Box 1.8 Challa Chico School, Bolivia

Challa Chico School in rural Bolivia is located in a small village without electricity. Ms Reque, a teacher at the school, says: 'I just want to say I have 12 years of work and that at this point in my life, I have to continue working in conditions of a few centuries ago. The quality of life is low when teachers work in schools without power. The situation of unease and discomfort is constant – only the joy of children encourages me.'

Poor access to energy in the workplace is also a major concern for many educated professionals as their daily tasks are constrained by a lack of proper equipment. Staff in facilities constrained by, among other things, poor energy access can often be demotivated and have higher levels of absenteeism (Ghuman and Lloyd, 2007).

Access to modern energy services is clearly not a silver bullet for the problem of attracting and retaining qualified staff in rural areas, but it is significant in that it enables other amenities that people rightly expect: lighting, safe water and sanitation, clean and fast cooking, reliable communications, and entertainment.

Box 1.9 Bweyeye Health Center, Rwanda

Bweyeye Health Center is in the remote Rusizi District of Rwanda. Driving to the nearest hospital takes four hours along a potholed dirt road. The centre serves 13,000 local people, but without electricity people need to be referred to the hospital for anything other than basic health-care needs. The centre has 10 nurses, but no doctor.

Mr Serge, who heads the centre, explains: 'We have facilities and some equipment that a doctor could use for surgery – sample testing and other services – but we could not get access to a doctor's services because no doctor will accept to live in the areas without electricity. They know they cannot do surgery without the right equipment and light at night.'

Summary: energy for community services

This chapter has set out the importance of improving energy access for community services.

The question of how to improve energy services in community institutions is a neglected aspect of the emerging energy access debate. The limited available data strongly suggests that energy access rates for community services are poor in many countries, and there is very limited evidence of progress, particularly in isolated communities.

People want and need improved energy services in their homes and places of work. Governments, donors and utilities focus mostly on domestic use and access for enterprise as it supports people's well-being and incomes. Yet some of the most important aspects of people's daily well-being are dependent on the reliable delivery of modern energy not to their homes or places of work, but to schools, clinics, institutions, and community infrastructure. We have seen in this chapter how energy for community services can support human development, especially in health and education.

There are a few good examples of where energy needs have been usefully reflected in regional energy targets, such as the Strategy on Scaling-up Access to Modern Energy Services, which was adopted in November 2006 by the East African Community Council of Ministers. Target 3 is 'to provide access to modern energy services for all schools, clinics, hospitals and community centres' (EAC, 2009). There are also good examples of individual projects. Energizing Development (2013) reports that since 2005 more than 35,000 social infrastructure institutions and small enterprises in 18 countries have been benefiting from access to modern energy services.

Increasing the technical capacity of governments in policy and planning, as well as at the community level, is needed to design, deliver and maintain energy services, while making good use of modern technologies (UNDP, 2011). The incentives and enabling conditions must also be right for governments, which play a critical role in planning and financing energy investments.

In order to meet the targets for Universal Energy Access by 2030, there are three main priorities:

- **Increased awareness** among governments, international organizations, and sector institution staff at the local level of the need to improve energy for community services, the technical options available, including the costs and benefits offered by energy efficiency, supply technologies, and end-use energy appliances.
- **National level targets and monitoring**, possibly linked to a regional or international framework that sets ambitious goals and tracks the level of energy services for community use. Data is very sparse, so more systematic and better-resourced monitoring is needed to improve the knowledge base.
- **Better targeted public investment** will help to deliver energy access for community services in remote and impoverished regions. Effective public–private partnerships are needed with the involvement of NGOs, government, and the private sector.

2

A framework for defining and measuring access to energy

In this chapter, we present and discuss the proposed SE4ALL framework for tracking progress towards universal access to energy that is being developed by the World Bank, Practical Action, and partners as part of the Defining and Measuring Access to Energy for Socio-Economic Development project. The outcome will be a proposed framework for defining and measuring access to energy that is accepted by the World Bank and partner agencies and initiatives including SE4ALL. The work builds on the *PPEO* indicators and is in coordination with a core group of agencies, including Energizing Development (EnDev), UNIDO, UNDP, World Health Organization, Global Alliance for Clean Cookstoves, and International Energy Agency.

As momentum gathers around the goal of Universal Energy Access by 2030, a common understanding of access to energy is now imperative.

Critical to determining how we tackle energy poverty is the way in which access to energy is defined. In the past, energy access has been described as household connection to grid electricity and the use of a modern fuel. This fails to recognize the use of energy for productive ends or community services, neglects the role of intermediate energy technologies, and does not consider how people use and ultimately benefit from energy.

How access to energy is defined is critical to determining how we tackle energy poverty

The proposed framework offers an improved conceptual understanding of energy access. It has the following strengths:

- It represents households, livelihoods and community services.
- It promotes measurement of modern energy services.
- It includes important intermediate energy technologies, and incremental improvements that deliver energy services.
- It includes electricity, cooking fuels and mechanical power are included.

Figure 2.1 illustrates the framework for defining and measuring access to energy. It includes households, enterprises and community services as users of energy, and identifies the relevant energy supply types for each user. The energy supply is depicted as a multi-tier index, as per the expanded frameworks shown and discussed around Figures 2.2 and 2.3. The energy services that are important for each user group are also included as a necessary component in defining and measuring energy access. The potential improvements to people's lives resulting from modern energy services are presented as development goals.

The framework shows the energy results chain, from energy supply to the energy services that are enabled, and the potential development impacts that people can realize from using energy services. It is clear that measuring energy services, in addition to energy supplies, brings us closer to the potential development benefits of energy.

Marieme Bamba showcases her solar workshop in Soudiane, Senegal. She has been trained by the Barefoot College in India, and now earns a living as a community solar engineer (Alicia Field, AliciaFieldPhotography.com)

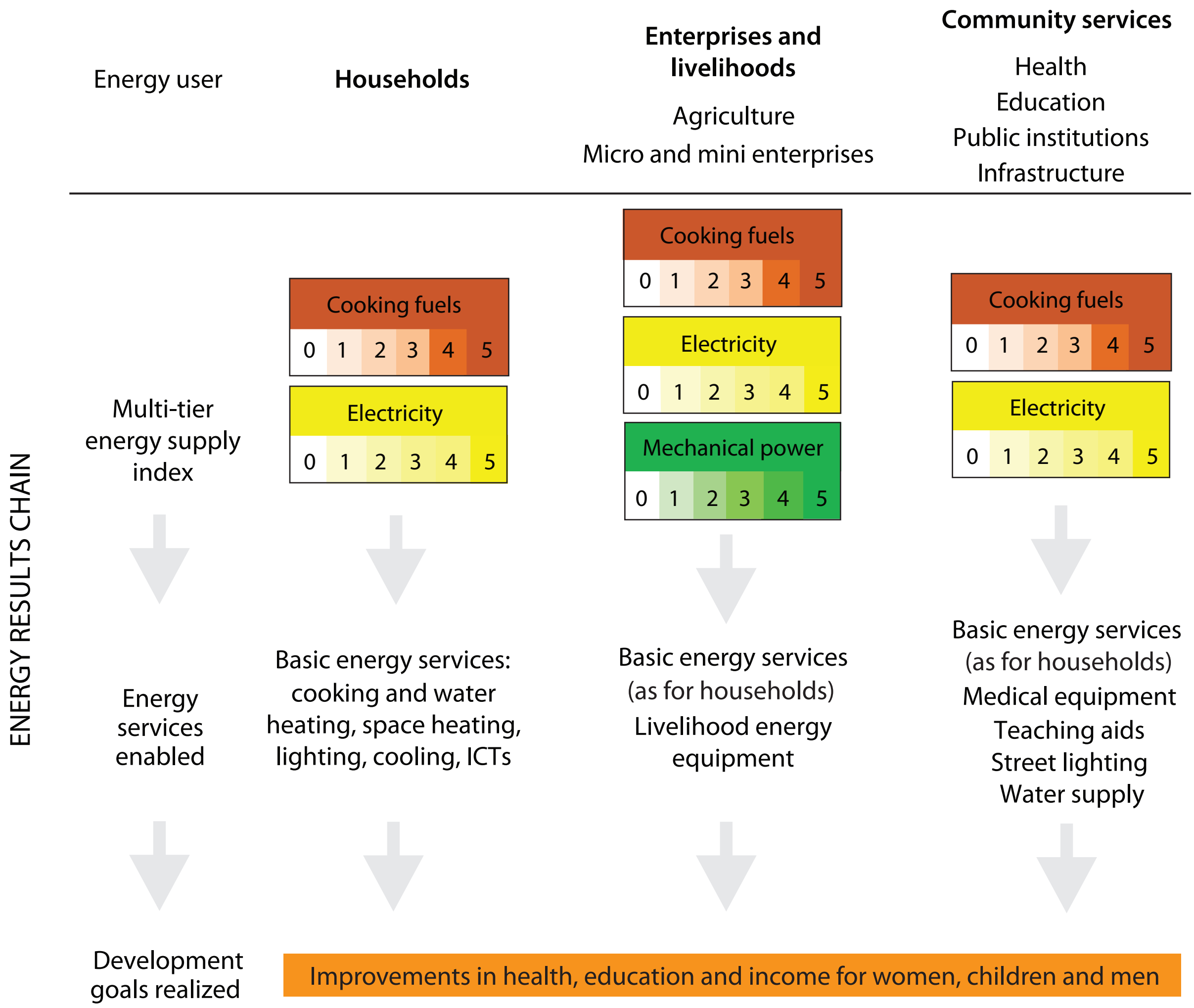


Figure 2.1 Framework for defining and measuring access to energy

Source: Practical Action and the World Bank / ESMAP, Defining and Measuring Access to Energy for Socio-Economic Development project

The multi-tier approach to measuring access to energy

Binary definitions of energy access – 'having access' or 'not having access' – fail to capture important differences in quality and quantity of energy supply technologies. Moreover, they do not recognize the energy supply ladder, whereby a user's improved energy access leads to more demand for greater quantity and quality of energy. Intermediate technologies are critical steps on the pathway to reliable, available, adequate, and high-quality supply.

The SE4ALL initiative is proposing use of multi-tier frameworks, as opposed to binary definitions, to track progress towards Universal Energy Access by 2030. This builds on the Energy Supply Index introduced in previous editions of *PPEO* and is grounded in the ways poor people actually experience energy access. Tiers are based on the attributes of people's energy supply, and the services they use based on that supply. Indicative frameworks for both household electricity and household cooking are proposed in the SE4ALL Global Tracking Framework report.

As of January 2013, the frameworks are being developed as part of the report consultation. Figures 2.2 and 2.3 illustrate Practical Action's representation of the frameworks adapted from the consultation documents. We have added information about the types of technology which currently deliver the energy attributes at various tiers, emphasising the important role that intermediate technologies can play even at some of the higher tiers.

The indicative household electricity framework (Figure 2.2) has six tiers: each defined by electricity supply attributes such as quantity, duration, evening availability, affordability, quality of supply, and legality of connection. A higher tier represents an electricity supply with better attributes and the possibility of access to more modern energy services, which can translate to improved well-being for users. The technologies likely to deliver these attributes range from kerosene/candles, through to intermediate electricity technologies such as solar lanterns that enable lighting, radio and mobile phone charging, to reliable grid supply that allows all electric applications.

To assess a household using the multi-tier framework will involve consideration of both the electricity supply attributes and the energy services. The methodology for assessing and analysing the level of access continues to be discussed and developed by partners working on the SE4ALL initiative. Additional questions in household surveys such as USAID's Demographic and Health Survey (DHS) and the World Bank Living Standards Measurement Surveys (LSMS) could support this assessment, as could the Total Energy Access questionnaire presented in *PPEO 2012*, which uses 14 questions to assess the energy services accessed in a household.

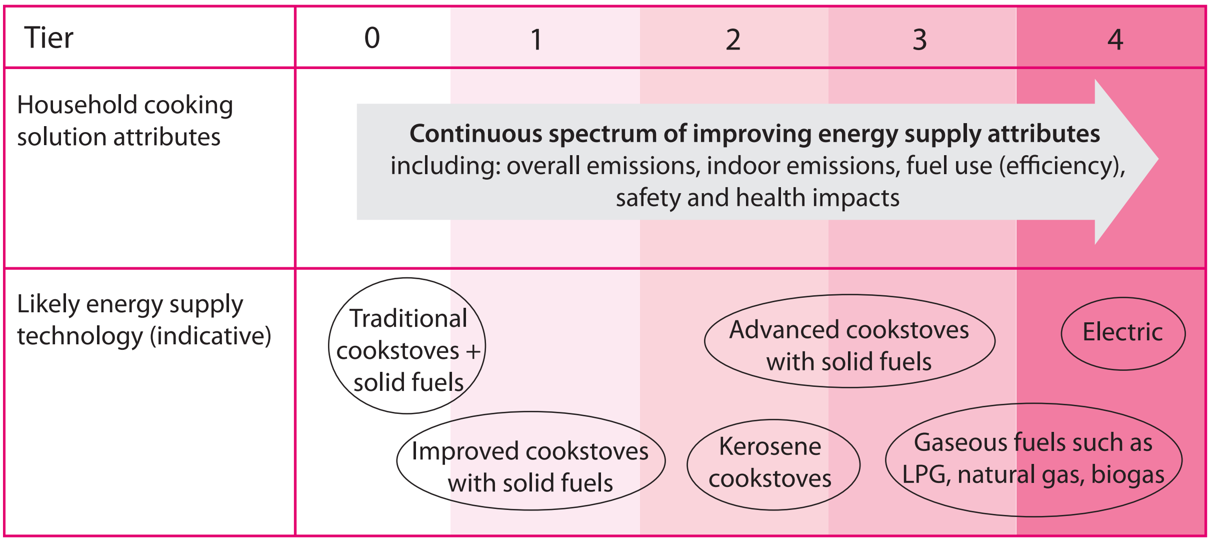
Regarding cooking, in reality the transition to modern technologies is multi-faceted, with multiple fuels and cookstoves often used simultaneously. This is due to cultural practices, convenience, affordability, and fuel availability constraints

Tier	0	1	2	3	4	5
Electricity services	None	Electric lighting, radio, mobile phone charging	Tier 1 + multi-bulb lighting, air circulation, TV	Tier 2 + water heater, rice cooker	Tier 3 + refrigerator, mechanical loads	Tier 4 + electric cooking, space heating and cooling
Energy supply attributes		**Continuous spectrum of improving energy supply attributes** including: quantity (watts), duration (hrs), evening supply (hrs), affordability, legality, quality (voltage)				
Likely energy supply technology (indicative)	None	Solar lanterns	Stand-alone home systems	Mini-grids with limited supply or poor grid connection	Unreliable grid with limited supply	Reliable grid with 24-hour supply

Figure 2.2 Indicative multi-tier framework for household electricity access

Source: adapted from SE4ALL, 2012

Step 1: Measure technical attributes



Step 2: Measure household use attributes

Convenience	Conformity	Adequacy
<12 hrs/week spent on fuel collection and preparation and <15 mins/meal spent on stove preparation	Chimney/hood/skirt are either being used or not required and regular cleaning and maintenance is done	Use of primary solution is not constrained by availability or affordability of fuel, or by the number of burners or secondary solution is in use but is not of a lower technical grade

Figure 2.3 Indicative multi-tier framework for household cooking solutions

Source: adapted from SE4ALL, 2012

Intermediate technologies can offer the best option for households constrained by affordability and availability

(SE4ALL, 2012). The household cooking solutions framework (see Figure 2.3) is being developed in coordination with the Global Alliance for Clean Cookstoves, the World Health Organization and the International Standards Organization. It proposes combining a measure of the technical attributes of the stove and how the stove is used in the home (whether it is combined with using other fuels and stoves), to rate a household's cooking solution on a five-tier index.

Assessing household cooking solutions is challenging due to the range of stoves and their highly context-specific performance. The SE4ALL tracking framework proposes a network of designated certification agencies and testing laboratories to be set up for country-level certification and labelling of cooking solutions according to the technical attributes. Further, household surveys need to be enhanced to capture information about the convenience, conformity and adequacy of the primary (and secondary) fuels, as well as to assess the current distribution of cooking solutions across various tiers (SE4ALL, 2012). The methodology for assessing stove performance and use, and analysing the measurements, continues to be discussed and developed by partners working on the SE4ALL initiative.

Street lighting in Yanacancha, Peru, is provided by a community-owned micro-hydro system (Practical Action / Matt Barket)

A target of universal access to modern fuels for cooking by 2030 is unachievable for most countries (Practical Action, 2012), therefore inclusion of improved cookstoves is welcomed. They are a significant improvement for many, in terms of reducing indoor air pollution and fuel use, and may offer the most appropriate option for many households that are constrained by affordability and availability.

The frameworks for electricity and cooking could be used to assess a single household, or applied to a country or region with the number or proportion of households identified in each tier. This would help in measuring the level of access. They could also be used as the basis for agreeing minimum standards at national and global levels.

In the medium term (next four or five years) the SE4ALL initiative proposes to measure progress on access at both global and national levels. It is suggested that opt-in countries adopt the multi-tier tracking framework. This will enable governments and other actors to assess the opportunities and challenges, and target their resources accordingly. National data collection initiatives need to be supported to ensure systematic and comprehensive monitoring. At the global level, continued data limitations in countries not opting in to SE4ALL will limit the use of the multi-tier framework, so tracking will happen using a simplified tier system.

The baseline for tracking progress on household electricity and cooking fuels since the inception of SE4ALL uses data from 2010. Given the limitations of the existing data the baseline uses a single-threshold (or binary) definition.

Measuring energy for productive use

Frameworks for defining and measuring energy access for households and community services are already relatively advanced. While some work has been done on measuring energy for productive use (*PPEO* and World Energy Outlook, for example), the third dimension of the SE4ALL framework requires much further work. A framework for measuring energy access for productive use is one important element of this that is needed; a suggested approach model is presented in Figure 2.4. There is a recognition that energy for earning a living is inherently difficult to define due to the vast array of enterprise activities across the formal and informal sectors, their wide range in size, and the multiplicity and mix of energy supply and service technologies. Yet it is central to people's livelihoods and is largely accessible in the form of mechanical power. Mechanical power technologies are typically high-energy devices that can be put to productive use. Common technologies include machinery for agricultural production and processing, manufacturing tools, and water pumps.

Tier	0	1	2	3	4	5
Likely energy supply technology resource	Human power	Human power; Animal power	Animal power	Renewable power; Engine	Renewable power; Engine; Electrical power	Electrical power
Possible energy technologies for key livelihood activities						
Water pumping	Bucket	Treadle pump	Hydraulic ram pump	Water-current turbine	Solar PV water pump, motorised pump	High power electric pump
Agro-processing	Hand pounding	Animal powered mill	Traditional water mill	Improved water mill	Diesel-powered mill	High power electric mill
Small-scale manufacturing	Hand tools	Treadle tools	N/A	Mechanical lathe	Engine-powered circular saw	Electric saw

Figure 2.4 Indicative multi-tier framework for mechanical power for productive use

Source: adapted from UNDP, 2009

Mechanical power is not an energy supply; rather it is a kinetic form of energy such as a rotating shaft from a turbine or engine. Mechanical power can be generated from a range of energy resources/supplies, including human, animal, renewable (commonly rivers and wind), engines, and electricity-using motors. This multiplicity of supply types, coupled with the wide range of activities it supports, makes mechanical power difficult to define and measure in a framework.

Electrical motors and diesel engines are the prominent modern mechanical power technologies. Some practitioners argue that mechanical power can therefore be subsumed into frameworks for electricity and liquid fuels. This neglects, however, important intermediate technologies such as micro hydro-driven carpentry tools, wind-powered water pumps, and human-powered treadle pumps. Furthermore, the historical neglect of mechanical power – and indeed energy for earning a living – demands that mechanical power is given due prominence in how we define and measure access to energy.

Very little information exists relating to energy for earning a living; there is little data on current energy for productive use or ways of measuring progress. Figure 2.4 therefore presents an indicative mechanical power scale showing how the range of energy resources / supply technologies and applications can be tiered, thereby providing a basis for measurement.

3

An analysis of commitments to Sustainable Energy for All

Chapter 2 outlines the way in which energy access will be measured in order to be meaningful to poor people. Keeping such definitions in mind, this chapter focuses on commitments made to SE4ALL, specifically, the energy access objective and the extent to which they respond to the energy needs of households, enterprises and communities.

National governments, multilaterals, private sector, and civil society actors have made formal commitments to SE4ALL. The majority of the commitments focus on the energy efficiency objective. The private sector is responsible for 61 per cent of the 138 commitments across all objectives (see Figure 3.1).

Figure 3.1 SE4ALL commitments by objective and sector

Source: data from SE4ALL, 2012

As of August 2012, 55 developing countries had opted in to the SE4ALL initiative. Figure 3.2 presents the number of countries and their populations across three regions that have opted in to SE4ALL compared to the total number of developing countries worldwide.

Efforts to build a movement under the SE4ALL initiative are to be commended. However, there remain a large number of countries in the developing world that have not signed up to the commitment to bring universal energy access to their people. There are 29 countries in Asia and the Pacific alone – with a combined population of close to 3 billion people – that have not opted in to SE4ALL. These notably include India, where 72 per cent of the population rely on traditional biomass use for cooking and 25 per cent are without access to any electricity.

This chapter analyses the 138 commitments published on the SE4ALL website. Commitments vary in nature across finance, policy, activities, and access to

SE4ALL commitments are commendable, but the scale appears inadequate

Nights are lit only by open fires in the village of Namoruputh, Turkana, northern Kenya (Practical Action / Jamie Oliver)

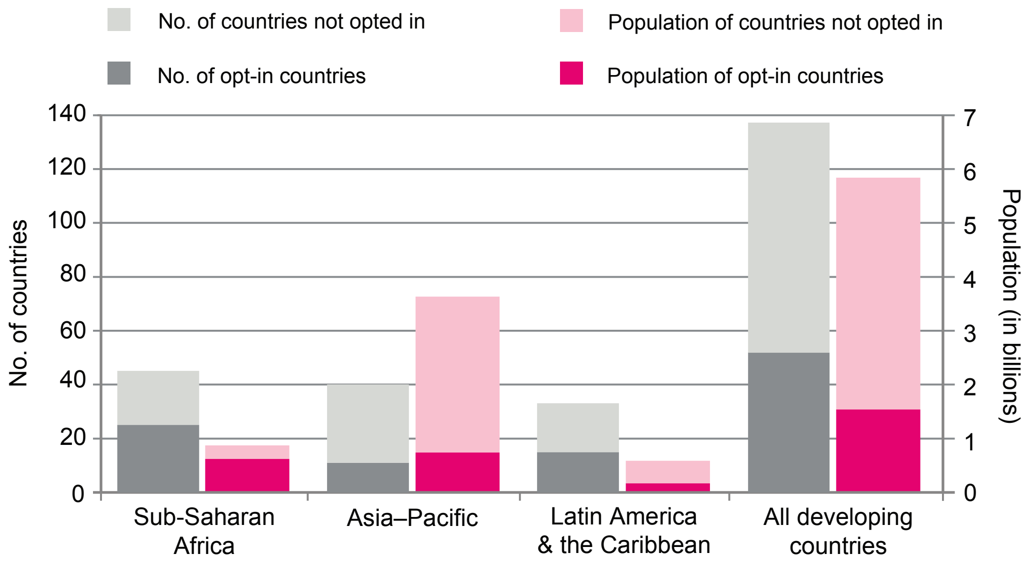


Figure 3.2 Number and population of SE4ALL opt-in countries by region compared to all developing countries

Note: Countries grouped into regions according to UNDP/WHO, 2009.
Source: Country data from SE4ALL, 2012. Population data from UN database.

products. They also vary significantly in scope and scale. Commitments range from the EC Energizing Development Initiative commitment to provide energy access for an additional 500 million people by 2030; to ADB's Energy for All Partnership to provide 100 million people access to modern energy by 2015; and Toyola Energy's commitment to sell at least 3 million energy-efficient cookstoves in Ghana. The analysis has been limited by the paucity of data.

SE4ALL places an emphasis on the private sector in achieving universal energy access; indeed almost half the commitments relating to the energy access objective are made by private sector actors.[12] The majority of these are companies setting goals on providing solar technology solutions such as stand-alone solar home systems, solar lanterns, and mobile chargers. For example, d.Light Design, a social lantern manufacturer, has committed to providing their products to 30 million people by 2015. Others, such as Accenture, are developing partnerships to engage with the UN, private sector, and civil society on energy access projects. All commitments are welcome but, with the exception of the Energy Transportation Group providing US$50 million for transition to LPG for cooking, private sector actors do not publicly state the funding or investment associated with their commitment.

Civil society's nine commitments (29 per cent of the total) comprise eight based in Europe and the USA, and only one based in a developing country – TERI in India. Civil society commitments include: TERI's aim to provide lighting for ten million households through solar and other clean technologies; ENERGIA committing to gender mainstreaming in energy programmes and policies; and Practical Action continuing to produce relevant analysis and engagement with key actors as a contribution to a movement for change on energy access.

Funding commitments specifically in support of the SE4ALL energy access objective total approximately $7.8 billion to be delivered by 2030. The majority of funding commitments have been made by governments and multilateral agencies, including the OPEC Fund for International Development (OFID) which

Box 3.1 Practitioner's perspective on private sector commitments to SE4ALL

'Eighty-four private companies have made commitments to the SE4ALL initiative's three objectives. The majority of these companies are large corporations, and most of these commitments concerned the internal operations of the companies involved.

'However, our ability to assess the substance and likely impacts of the commitments made by the private sector is seriously limited by their general lack of transparency. They tend to give no specifics on the amount or additionality of resources being committed. As an illustration, of the total stated monetary commitment by all players to SE4ALL, 99.9 per cent is from governments and development banks. Private sector commitments tend to avoid providing monetary figures, instead stating targets, on efficiency for instance, which will be difficult to monitor from the outside.

'A further problem in assessing the worth of private sector commitments is the difficulty in determining whether the commitments are additional for SE4ALL, or would have happened anyway under a business-as-usual scenario. Some commitments appear to describe companies' normal operations, while few companies include information about their commitments on their websites. Inadequate information prevents a valid assessment of additionality for over 60 per cent of private commitments, while 28 per cent were judged to be not additional on the basis of the information that is available.

While the commitments of the private sector to SE4ALL are laudable and potentially significant globally, the value of these commitments cannot be determined without more transparency on the part of those companies involved.'

Sam Barnard, Overseas Development Institute

announced $1 billion for the Energy for the Poor initiative; and Brazil's allocation of $4.3 billion to achieve domestic universal access.

In 2009, an estimated $9.1 billion was invested globally in energy access, yet achieving universal access to energy by 2030 will require an annual average investment of $48 billion per year,[13] five times 2009 levels, mainly invested in sub-Saharan Africa (IEA, 2012). Of course, many commitments such as the European Commission and ADB highlighted earlier are aligned with but operate outside of the SE4ALL initiative. However, there is still a significant funding shortfall for achieving Universal Energy Access by 2030.

The proposed SE4ALL tracking framework includes three user groups: households, enterprises, and community services. Figure 3.3 shows that nearly half of the commitments focus on households, only one commitment focuses on community

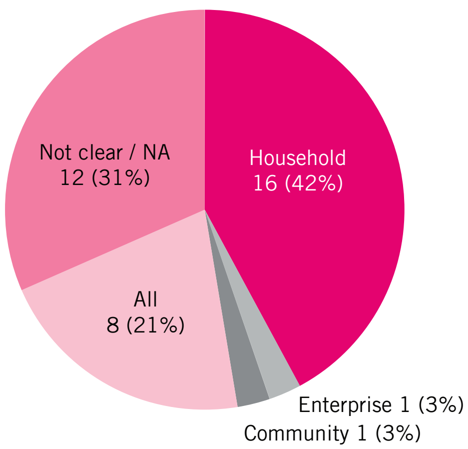


Figure 3.3 Commitments to the energy access objective by user group (n = 38)

Source: SE4ALL, 2012

services, one on enterprises, and some on all three (others are not linked to a specific energy supply). Given the scale of the challenge to ensure Universal Energy Access for health centres, schools and other community services – presented in Chapter 1 – the lack of attention on this important area seems a significant gap. Supporting livelihoods and enterprises in developing countries will also require increased focus.

Of the 16 commitments focusing on household energy, 10 relate to electricity, five are on cooking fuels, and one includes both (see Figure 3.4). Given that globally there are 2.7 billion people without access to modern fuels for cooking, and 1.3 billion people without access to electricity (Practical Action, 2012), more attention needs to be paid to cooking.

More attention needs to be paid to energy for community services

A few significant initiatives are contributing to household cooking through SE4ALL. For instance, the Global Alliance for Clean Cookstoves (GACC) has a target of 100 million people using clean cookstoves in Africa, Asia, and Latin America by 2020. The World LPG Association also commits to launch a Cooking for Life programme, with the aim of 50 million people in developing countries switching from biomass to LPG by 2018. This is a major and welcome boost, but to achieve Universal Energy Access by 2030, 150 million more people must get access to clean cooking facilities every single year.

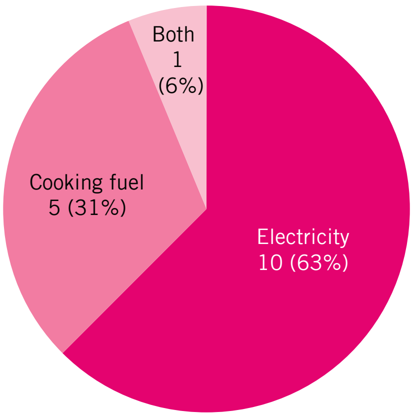


Figure 3.4 Commitments to household energy according to supply type (n = 16)
Source: SE4ALL, 2012

The commitments relating to electricity all focus on off-grid technologies, although it seems only on low-power technologies, such as solar home systems and solar lanterns, and not mini-grid systems. The majority of these commitments are from manufacturers of off-grid lighting options. The energy needs for earning a living and community services cannot be met with small-scale solar – higher-power supply and mini-grid technologies are essential.

Conclusions

- Progress is being made in agreeing a framework to define and measure access to energy in a way that reflects the needs of poor people. This will have to be translated into practice to ensure that scarce resources are better targeted in the years ahead.

- SE4ALL commitments are commendable – in their own right and for galvanizing global action. However, they suffer from two major challenges: a) their additionality compared to 'business as usual' is questioned, and b) the scale of commitments appears inadequate.
- SE4ALL commitments focus encouragingly on much-needed decentralized systems which, according to the IEA, will need to generate 55 per cent of all new electricity investment by 2030. The emphasis on low-power technologies, such as solar home systems and solar lanterns rather than mini-grid systems, will need to be addressed.
- Access to clean cooking facilities is vital, particularly for women and children, and is not adequately represented in commitments made to date. Evidence also suggests that energy for earning a living, currently under-represented, is important to generate incomes and thereby pay for energy services.
- Energy for community services, as outlined in Chapter 1, is a critical yet neglected area. Consequently, investment will need to be targeted towards supporting these services.

Encouragingly, SE4ALL commitments focus on much-needed decentralized systems

4

The Energy Access Ecosystem Index

A major shift in priorities is needed to improve on the 'business-as-usual' energy access scenario. The scale of investment needed will simply not happen without changes in the energy sector and beyond. Progress means a focus on energy not only for households, but for earning a living and for community services.

Improving access to energy in developing countries is much more complex than supplying new or different products and services. It is vital to analyse each national context and engage with all actors: energy users, policymakers, businesses, investors, international organizations, and civil society organizations. Universal access will not be achieved unless many of the integrated, and often conflicting, issues – inside and outside the sector – are addressed.

PPEO 2012 first introduced the concept of the Energy Access Ecosystem and a way to measure its 'health' as a way of understanding the wider country context that can support or hinder energy access. The concept has roots in the idea of a business ecosystem[14] (see Box 4.1), but reaches beyond the business context to consider important aspects of enabling policy, capacity and finance. Its aim is to analyse the policy, capacity and finance dimensions at national level, in order to identify pathways for action. For this year's report we have revised the index, reducing the number of indicators from 17 to 9 (see Figure 4.1).

The Energy Access Ecosystem approach analyses the country context to identify pathways for action

Box 4.1 Defining the Energy Access Ecosystem

The application of the term 'business ecosystem' was adapted from management theory. At its heart is a natural ecosystem analogy, recognizing co-evolution and collaboration, as well as competition, as means to achieve healthy ecosystems providing products and services. It also highlights the importance of governance systems, with flow of money supporting the creation and regeneration of the system, and the skills of those creating and maintaining that system.

The Energy Access Ecosystem recognizes multiple interrelated systems in an energy sector, which collectively deliver energy supplies and appliances using a mix of energy sources and a range of technologies. Policy, capacity, and finance are critical dimensions driving change in an energy access ecosystem. A healthy ecosystem is one that maintains the sustainability of its vigour, organization and resilience. In this context, vigour is a measure of the system's activity or production; organization is a measure of the number and diversity of interactions between the components of the system; and resilience is the system's ability to maintain its structure and function in the presence of stress (Mageau et al., 1995).

For creating energy access, a healthy access ecosystem must be one in which expanding access to more and poorer people is an evolutionary outcome valued within the system, and in which policy and associated incentive structures play a crucial role (Practical Action, 2012; also see http://practicalaction.org/energy-access-ecosystems).

Using an ecosystems analysis, the growing global charcoal crisis highlights pressing policy, finance, and capacity issues. In many cases, powerful and politically connected entrepreneurs dominate the charcoal trade. Efforts to reform the sector are actively resisted and the bulk of charcoal profits are confined to a small group of actors along the supply chain. This results in inefficiencies, land degradation, and manipulation of markets (see NL Agency, 2010; World Bank, 2009).

Rickshaws travel through the streets of Dhaka at night, lit by streetlights. Lighting during the evening allows for safer travel – especially for women – extended work hours, and fewer accidents (Practical Action / Anisuzzaman Ujjal)

Figure 4.1 The Energy Access Ecosystem Index

Policy
1 Energy access prioritized in national policy National policy should include clear targets for achieving energy access in terms of electricity and modern cooking fuels/devices, and have clear targets for households, schools, hospitals and enterprises. 0 Little reference to EA in the PRSP or other flagship national policy 1 National policy has references to EA but no clear targets 2 National policy has specific energy targets including electricity, household cooking, health centres/school and enterprises 3 As above, with good evidence of secondary legislation to deliver targets
2 Effective rural energy agency or equivalent An effective rural energy agency or equivalent can help to plan and deliver decentralized energy services 0 Lack of clarity on which institution (or no institution) is leading on EA to rural areas 1 Rural energy agency or equivalent has been mandated, but is under-resourced or shows limited progress on improved access 2 Rural energy agency or equivalent has been mandated, has appropriate resources and shows progress on improved access. 3 As above and on track towards national EA targets
3 Transparent and accountable multi-stakeholder processes utilized in current energy policy formulation Transparent and accountable multi-stakeholders processes are more effective, engaging investors, project developers, donors, consumers and NGOs. 0 No formal procedure for transparent and accountable processes 1 Formal procedures for transparent and accountable processes in place, but not used by all stakeholders 2 Transparent and accountable processes used by all stakeholders, with transparent information systems and accountable relationships, with internal recognition 3 Widespread external recognition of transparent and accountable processes used by all stakeholders, with transparent information systems and accountable relationships.
Finance
4 National government budget and targeting of EA Governments play a major role in planning and delivering energy access, not only through enabling policies, but also by allocating and disbursing necessary funds for improving energy access. 0 No specific EA budget 1 Sector investment plan exists but the necessary funds are not being disbursed 2 Sector investment plan exists and necessary funds for EA are being disbursed 3 Sector investment plan exists with evidence of good progress on EA
5 Private sector investment in EA infrastructure Growing private sector investment in energy access infrastructure is a sign of a healthy and improving energy sector; although it is problematic to calculate, it is possible to track trends. 0 Private sector investment in EA infrastructure is static 1 Private sector investment in EA infrastructure is increasing but not sufficient to deliver access targets 2 Private sector investment in EA infrastructure is increasing at a rate that will help deliver access targets 3 Private sector investment in EA infrastructure is delivering access targets
6 MFIs engaged in EA markets A vibrant range of competing microfinance institutions (MFIs) can be an enabler for micro entrepreneurs, communities, and households to invest in energy access technologies. 0 Minimal proportion of active MFIs engaging in EA markets 1 Small and static proportion of active MFIs engaging in EA markets 2 A growing proportion of active MFIs engaging in EA markets 3 A high proportion of active MFIs engaging in EA markets

Capacity
7 Number and growth in ecosystem members A measurable indication of a healthy ecosystem is the growing number of its members, reflecting a more diversified sector that can respond to consumer demand. 0 A limited and static number of ecosystem members (firms, NGOs, etc.) from a limited range of sectors 1 A wide but static number of ecosystem members from a range of sectors 2 A growing number of ecosystem members from different sectors 3 A wide number of ecosystem members from different sectors are well established
8 Availability of decentralized EA products/models: improved cookstoves, electrical charging and lighting products, other products Wide availability of energy access products is a good indicator of market development, including users' demand for energy access equipment. 0 EA products not easily available for households and enterprises 1 EA products available in capital city, but limited range of products/brands for a limited number of applications 2 A wide range of EA products and brands available in the capital city 3 A wide range of EA products and brands available in most markets in the country
9 Availability of data on energy access and energy resources within the country for **a) households (electricity and cooking)** **b) enterprises (electricity, cooking and mechanical power)** **c) schools, health centres, etc.** Reliable data gathering systems are essential in order to design and monitor energy access programmes. 0 Data on energy access is not available for all EA levels and not regularly updated 1 Data on energy access is available, but not consistently, for energy resources for households, enterprises and community services, and is not regularly updated 2 Data on energy access and energy resources for households, enterprises and community services available from different sources (internet, national surveys, reports, etc.) but not systematized or regularly updated 3 Systematized procedures for continuous EA data collection and data-sharing platforms are in place

The Energy Access Ecosystem Index assesses the respective national capability for making progress towards Universal Energy Access. It does not reflect the current energy access status of a country. Instead it highlights barriers and opportunities on the pathway to Total Energy Access. Therefore, two countries with similar current energy access status might have very different Energy Access Ecosystem ratings.

In the following section, the report applies the index by analysing data from three countries.

The Energy Access Ecosystem in practice

Table 4.1 provides data on energy access and human development in Bangladesh, Bolivia and Rwanda. These figures are useful to contextualize the Energy Access Ecosystem Index results as presented below.

Bolivia is by far the most advanced in terms of energy access and human development, followed by Bangladesh and then Rwanda.

The country research has been carried out through a mix of desk-based research, consultations and interviews in the three countries. Detailed guidance was provided to country researchers to allow comparable and measurable findings across the three countries. Scores between 0 and 3 have been determined, with 0 indicating very poor conditions and 3 meaning strong evidence of enabling conditions to

Table 4.1 Country statistics on energy and human development

	Electricity access (%)				*Fuel access (%)*	*IEA Energy Development Index EDI*[1]	*Human Development Index (HDI) rank*[2]
	Households	*Schools*	*Health centres*	*Productive use*	*Modern fuel (population)*		
Bangladesh	46	No data	77	No data	9	0.230	0.500 (146)
Bolivia	78	No data	No data	No data	77	–0.43	0.663 (108)
Rwanda	5	36	82	No data	<1	0.06	0.429 (166)

1 The EDI results (0 to 1) represent a fraction of the *maximum developing country value* across four energy access and consumption indicators

2 Country ranking out of 187 countries, UNDP website

Source: Saha, 2002; MOH [Uganda] and Macro International, 2008; UNESCO, 2011; IEA, 2012; UNDP/WHO, 2009; UNDP, 2011

achieve energy access. A mixed team of local and international practitioners was involved in compiling the index based on primary country reporting.

Policy

Policy indicators examine policies that will directly support the delivery of energy access. This includes the highest level of policy, the allocation of responsibility for delivery of government objectives, and the transparency of policy processes. A wide variety of enabling factors such as corruption and ease of doing business are considered as contextual issues, but are not included as indicators.

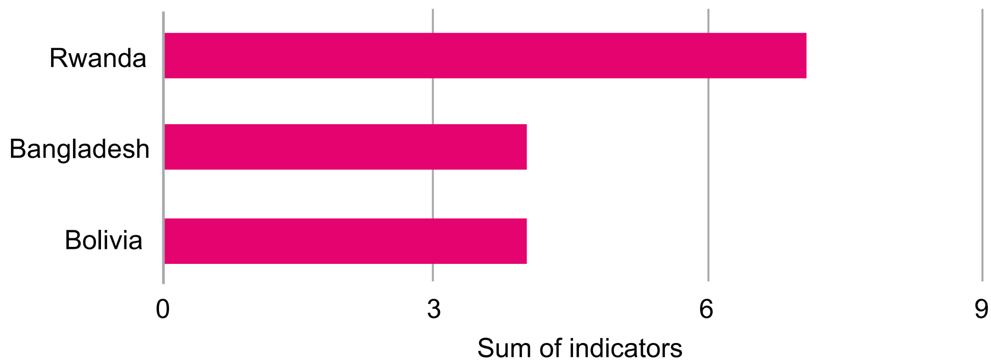


Figure 4.2 Energy Access Ecosystem policy ratings

Note: Each rating is the sum of three indicators.
Indicator 1 – energy access prioritized in national policy
Indicator 2 – existence of an effective rural energy agency or equivalent
Indicator 3 – transparent and accountable multi-stakeholder processes utilized in energy policy formulation

In Rwanda energy access is extremely low: 5 per cent of the population have access to electricity; less than 1 per cent use modern fuels (UNDP/WHO, 2009). Yet there is good evidence of leadership and real policy focus in supporting efforts to reduce energy poverty. Energy access is prioritized in the Poverty Reduction Strategy Paper, with a targeted budget. The country does well on all policy indicators. Bangladesh also has specific policies targeting energy access, for both cooking and electricity;

however, a lack of shared transparent procedures among stakeholders has been highlighted by the research. In Bolivia there are household electrification plans, but 30 per cent of the rural population have no access to modern fuels and there are no clear targets for cooking fuels or for improving other energy access levels.

Finance

Finance indicators track recent progress on private and public investments in energy access against government plans. The existence and progress of a sector investment plan on energy access is a good indicator, but among the three countries finance disbursed to the energy sector is not always targeting all important sub-sectors of energy access. In Bangladesh 4.8 per cent of GDP is allocated for electricity generation. This is a relatively large figure, however, it is largely spent on high cost grid connection rather than equally needed mini- and off-grid systems.

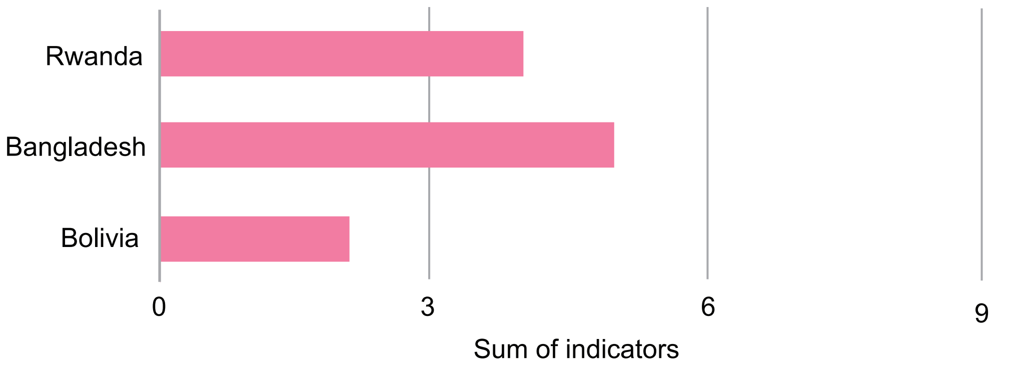


Figure 4.3 Energy Access Ecosystem finance ratings

Note: Each rating is the sum of three indicators.
Indicator 4 – volume of national government budget targeting EA and % of total government budget
Indicator 5 – volume of private-sector investment in energy infrastructure per capita
Indicator 6 – number of MFIs engaged in EA markets, of total active MFIs

Increasing private investment in energy infrastructure is essential since public funds are very rarely sufficient to meet energy access goals. The effects of regulations and incentives are only evident after some time has passed. This is probably the case for Rwanda, where excellent government policy efforts have yet to result in increased private sector investment. Bangladesh has seen substantial growth of companies investing, for example, in manufacturing of solar panels. This is attributed to different factors, including the Bangladesh Bank creating a US$25 million refinancing facility for the commercial banks and financial institutions to lend to renewable energy projects at a concessional rate. In Bolivia the responsible municipalities are able to cater for regular budgets, but they have great deficiencies in channelling their increased financial resources into energy related investments. Their human and institutional capacity to improve access to modern energy for households and community-run social infrastructure institutions is very low (Energypedia, n.d.). Furthermore, microfinance organizations are a central part of the ecosystem and their engagement in the energy access market is often vital in enabling the poorest people to access energy. Currently, only in Bangladesh is this sector developed enough to genuinely have impact.

Capacity

A thriving energy access ecosystem is important for innovation and service delivery

In the context of delivering increased access to energy in developing countries, particularly in rural and challenging environments, a thriving energy access ecosystem is important for both innovation and service delivery. More active stakeholders, such as NGOs, private sector entities, universities, and government agencies, are needed in most countries in order to meet the energy access challenge, as well as greater diversity of products and more energy sector data.

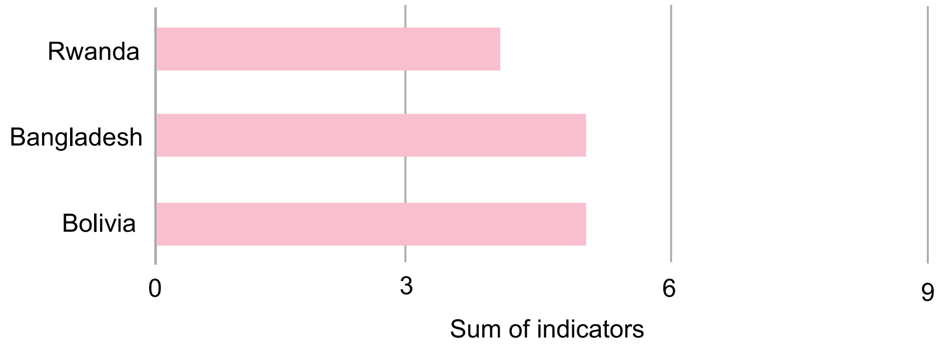


Figure 4.4 Energy Access Ecosystem capacity ratings

Note: Each rating is the sum of three indicators.
Indicator 7 – number and growth in ecosystem members (firms, NGOs etc.)
Indicator 8 – availability of decentralized EA products/models
Indicator 9 – availability of data on energy access and energy resources within the country

All three countries show an increasing number of ecosystem members. Product availability, such as stoves, solar lamps or diesel engines, suggests stronger markets and accessibility of energy access products. It also provides an insight on users' demand for products. All three countries report scarce availability of data on energy access, which is a barrier to businesses investing in the sector and also to government or civil society engagement.

Energy Access Ecosystem Index ratings

There are a few different issues that arise from the analysis of the energy access ecosystems in Bangladesh, Bolivia and Rwanda.

Policy is very strong in Rwanda, with policy frameworks and commitments in place. For instance Rwanda's 'Vision 2020' foresees that 35 per cent of the population will have access to electricity in 2020 (up from 2 per cent in 2000), and wood consumption will decrease to 50 per cent of national energy consumption (down from 94 per cent in 2000). The electricity access roll out programme includes strong grid and off-grid components for households and community services. The critical factor is to now translate this into finance and capacity to support a step change in energy access rates.

Despite similar policy and capacity scoring, Bangladesh emerges stronger than Bolivia on financing. Country energy access rates in Bangladesh are low but there is very strong political commitment, policy is in place, and higher levels of investment are starting to show as a result of policy change. The solar sector is one highlight, with new private investment and a diversity of technologies including for access.

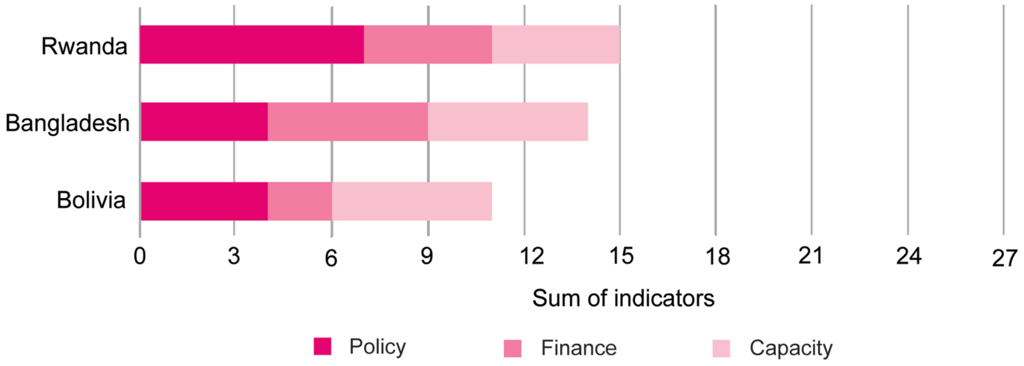


Figure 4.5 Energy Access Ecosystem Index ratings for Bangladesh, Bolivia and Rwanda

Compared to the other two countries, Bolivia is well ahead on energy access rates. However, more needs to be done to increase momentum on policy, capacity, and particularly finance, in order to further advance towards universal access.

Key lessons from using the ecosystems approach in these three countries include:

- The Energy Access Ecosystem Index could be implemented as part of an annual review process to track progress at national level.
- The findings would enable civil society to engage in relevant policy fora and processes in order to hold governments to account, especially with regards to development of national financing and action plans.
- In order to realize the full potential of the ecosystems approach it is recommended to engage in a multi-stakeholder consultation process, bringing together all relevant actors operating in the national energy sector. The analysis provides a critical stepping stone for dialogue and participation of actors otherwise excluded from the policy- and decision-making processes.

5

Framework for action

The current profile of energy access is unprecedented. Under the auspices of the SE4ALL initiative, national governments, multi-laterals, private sector, and civil society actors have pledged to prioritize Universal Energy Access by 2030.

However, commitments to improve energy access do not automatically translate into delivery for poor communities in ways which make the most meaningful difference to their lives. Clearly there is significant opportunity for new actors, new finance and new commitment to see a step-change on access to energy. But there is also a risk that large-scale infrastructure investment will continue to dominate, boosting power supplies to cities and industry, and ensuring that universal energy access is as distant a prospect as it was decades ago.

Commitments to improve energy access do not automatically translate into delivery for poor communities

For SE4ALL to truly succeed there is a need to establish and follow a new energy narrative: one which recognizes the full range of services that poor people want, need, and have a right to, and encourages the development of healthier energy ecosystems that value all technologies, finance and actors required to achieve Universal Energy Access by 2030.

PPEO, based on experience across Latin America, Southern Asia and sub-Saharan Africa, makes the following recommendations to help ensure that the potential of SE4ALL, to provide people with the power to challenge their poverty, is realized.

Promote a service-based rather than supply-based approach to energy definition and delivery

A definition of access which is based on household connections to the grid will not end energy poverty. Achieving Universal Energy Access by 2030 will require that we recognize the full range of people's energy needs, not just at household but also enterprise and community services levels. We welcome the standardized multiple-tier definition and tracking approach proposed in the SE4ALL Global Tracking Report, and encourage public and private investment to reflect this by better targeting interventions at people's multiple energy needs, within and beyond the household context. Specifically, we urge all SE4ALL 'opt-in' countries to adopt the multi-tier framework and to ensure that this guides both the delivery and the monitoring and evaluation of their interventions in the coming years.

Increase financing for decentralized solutions

World Energy Outlook modelling (IEA, 2011) indicates that to reach Universal Energy Access by 2030, 55 per cent of additional electricity generated will need to be in mini- and off-grid solutions. Also, improved cookstoves and sustainable fuel supply chains have a significant role to play for people without clean cooking solutions. National plans and the portfolios of donors, multi-laterals and private sector players should acknowledge the necessity of decentralized schemes. This ought to be done through the creation and expansion of new and existing finance windows, specifically for mini-grids, off-grid systems, improved cookstoves, and fuel supply chains.

A community works to build a micro-hydro system in Zimbabwe, using the power of the river to generate electricity for their local services (Practical Action)

Encourage an ecosystems understanding of the energy landscape

As of August 2012, 55 developing countries had opted into the SE4ALL initiative and, in doing so, will be developing gaps analyses and national action plans to scope out the ways in which they can work towards their 2030 targets. Successful delivery of these national plans will depend on assessing and addressing the deficit in policy, finance and capacity. A multi-stakeholder approach to applying the Energy Access Ecosystem Index would enable better measurement and integration of the full range of people, organizations, policies, technologies and types of financing that will be necessary to achieve universal access.

Create the space and support civil society

Civil society engagement could make the difference in delivering SE4ALL

Internationally, SE4ALL now rightly recognizes civil society as the 'third pillar' of the initiative, alongside business and government. Civil society provides an accountability mechanism and a link to the voices and needs of poor people. Furthermore, civil society contributes evidence of innovative approaches, models and technologies that work in terms of impact, cost and performance. Given the expertise of civil society, real engagement, in both North and South, could make the difference between SE4ALL genuinely delivering for poor people, or not. Therefore a clear and considered programme of engagement with civil society at national and international levels is fundamental. This needs to be supported by finances to operationalize these plans in both the short and long term.

Beyond the International Year of Sustainable Energy for All

The next 12 months are critical in advancing progress towards Universal Energy Access. To maintain the momentum and ensure the integrity of the initiative it is vital that these commitments convert into concrete action. For all countries that have joined the SE4ALL initiative, support is now required to plan, implement and demonstrate that Universal Energy Access is achievable. Clearly, countries are at different stages but to reach the SE4ALL objectives by 2030, all countries opting in must be supported to design and deliver their national plans.

The next 18 months will also see progress on defining and refining the post-2015 agenda. It is likely that the current profile of energy access will secure it a space in the development debate, but it is the definition upon which a global goal is based that will dictate the difference it makes to the billions of people living in energy poverty.

As money often flows to what is measured, it is crucial that we continue to champion poor people's perspectives and their full range of energy needs, challenging donors and decision-makers to mainstream them in plans, goals and funding portfolios of the post-2015 landscape.

Notes

1 Extrapolated statistic from data collected in seven countries in sub-Saharan Africa (Kenya, Namibia, Rwanda, Ghana, Tanzania, Uganda and Nigeria – with a combined population representing 37% of the total in the region) and from two countries in South Asia (India and Bangladesh – a combined population representing 84% of the total in the region). See NCAPD et al. (2011), MOHSS (2010), Saha (2002), NBS and Macro International (2007), MOH and Macro International (2008), NIS et al. (2008).

2 Extrapolated statistic from data collected in 31 countries in sub-Saharan Africa, two countries in South Asia and five countries in Latin America (data taken from UNESCO, 2007, 2008, 2011). The 38 countries have a combined primary age population representing 43 per cent of the developing world total.

3 *PPEO 2013*, like the previous editions in 2010 and 2012, is concerned with energy access for poor people, although there are extremely important links with the other two SE4ALL targets.

4 Bolivia's HDI ranking from 2011 is 108 (UNDP HDR, 2011).

5 Other agencies involved include Energizing Development, UNIDO, UNDP, World Health Organization, Global Alliance for Clean Cookstoves, and International Energy Agency.

6 Extrapolated statistic from NCAPD et al. (2011), MOHSS (2010), Saha (2002), NBS and Macro International (2007), MOH and Macro International (2008), Amanyeiwe et al. (2008) collected in seven countries in sub-Saharan Africa (Kenya, Namibia, Rwanda, Ghana, Tanzania, Uganda and Nigeria – with a combined population representing 37% of the total in the region) and from two countries in South Asia (India and Bangladesh – a combined population representing 84% of the total in the region)

7 The project is called Defining and Measuring Access to Energy for Socio-Economic Development and is produced by Practical Action in coordination with a core group of agencies, listed in footnote 5.

8 Extrapolated statistic from data collected in 31 countries in sub-Saharan Africa, two countries in South Asia and five countries in Latin America (data taken from UNESCO, 2007, 2008, 2011). The 38 countries have a combined primary age population representing 43 per cent of the developing world total.

9 It is recommended that all rooms used by children have a temperature of 19°C (WHO, 2007b).

10 Based on the extrapolation of data from these regions (taken from UNESCO, 2007, 2008, 2011), the figures for East Asia and the Pacific / Central Asia are 91 million and 11 million respectively.

11 For health care see cohort studies in 2011 by the Consortium for Research on Equitable Health Systems (CREHS) <www.crehs.lshtm.ac.uk/publications.html>. For education, see Mulkeen (2005).

12 For evidence and commentary in relation to SE4ALL and the private sector's role in energy access, see Bellanca (2012).

13 This figure is large, but is only around 3% of the global energy-related infrastructure investment required by 2030 (IEA, 2012).

14 Productivity, robustness, and niche creation are critical success factors in the Business Ecosystems approach (Peltoniemi and Vuori, 2004).

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