Energy Access Practitioner Network

Towards Achieving Universal Energy Access by 2030

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SUSTAINABLE ENERGY FOR ALL

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Foreword

Energy is central to development and wealth creation. Access to modern energy services is critical to achieving the Millennium Development Goals — whether in health care, education or poverty reduction, or for enhancing agriculture and clean water systems.

That is why achieving universal access to modern energy services has been adopted as one of the three objectives of the United Nations Secretary-General's Sustainable Energy for All Initiative - the other two being a doubling of the global rate of improvement of energy efficiency and a doubling of renewable energy in the global energy mix by 2030.

Profound changes are beginning to transform the way we supply, transform, deliver, and use energy services – a trend that a revitalized global energy dialogue can reinforce. But in this process we should not neglect the needs of the 1.3 billion people in the world who still lack any access to electricity and the almost three billion lacking access to improved cooking solutions. This is a significant challenge.

This is where the work of the Energy Access Practitioner Network can play a valuable role. The Network can help ensure the delivery of sustainable energy services to communities and households that utilize innovative financing solutions and delivery mechanisms, and unique knowledge of local leverage points.

Often operating under the most demanding conditions, these businesses deliver energy services to those who need them the most. In doing so they are helping to provide the development benefits they need through the creation of new markets, businesses, and jobs; delivering needed health services and saving lives; building community cohesion; and supporting women and enhancing economic development.

They need our strong support to achieve universal access by 2030 and sustainable development for all.

Kandeh Yumkella, Director-General, UN Industrial Development Organization; Chair, UN-Energy; Co-Chair, The United Nations Secretary-General's High-Level Group on Sustainable Energy for All

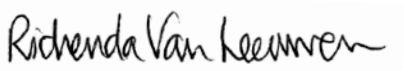
Statement by Energy Access Practitioner Network Coordinator

For many years, the prevailing myth in the energy sector was that there were no cost effective ways to extend energy infrastructure to very poor communities, and that renewable energy solutions were too expensive for the poor. Many of the organizations represented here, both pioneers and newcomers to the sector, have proved and continue to show that energy services – when combined with the right types of investment capital, applicable technology, strong management teams, and tailored consumer financing – can indeed provide electricity and the economic and social benefits that this brings in terms of lights for children and adult education, better health outcomes through electrification of medical clinics, increased agricultural production, and market development.

It is estimated by the World Bank's Lighting Africa Program that annual global expenditures for kerosene-based lighting amounts to $37 billion. The people depending on these rudimentary forms of lighting are often already paying the most as a proportion of their household income for inadequate, dangerous, and unhealthy energy sources that kill many women and children prematurely. To those who object to a market-based orientation in the delivery of energy services, it is clear that a market already exists. Further, solutions are available to help provide improved energy services to even the poorest households, both affordably and sustainably, when structured to align with family cash flows and when supported by policies at both national and local levels.

The practitioners included here recognize the need to build sustainable supply chains and to put the customer at the center. Thus, the focus should not be solely on the installation of the solution set, but ensuring that the parts and maintenance required over the full life of the system are available in the local setting. This entails an emphasis on quality – of components, of products, of installation, of user education, and of support following the installation. It also requires listening to customers and designing and delivering the solutions they desire, keeping in mind that the majority of these customers are women. And at the broader level, it means developing and implementing policies that are well tailored to support economic development in poor communities.

By focusing on the input of the practitioners in the network, and the communities with which they work, this set of recommendations is not intended to serve as a strongly analytical, highly academic or exhaustive list of contributions to achieving energy access, since those have been well covered in other publications. Instead, it draws on the combined practical experience of the people working on the front lines of delivering energy services in some 125 countries around the world. It highlights their challenges and opportunities, the needs they are confronting daily, and a range of policy, financing and technical recommendations that they have identified as the roadmap for scaling towards universal energy access. In this way, it will help the communities and customers they serve to embrace the development benefits in health, income generation, agriculture, education, gender equity and the environment that access to energy can provide, supporting sustainable development for communities around the world.



Richenda Van Leeuwen, Energy Access Practitioner Network Coordinator and Executive Director, Energy and Climate, Energy Access Initiative, United Nations Foundation

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Additionally, thanks are due to the United Nations Foundation team who coordinate the work of the Practitioner Network, including Richenda Van Leeuwen, who established and directs the network, and Yasemin Erboy, Ryan Hobert, Aneri Patel, and Tripta Singh, who coordinate working group activities. We also want to acknowledge the efforts of Corinne Hart, Innocent Onah, Himani Phadke, and Amy Sticklor, who helped make this report possible.

Special thanks go to Judy Siegel, who drafted this report based on the input of the working groups, practitioner meetings and other consultations which have taken place over the last 18 months. Thanks also to the editors, Reid Detchon, Yasemin Erboy, Ryan Hobert, Richenda Van Leeuwen, and from the UN Secretary-General's High-Level Group on Sustainable Energy for All, Christine Eibs Singer.

Last, thanks to you, the reader, for your careful reading and consideration of the vision and needs of the practitioners outlined here. We hope that you will draw valuable insights from these recommendations set about the challenges still existing and the innovations and opportunities the practitioners are embracing. Their role is vital in catalyzing the sector further to address the issue of energy poverty for our countries and communities through the contribution they make in delivering mini- and micro-grid and off-grid solutions, and to support the achievement of universal access to modern energy services by 2030 and the broader development benefits it brings.

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List of Abbreviations

ANSI	American National Standards Institute
ARE	Alliance for Rural Electrification
BoP	Base of the Pyramid
BOS	Balance of Systems
CO_2	Carbon Dioxide
DC	Direct Current
DEEP	Developing Energy Enterprise Project
DRC	Democratic Republic of Congo
ENDA-TM	Environment on Development Action in the Third World
GHG	Greenhouse Gas
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (German Agency for International Cooperation)
GSM	Global System for Mobile Communications
GVEP	Global Village Energy Partnership
GW	Gigawatt
HPS	Husk Power Systems
IAF	International Accreditation Forum
ICT	Information and Communication Technology
IDEAAS	Instituto para o Desenvolvimento de Energias Alternativas e da Auto Sustentabilidade (Institute for Development of National Energy and Sustainability)
IEA	International Energy Agency
IEC	International Electrotechnical Commission
IECEE	International Commission on the Rules for the Approval of Electrical Equipment
IEEE	Institute of Electrical and Electronic Engineers
IRECO	International Renewable Energy Certification Organization
ISO	International Organization for Standardization
ISP	Institute of Sustainable Power
kWh	Kilowatt hours
LED	Light Emitting Diode

LPG	Liquified Petroleum Gas
MDGs	Millennium Development Goals
MFIs	Microfinance Institutions
NABCEP	North American Board of Certified Energy Practitioners
NGO	Non-Governmental Organization
O&M	Operations and Management
OECD	Organization for Economic Cooperation and Development
PPA	Power Purchase Agreement
PV	Photovoltaics
PVGAP	Photovoltaic Global Accreditation Project
R&D	Research and Development
RREAs	Rural/Renewable Energy Agencies
REEEP	Renewable Energy and Energy Efficiency Partnership
REN21	Renewable Energy Network for the 21st Century
SELCO	Solar Electric Light Company (India)
SELF	Solar Electric Light Fund
SHS	Solar Home Systems
SKDRDP	Sri Kshethra Dharmasthala Rural Development Project
SMEs	Small and Medium Enterprises
UK	United Kingdom
UN	United Nations
UNDP	United Nations Development Programme
US	United States
UNEP	United Nations Environment Program
VAT	Value Added Tax
WEO	World Energy Outlook
WHO	World Health Organization

Executive Summary

Meeting the electricity needs of 800 million people who will not be reached by traditional utilities is a daunting challenge. To date, energy access in unelectrified areas has typically relied on a cadre of practitioners, including small-scale enterprises (SMEs), social enterprises, and non-governmental organizations (NGOs) – often struggling on their own or with limited support – to run a successful energy operation under the most demanding conditions.

Several of these entities have been working diligently over the last two decades to mitigate barriers and move the market forward, but it has not been easy. In the process they have been hampered by a myriad of obstacles: unsupportive policy environments; inadequate financing for customers, assets, and operations; and insufficient resources for developing innovations and building capacity to serve the poor.[1]

Today, established entrepreneurs are positioned to expand energy service delivery. Moreover, a variety of new-to-market entrants have been emerging, many of which have benefited from the pioneering efforts and experiences of their predecessors. These practitioners are bringing fresh approaches, products, and services to the marketplace – propelled by evolving technologies, financing mechanisms, and business models that are adaptable to the poor. And, they are already delivering significant on-the-ground results.

Based on in-depth consultations with these energy service providers over the last two years, the United Nations Foundation formed a global Energy Access Practitioner Network to identify and address market barriers to the effective delivery of energy services. It focuses on promoting the adoption of new technologies and innovative financial and business models as well as the dissemination of best practices and advocacy towards achieving universal energy access. This Practitioner Network, which seeks to formalize the fragmented off-grid energy service industry, has since become a key component of the UN Secretary General's Sustainable Energy for All initiative, which among its objectives calls for universal access to modern energy services by 2030. It serves as a "network of networks," seeking not to duplicate the work of others in this space, but rather to serve as an integrating platform for action. It is a sister initiative to the Global Alliance for Clean Cookstoves, which focuses on improving the adoption of increasing cooking and heating solutions towards eventual universal adoption, the other pillar of energy access.

Practitioner Network participants operate through informal working groups on key topic areas to highlight issues hindering achievement of universal energy access by 2030, and where possible, to offer specific recommendations for short and long term solutions. Current working group themes include energy and agriculture, energy and health, finance and investment, mini- and micro-grids, resource mapping, standards, and supply chains and entrepreneurship. Other working groups may be added in the future, as determined by the Network participants. The working groups also serve as a platform to make contacts, catalyze new partnerships, and exchange ideas in a more systematic, integrated manner in order to drive concerted action towards the 2030 universal energy access objective.

[1] J. Rogers, Navigant Consulting and Soluz USA, Innovation in Rural Energy Delivery – Accelerating Energy Access through SMEs, Massachusetts, 2006, page 3.


COWBELL
COWBELL
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Introduction

Overview

Energy drives development. Access to clean, safe, affordable sources of modern energy is critical for improving people's lives and livelihoods, yet is still lacking in many parts of the world. At present, 1.3 billion people have no access to electricity, with an additional billion "under-electrified" due to quality and intermittency problems.[2] Almost three billion people continue to rely on traditional biomass for heating and cooking needs, despite enormous health and safety consequences, particularly for women and children.

Increasing energy access to the unserved is doable and desirable. Governments, development organizations, the private sector, financial institutions, NGOs, and academia have demonstrated their interest and support through a variety of programs and projects in developing countries worldwide. Rural households and businesses have shown their demand for energy, paying high prices for poor quality energy services – often the only option available or affordable in the local marketplace.

Recent technology advances are reducing costs, improving product performance, and finding new approaches to providing affordable solutions. Energy service providers are also deploying a range of business models to extend energy service delivery, including to remote areas. Nonetheless, though progress is being made, these activities are not yet on a path to scale sufficiently. In fact, the International Energy Agency (IEA) projects that by the year 2030, absent significant concerted action, there will still be at least one billion people without electricity access. Under business as usual the energy gap is not closing.

Recognizing this situation, the UN General Assembly declared 2012 as the International Year of Sustainable Energy for All – making more accessible, cleaner, and more efficient energy a priority of the United Nations. Moreover, in September 2011, the UN Secretary General announced his Sustainable Energy for All initiative, a core component of his sustainability agenda. The initiative seeks to bring all sectors of society together – businesses, governments, investors, community groups, and academia – in support of three interlinked 2030 objectives:

1 **ensure UNIVERSAL ACCESS to modern energy services**

2 **double the global rate of improvement in ENERGY EFFICIENCY**

3 **double the share of RENEWABLE ENERGY in the global energy mix**

Benefits of Universal Energy Access

Energy is a pre-requisite for progress, empowering the leap from poverty to a better future. Expanding access to clean, reliable, and affordable energy services for heating, lighting, communications, and productive uses is critical for enabling sustainable

[2] IEA World Energy Outlook (WEO) 2011, p. 472.

Defining Energy Access

Although there is no universally agreed definition, the International Energy Agency has defined modern energy access as: a "household" having reliable and affordable access to clean cooking facilities, a first connection to electricity, and then an increasing level of electricity consumption over time to reach the regional average. The initial, minimum level of electricity for rural households is assumed to be 250 kilowatt-hours (kWh), which, for example, could provide for use of a floor fan, a mobile telephone, and two compact fluorescent lights for five hours per day. (Source: IEA, World Energy Outlook 2011.)

This definition, however, does not include other categories, such as energy to power businesses and public buildings, including schools and medical centers, and for the agricultural sector, all of which are critical to development. Further, it does not reflect the rapid changes in the off-grid energy sector such as advances in Light Emitting Diodes (LEDs), which are experiencing rapid performance increases and declining costs, enabling households and small businesses to have quality lighting at increasingly competitive prices. A more inclusive energy access definition, with broad-based support, remains to be developed.

development. Well-performing energy systems that provide efficient access to modern forms of energy strengthen opportunities to escape poverty.

Access to energy provides consumers with the means to generate income – which in turn creates wealth, opens new markets, and expands opportunities for progress in every aspect of development. Energy access enhances equity, particularly in terms of gender issues and by addressing extreme poverty. In addition, utilization of renewable energy and energy efficiency technologies can reduce climate change and other emissions in developing economies and communities, which are often the most at risk.

Increasing energy access means reaching all sectors of society and economy – residential, commercial, agricultural, institutional, and industrial – as they are strongly interconnected. This necessitates providing energy services to those without access, whether they are in urban, peri-urban, or rural areas. Urban areas may have some electricity access, but quality can be poor and service unreliable. In rural areas, physical access is often non-existent, and where it is obtainable, can be expensive and of inadequate quality and/or quantity.

Sectoral benefits of energy access include:

- *In agricultural markets*, a dominant sector in many countries and a potential growth area, energy contributes to progress through increased and diversified crop production, powering the chain of farm-to-shelf production, and transporting products to market.
- *In rural health facilities*, energy provides power for lights, equipment, running water, and communications. It operates refrigerators that store critical drugs and vaccines, sterilizers and other medical instruments, and computers to access medical information and data for storing and retrieving records. Access to electricity leads to reductions in maternal and infant mortality.
- *In schools*, energy is needed for electric power, basic heating, food preparation (often the main meal for students), water, and sanitation. Also, schools regularly

Lighting Up the Idjwi Clinic in the Democratic Republic of Congo

WE CARE Solar designs cost-effective, portable solar suitcases that power critical lighting, mobile communication, and medical devices in low-resource areas without reliable electricity. By equipping off-grid medical clinics with solar power for medical and surgical lighting, walkie-talkies, and essential medical devices, WE CARE Solar facilitates timely and appropriate emergency care, reducing maternal and infant morbidity and mortality, and improving the quality of care in Africa, Haiti, and other regions.

Dr. Jacques Sebisaho witnessed the power of the solar suitcase when he returned to the Idjwi clinic in the Democratic Republic of the Congo. The clinic had no power, and when night fell, it was impossible to provide adequate medical care. Dr. Sebisaho realized that "light is the force behind everything. I have no words to describe how confident I am knowing we could do anything, day or night. This sounds obvious to someone in the U.S., but light means the world in DRC."

Dr. Sebisaho knew the solar suitcase would make a difference but did not anticipate the impact it would have on the quality of care and mobilization of the entire community. In Idjwi, like most rural areas of Africa, people seek care after they have exhausted all options at home. Women and children, like the majority of patients, come to the clinic late in the afternoon or evening when there is no light in the clinic. The Idjwi clinic has lost many patients – not because it did not have qualified personnel, adequate medicines or supplies, but because medical staff could not function at night without light.

The importance of light became particularly important during a recent cholera outbreak. This time all the patients survived, whereas previously a majority would have died. Also, most pregnant women come to the clinic when they are certain it will not take long to give birth; usually this occurs during the night when they hope to have the baby the same evening and return home the next day (most of them have 8-9 children to care for). With no light, the risks of losing either the baby or the mother are very high. With the solar suitcase and the light it provides to the clinic, the lives of many women and babies have been saved. More women are encouraged to deliver at the clinic, avoiding unnecessary complications or deaths at home. The entire community now understands the huge difference light makes.

www.wecaresolar.org

serve as community centers, with electricity enabling adult literacy through evening classes, and outdoor lighting making facilities more accessible and safe at night for meetings and community gatherings. Lighting and educational equipment also help attract and retain teachers in rural areas.

- *In small and medium enterprises*, energy services contribute to improved productivity through mechanization, food preservation, communications (telephones, radio, computers), and working conditions. It also draws customers to the marketplace, extending working hours and helping to boost sales.

The Energy Context

According to the IEA's New Policies Scenario, global energy demand will grow 36 percent by 2035. Countries that are not part of the Organization for Economic Development (OECD), led by China and India, are projected to account for 93 percent of the increase, with the OECD share of world demand declining from 44 percent today to 33 percent in 2035. Fossil fuels – oil, gas, and coal – will continue to dominate energy use, accounting for 74 percent of the world's primary energy mix, with modern renewable energy, which is starting from a relatively small base, growing from 7 percent in 2008 to 14 percent by 2035.[3]

Staying on this path will have enormous consequences. Through 2035, the global energy supply infrastructure will require an investment of $33 trillion, almost two-thirds of which is in non-OECD countries. If the world does not direct those investments to climate-friendly technologies, emissions will continue to increase and are 53 percent higher in 2035 than in 2010. By 2035, non-OECD energy-related emissions of CO_2 are nearly 2.5 times those of OECD.

In this scenario, carbon dioxide (CO_2) emissions would grow to 35 gigatons by 2035, a 21 percent increase over the 2008 level, resulting in a likely temperature rise of more than 3.5°C over the long term (exceeding the Copenhagen Accord target of 2°C). From an energy security perspective, many countries will more than double their spending on imported oil and gas, reaching $2.6 trillion. Moreover, based on recent experience, importing countries should expect continued supply and price volatility from fossil sources. Finally, despite overall growth in global energy use, a majority of the world's population will continue to lack access to modern energy by 2030.[3]

In comparison, achieving universal energy access by 2030 necessitates incremental electricity generation of around 950 terawatt hours by 2030, at a cost of approximately

[3] IEA, WEO, 2010.

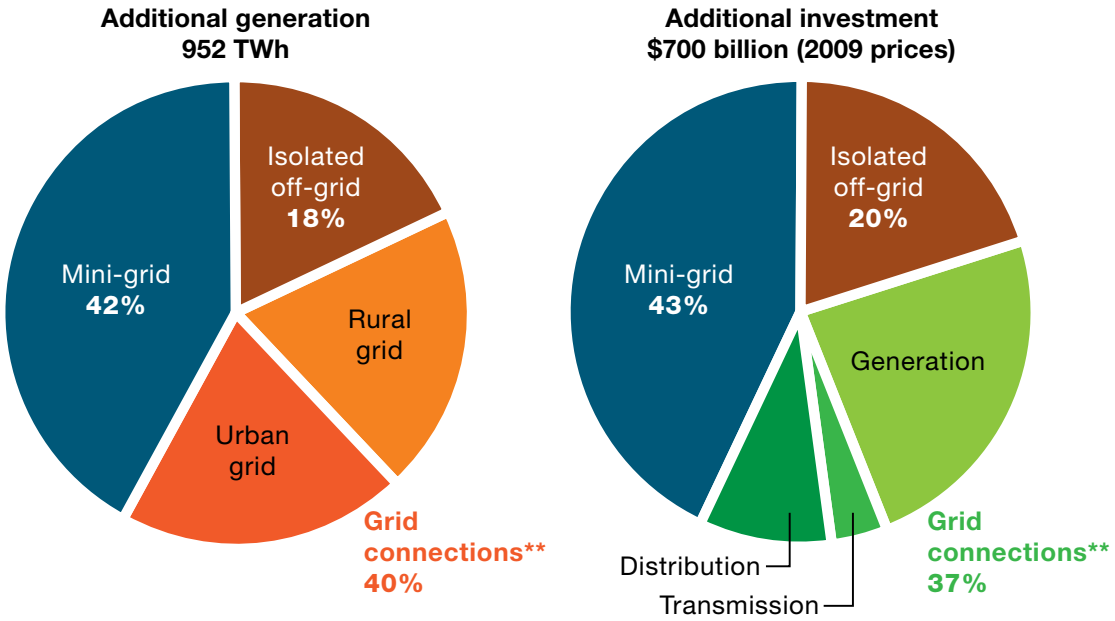
$700 billion ($33 billion per year on average over the period 2010-2030, which is equivalent to just 5 percent of the annual global investment in the power sector for IEA's New Policies Scenario (see Figure 1).[4] This is projected to lead to just a 2.5 percent increase in global electricity generation. Demand for fossil fuels would grow by only 0.8 percent with CO_2 emissions rising by merely 0.7 percent. Both of these figures are trivial in relation to high potential greenhouse gas emissions in developed and emerging economies over the next 20 years.[5]

As Figure 1 shows, only *40 percent* of these electricity needs are projected to be met by grid electricity in both urban and rural areas. Annual investment averages around $7 billion in the New Policies Scenario, with government finance and the private sector being the primary sources.[6] Although grid extension increases in coverage, and is a critical component in the energy access agenda, it faces challenges in meeting the electricity requirements of dispersed households and businesses that are yet to be served because of:

- Low population densities
- Dispersed, hard-to-access areas
- Poor consumers with low electricity consumption levels
- Connections to the electricity grid that are economically prohibitive and/or may take years
- Political interference, focusing on favored constituents
- Difficulties in maintaining electricity lines
- Challenges in fee collection.

Expanding electrification to the remaining 60 percent of the population, particularly in rural areas, will depend primarily on non-traditional approaches such as mini- and

Figure 1. Incremental Electricity Generation and Investment in the Universal Modern Access Case*, 2010-2030



**Compared with the New Policies Scenario*

***includes generation, transmission and distribution for both urban and rural grids*

[4] Ibid, page 257.

[5] IEA, WEO 2011, p. 469.

[6] Ibid, p. 477.

micro-grids and isolated off-grid applications. (See Table 1.) Investment in these systems is projected to average around $6 billion annually, with the private sector representing a significantly smaller share of the total, reflecting the obstacles to developing commercially viable projects.[7] This is one of the challenges that the Practitioner Network hopes to address through supporting and disseminating new business and financial models that demonstrate viable ways to address the energy access issue through smart combinations of products, projects, and processes.

Isolated off-grid systems involve generating capacity for a single point of demand, such as a rural health clinic, school, household, or business. Mini-grids comprise village and district-level electricity networks in rural or remote areas, where the power demand points are linked in a small low-voltage grid that may have multiple generating sources.[8] Micro-grids operate small modular power generation technologies like mini-grids, however, these are typically combined with smart energy management and storage systems that can improve the operations of electricity systems at or near the end user. They can be utilized in off-grid as well as grid-based networks.[9]

These options can supplement grid electrification strategies in a country, creating demand for greater electricity use as it becomes available. They typically rely on environmentally beneficial renewable energy resources. Figure 2 shows the evolution of renewable energy applications for the off-grid market over the last 30 years, starting with isolated technologies deployed in the 1980s; moving to larger, multi-technology systems in the 1990s; and introducing smart micro- and mini-grids in 2008, for example, in India. Each of these options has a role to play in the off-grid marketplace.

Today, the need for off-grid electricity services is greatest in Sub-Saharan Africa, India, and other parts of Asia, as well as parts of the Caribbean and Latin America that have not yet achieved full coverage. Over the next 20 years, however, Africa is projected to surpass Asia to become the largest unelectrified market in the world and the one most in need of modern energy services.

Table 1. Projected Generation Requirements to Reach Universal Energy Access by 2030[10]

Region	Generation Requirements by 2030			
	On-grid	Mini-Grid	Isolated Off-grid	Total
Africa	196	187	80	463
Sub-Saharan Africa	195	187	80	462
Developing Asia	173	206	88	468
China	1	1	0	2
India	85	112	48	245
Other Asia	87	94	40	221
Latin America	6	3	1	10
Developing Countries*	379	399	171	949
World**	380	400	172	952
Percent Generation requirements by type	40%	42%	18%	100%

**Includes Middle East countries*

***Includes OECD and transition economies*

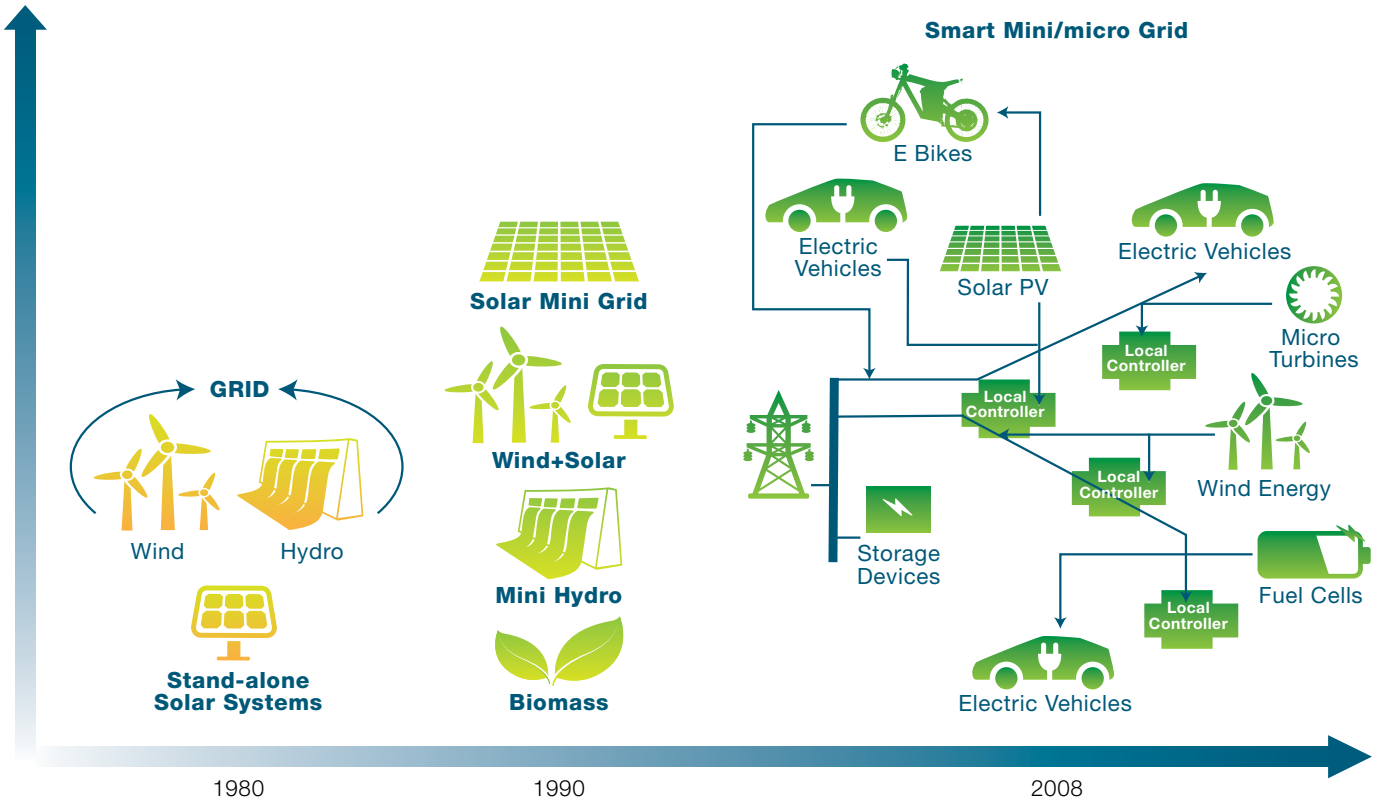
7 Ibid.

8 World Bank RE Toolkit.

9 A. Chaurey, TERI, Smart Micro-grids in the Context of Emerging Markets for Renewables, Power for All, Last Mile Access, June 2010.

10 IEA, United Nations Development Programme, and United Nations Industrial Development Organization, Energy Poverty – How to Make Modern Energy Access Universal? OECD/IEA, September 2010, pps 18-19.

Figure 2. Renewable Energy Market Transition[11]



Emerging business models, technology advances, and cost reductions can help these countries leapfrog the traditional utility approach, accelerating the transition to "wireless power", similar to the way the telephone industry in developing countries passed over landlines, going straight to wireless networks.

Role of Renewable Energy

Renewable energy technologies – biomass, geothermal, hydropower, solar, wind, tidal and wave power – are expected to play a major part in providing modern energy services worldwide. These technologies leverage local resources and can often be sited close to load centers, reducing the need for costly grid extension and helping to lessen the need to import expensive diesel fuel. Renewable energy technologies enhance energy security by decreasing dependency on fossil fuel imports, thereby contributing to reduced national debt, improving trade balances, and providing a hedge against fossil fuel price fluctuations. Renewable energy is also a carbon-free energy source in its operation and is therefore a climate-friendly solution.[12]

In the last few years tremendous progress has been made in reducing the costs and improving the performance of these technologies – moving them from niche to mainstream markets based on technological and commercial maturity. In the 2005-2010 period, total global capacity of many renewable energy technologies grew at average rates ranging from 15 to 50 percent annually. Wind power added the most new capacity, followed by hydropower and solar photovoltaics (PV); biomass and geothermal for power and heat also grew strongly.[13] Record investments in these technologies have also occurred, despite the economic downturn. In 2011, overall clean energy investment reached $263 billion. This compares to just $54 billion back in 2004.[14]

11 Ibid.

12 Although renewable energy technologies typically lack the greenhouse gas (GHG) and other emissions of fossil fuel technologies in operation, there remain some emissions in the production of the technologies.

13 REN21, 2011, Renewables 2011 Global Status Report, p. 11. (Paris: REN21 Secretariat.)

14 Bloomberg Energy Finance, *Solar Surge Drives Record Clean Energy Investment in 2011*, Press Release.

Today, developing countries are competing with the industrialized world in terms of new financial investment and global renewable energy capacity. This strong growth is projected to continue, with expansion planned in all regions of the world.

In off-grid markets, renewable energy technologies are increasingly recognized as the cheapest, cleanest, and most sustainable option for delivering energy services for most applications – assuming a sufficient resource is available. These technologies are typically the preferred choice for providing electricity for household and community applications throughout the developing world, including lighting, communications, telephones, and electronic devices such as computers, radio, and television. For example, small-scale solar photovoltaic systems provide power to millions of households and micro-hydro configured into village or larger scale mini-grids serve many more. (REN21, 2011.) Solar technologies can be particularly useful for Sub-Saharan Africa, which has high solar insolation levels.

The Energy Access Practitioner Network

The Practitioner Challenge

Meeting the electricity needs of 800 million people – 60 percent of the total who now lack access and will not be reached by traditional utilities – is a daunting challenge. To date, this challenge has been met mostly by a group of practitioners, including small and medium scale enterprises, social enterprises, and NGOs that struggle to deliver successful energy products and services under the most demanding conditions:

- Technically, they may lack access to quality products and services, face supply chain challenges in delivering products to customers, or are without the market clout to obtain products in sufficient quantities at competitive prices in a timely manner.
- Financially, these enterprises confront difficulties in attracting the right type of capital, the right amount of capital, and in ensuring a predictable flow of money to enable planned growth and fund multiple generations of innovation. Investors prefer to finance more mature companies that have an established track record and proof of concept, require larger amounts of capital, bring an established investor base, and promise high commercial rates of return.
- Organizationally, practitioners may lack the business and management skills needed to expand their business ventures to take advantage of opportunities existing in the market.
- Lastly potential customers – those most in need of electricity and the advantages it provides – need guidance to understand fully how these services can improve their quality of life, save them time and money, and be financed affordably.

Typically, energy entrepreneurs operate in rural areas without benefiting from being able to assess the experience of their counterparts, either in their own country or in other parts of the developing world. They may lack information on what has worked and what has failed in providing energy services in other locales, business approaches to streamline their operations, and sources of assistance in the scale up of energy delivery to those lacking modern energy services. They may not speak English, have internet access, or come to the attention of international "impact investors" who provide financial support for social entrepreneurs. Thus they need to bootstrap their operations – a challenge in any context – and a particular obstacle to women seeking to become energy entrepreneurs.

Many entrepreneurs have begun to address these challenges by building their business and customer base (often low-income), understanding technology solutions (typically renewable energy), employing a range of delivery models, learning about local financing options, and establishing a track record in reaching those unserved or underserved. Nevertheless, the number of players in the off-grid marketplace today, and the scale at which they are operating both as individual companies and in the aggregate, is inadequate to reach universal electricity access in less than 20 years. Further, those pioneers that are delivering electricity services in this market confront a myriad of obstacles that must be tackled to grow, expand, and replicate their approaches.

The Practitioner Network

To help meet the energy access challenge, the United Nations Foundation launched the global Energy Access Practitioner Network in the spring of 2011. This group brings together practitioners from the private sector and

Energy Access Practitioner Network Origin

The Network was organized by the United Nations Foundation following consultations with numerous energy practitioners working throughout the developing world. These practitioners recognized the fragmentation that still exists in the sector, and expressed the need for a platform to engage on a range of technical, financial, business, and related issues they confront in the delivery of off-grid electricity services. They also view the Network as an important medium for engaging in the Sustainable Energy for All initiative.

Practitioners deem the Network as critical if the ambitious universal energy access objective is to be realized by 2030. By working together as a network, rather than as individual organizations, their collective views and priorities can be conveyed to policy makers, funders, and other stakeholders, and their chances of success are enhanced.

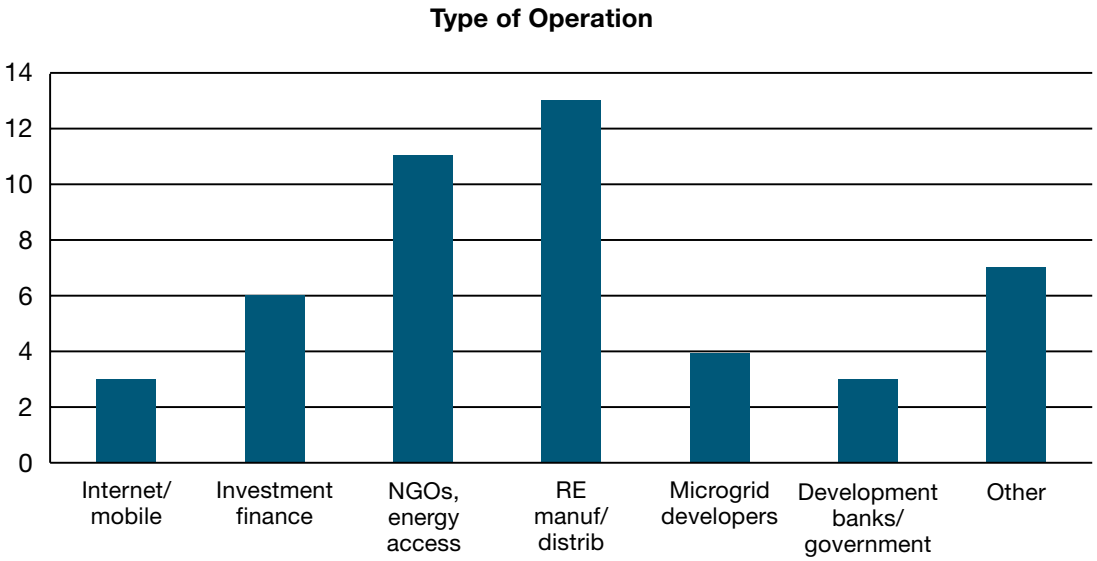
civil society working in a range of developing country contexts to develop a more integrated approach to energy access. The Energy Access Practitioner Network is a complementary organization to the Global Alliance for Clean Cookstoves, which focuses on scaling up access to clean cooking solutions. It is also a component of the UN Secretary-General's Sustainable Energy for All initiative.

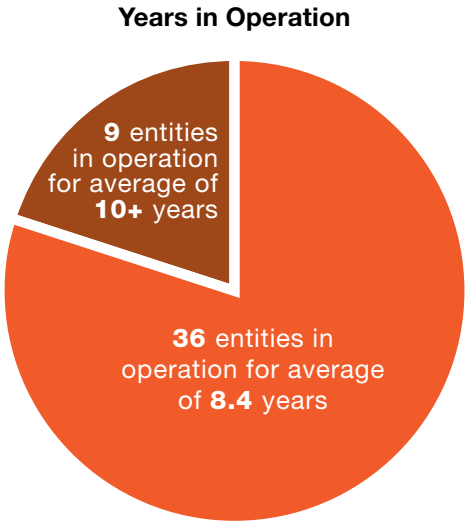
Network members are collaborating to catalyze the scale-up of renewable energy and low-carbon technologies and spur the market toward universal energy access. The focus of the Network is on the removal of market barriers to the effective delivery of energy services by promoting the adoption of new technologies and innovative financial and business models, as well as identifying and disseminating best practices and advocating for universal energy access. The Network emphasizes community and household level electrification via mini- and micro-grids and remote applications. Although humanitarian applications are included in the work of the Network, the primary emphasis is on developing market-based solutions that can be scaled up or replicated to help achieve the universal energy access objective. The Practitioner Network is open to all organizations and individuals that are actively involved in development, implementation, finance, investment, and other components of delivering electricity and increasing access to energy in developing countries and, where relevant, in OECD countries.

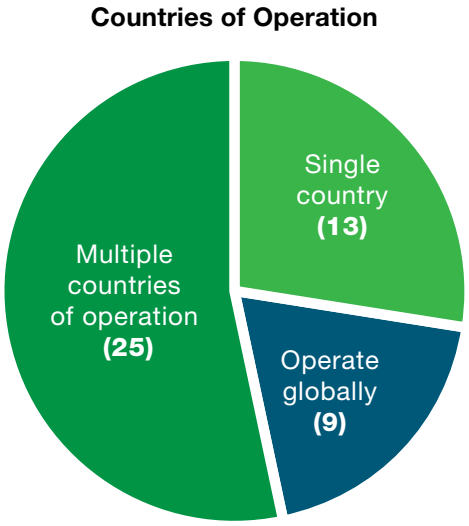
The Network also shares information on the latest innovations in delivering modern energy services, such as combining solar and mobile phone technology to offer pay-as-you go financing, mitigating payment hurdles by linking these into monthly system payments, offering "business in a bag" services for women-owned solar start-ups, and incorporating smart energy management into micro-grid systems.

In the first year in action, the Network has grown to more than 520 practitioners from some 345 organizations worldwide, including SMEs, equipment manufacturers, distributors, project developers, financial institutions, investors, and others involved or interested in scaling up the delivery of modern energy services. Based on a recent survey conducted of Network Practitioners – of whom about 12 percent initially responded – they connected over 3.6 million households annually. Cumulatively to date, the responding practitioners have provided electricity to a total of about 11.4 million households. The number of communities reached averaged 67 per respondent, with a total number of approximately 2,650 communities energized by respondents. Figure 3 summarizes additional survey findings. Though these numbers are significant, because of the response rate, the survey captures only a portion of the activities and impacts of the practitioners and should be viewed as indicative of what practitioners are achieving in the field.

Figure 3. Practitioner Network Survey (January 2012)
(45 initial respondents)







Working Groups

Practitioner Network participants have formed informal working groups on key topical areas of interest to them. Currently, these are energy and agriculture, energy and health, finance and investment, mini- and micro-grids, resource mapping, standards, and supply chains and entrepreneurship. Other areas may be added as additional issues and opportunities are identified.

The working groups seek to highlight existing and emerging issues hindering the achievement of universal energy access by 2030. Where possible, they offer specific recommendations for both immediate action and long-term solutions, including how each could potentially be realized. In addition, the working groups provide a mechanism to network, inspire, share information in a more focused manner, and motivate action.

As the Sustainable Energy for All initiative moves forward at the country level, working with a variety of stakeholders from governments, UN agencies, the private sector, and civil society, the Network will increase its engagement on country-specific activities as well. Many of the practitioners are already operating in numerous developing countries worldwide. They will bring their knowledge and expertise to scaling up energy access, including through the use of renewable energy technologies and more efficient energy products, systems, and services.

Relating the Practitioner Network to the Sustainable Energy for All Global Action Agenda

Within the broader Sustainable Energy for All initiative, a Global Action Agenda was recently created to chart a path forward for the initiative and its stakeholders. It also aims to help countries, based on technology choices that are appropriate to their unique challenges. The Action Agenda identifies 11 Action Areas as a framework for identifying high-impact opportunities and tangible entry points for stakeholders interested in taking action in specific areas of interest. The progress of stakeholder commitments in these Action Areas will be monitored closely to chart the success of the initiative.

The Action Areas include seven "sectoral" areas: (1) modern cooking appliances and fuels; (2) distributed electricity solutions; (3) grid infrastructure and supply efficiency; (4) large-scale renewable power; (5) industrial and agricultural processes; (6) transportation; and (7) buildings and appliances. There are also four "enabling" Action Areas: (1) energy planning and policies; (2) business model and technology innovation; (3) finance and risk management; and (4) capacity building and knowledge sharing. The working groups of the Practitioner Network, as well as the priority areas identified by the practitioners, mirror the immediate concerns of the initiative and are reflected in their recommendations.

Spurring Economic Recovery in Haiti

The Solar Electric Light Fund (SELF) has been working in the field of renewable energy, household energy, and decentralized rural electrification in developing countries worldwide for over 18 years, tackling a number of the issues identified by the Practitioner Network's working groups. Activities include establishing "in-country" joint ventures and "for-profit partnerships," developing projects with community and local stakeholders, designing micro-finance mechanisms, and building capacity of local technicians.

For example, SELF is boosting development in Haiti as part of the country's recovery efforts. In partnership with NRG Energy, which committed $1 million under the Clinton Global Initiative, SELF is bringing renewable energy to Haiti by electrifying 11 schools, several drip irrigation systems, and providing other community services.

As part of these efforts SELF is also powering a fish farm with solar. The Lashto Fish Farm is particularly beneficial in helping deliver fresh fish to the people of the region, while providing local jobs. SELF helped install over 60 solar panels that provide 24/7 power to aerate the three fish tanks that can hold up to 20,000 tilapia fish. Individual fishermen invest in and own about 2,000 tilapia. Caribbean Harvest, the site's operator, estimates that each fisherman can sell his or her portion for about $2.40/per pound, making a profit of about $1 per fish. Approximately 90,000 fish can be produced per year.

www.self.org

Practitioner Priorities

Based on a series of consultations, including conference calls and meetings over the past year, the working groups identified a number of priority areas that are critical to the scale-up of off-grid energy service delivery. These are:

- Understanding the market
- Improving policy and regulatory frameworks
- Facilitating finance
- Advancing mini- and micro-grids
- Improving standards and testing.

In addition, the need to address gender aspects across these priority areas was stressed.

Implementing these priorities will require the engagement of a range of organizations, including governments, the private sector, entrepreneurs, financiers, international development organizations, NGOs, and others. Network participants are committed to working on these issues in their countries of interest. Further, at a Practitioner Network meeting organized by the United Nations Foundation in December 2011, it was determined that the Network will explore the potential for collaborative country-specific activities. At present, the Network is working with the UN as it identifies initial country priorities in the context of the Sustainable Energy for All initiative.

Understanding the Market

Practitioners have indicated the need for better access to business intelligence data, supply chain information, and capacity development to enhance their performance and scale-up activities. Even those practitioners who have been active in rural energy service delivery for years identified these issues as an on-going priority given the dynamic, rapidly changing marketplace.

Business Intelligence

It is challenging for entrepreneurs to access reliable market data on the rural energy sector. Where this information does exist, it is often difficult, time-consuming, and expensive for

individual practitioners to obtain and update.

Business information needs identified by practitioners include renewable energy resource data at both the country and local levels (such as solar, wind, hydropower, and geothermal mapping) and renewable energy technology status, experience, costs, and suppliers. Additionally, information was requested on consumer attitudes and behavior for off-grid energy products, to include energy usage and requirements, purchase patterns, price points, product preferences, and customer satisfaction. At the national level, a compendium of information regarding policies in place around tariff structures has been identified as a need to help with initial macro assessments of market potential.

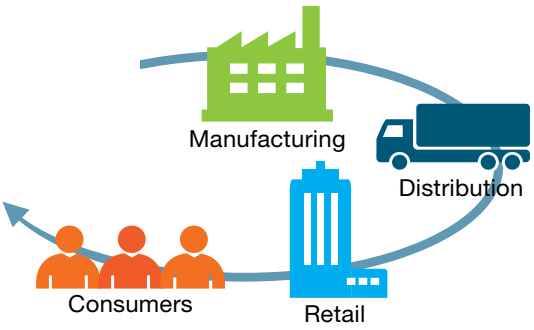
Collecting, collating, and reporting the information into easily accessible and understandable formats would also be useful. Tools should be adapted for the specific use of the private sector and investors, as well as practitioners on the ground. Also, market information will continuously need to be collected regionally and locally.

Supply Chain

The supply chain is a system of organizations, people, technology, information, and activities that move a product or service from the supplier to the consumer. This involves manufacturers, distributors, customers (e.g., retailers, bulk purchasers, etc.), and ultimately the consumer.

The supply chain for sustainable energy products and services is very difficult to develop, as most of the people living in energy poverty are in rural and remote places, where last-mile distribution provides many challenges. These include an absence of financial services for end users, difficulties for energy enterprises to attract capital for growth, lack of skilled technicians and employees, inability of distributors to have enough customers to buy wholesale in order to bring prices down, and a lack of efficient distribution channels such as retail outlets to make a business profitable.

Understanding of existing distribution channels that deliver products into rural markets, as well as the experience of established



companies, should be leveraged (e.g., microfinance institutions, large corporations in telecommunications/retail, and development and relief agencies). Timely dissemination of information on these networks and facilitation of market linkages will be valuable. Greater collaboration among the various actors and a series of interventions to support enterprise development and growth will help to build the significant scale required to achieve universal access by 2030.

Sharing the experiences of Network members in this area is also valuable. For example, EarthSpark International is identifying the best energy technologies to support their supply chains and deliver these to "frontline" clean energy stores at the community level in Haiti. The Institute for Development of National Energy and Sustainability (IDEAAS), a non-profit in Brazil that develops and demonstrates self-sustaining renewable energy for low-income rural populations, advocates the use of materials sourced in Brazil to benefit the local economy, keep costs down, and decrease the effect of currency risks, while promoting alliances with external vendors where imports are required. Mobisol GmbH, a young start-up company, offers solar home systems (SHS) coupled with microfinance and GSM (Global System for Mobile Communications) modems, for pay-as-you go systems. Following pilot of its activities in Tanzania and Kenya, one-third of its customers have already started their own business of selling electricity after completing payment of the Mobisol system. Mobisol works closely with its in-country partners to provide support across the supply chain, as demonstrated in Table 2.

Table 2. Supply Chain Experience from Mobisol's Pilot Implementation in East Africa

Obstacles	Mobisol's Work-Around	Recommendation
Lack of knowledge about government electrification plans (often governments like to keep these plans secret, promising services to many but not delivering)	Incorporate in customer contract that Mobisol takes back systems if grid arrives	Provide transparent electrification plans to practitioners
Sourcing balance of system (BOS) components (e.g., cabling, lamp holders, rods, spring washers) locally for pilot phase	Visit all local suppliers with an evaluation process (interview guidelines, sample purchases) to find suitable partners	Have certified local suppliers of electrical equipment
Finding good-quality direct current (DC) appliances to use with solar system in local area	Buy DC appliances in Berlin, Germany, and bring them to pilot area	Encourage manufacturers to market their products in the developing world (DC refrigerators, DC televisions, DC radios, multiple phone chargers, DC haircutters, etc).
Information on locally available technicians that would be suitable for training	Develop test procedure to assess their capacities	Provide standardized tests to assess capacity of local technicians (in East Africa they are called "fundis")
Availability of promotional and training material in local language	Translate materials through local partner and students	Offer translation service for practitioners

Human Resource Capacity

To meet the significant increase in energy supply operations and delivery, there will need to be a corresponding increase in a trained and educated workforce. Today, training programs have been instituted by Network participants that can assist in showcasing, replicating, and expanding energy access models in other countries and regions. These include:

- The Global Village Energy Partnership's (GVEP) Developing Energy Enterprise Project (DEEP) has provided training to support over 900 micro-entrepreneurs in East Africa.
- The Institute for Sustainable Power (ISP) coordinates, develops, and maintains international programs for the education and qualification of renewable energy, energy efficiency, and distributed generation providers.
- Energia, the international network for gender and sustainable development, provides practical tools and training to strengthen capabilities of practitioner project managers and policymakers in the design, development, and implementation of gender-sensitive rural energy access projects and national energy policies.
- Soluz Inc., part of the Global Transition Group, provides renewable energy training for microenterprises in Latin America. This includes technical and business training in photovoltaic and wind-electric technologies to entrepreneurs and companies in the areas of system design, installation, maintenance (basic and advanced), community water-pumping systems, and basic business skills.
- Solar Sister's '*business in a bag*' offers women the training, marketing, products, and financing to launch small-scale solar businesses in Africa.

Solar Sister Brings Light, Hope and Opportunity

Solar Sister invests in women to empower them with economic opportunity. The most important step to ending poverty is to create employment and income potential. Solar Sister does just that by empowering women with economic opportunity. Using an Avon-style distribution system, Solar Sister creates vital access to clean energy technology by building and extending the supply chain through women's rural networks. Solar Sister provides the women with a 'business in a bag', a start-up kit of inventory, training, and marketing support. The women become their own bosses, creating sustainable businesses and drawing on their natural networks of family, friends, and neighbors to provide the most effective distribution channel to rural and hard-to-reach customers.

Investing in women is not just the right thing to do, it's the smart thing to do. Leveraging the power of the market place, a one-time investment in a Solar Sister Entrepreneur creates a chain reaction of social impact as the Solar Sister Entrepreneur turns over her inventory again and again. Solar lamps replace toxic kerosene lanterns and solar cell phone chargers provide connectivity in even the most energy poor communities.

www.solarsister.org

Table 3. Practitioner Priorities for Understanding the Market

Activity	Sample Interventions Identified	Key Partners
Consumer and Market Research	Collect information on existing consumer and market research and make available to practitioners in a format that is easy–to-access and understand. This should focus on off-grid technologies, products, and resource areas. Conduct new consumer and market research where information is lacking. Organize consumer and market information into a database and other formats of most value to practitioners; provide mechanism for routine data update by practitioners and others.	*International development organizations, private sector, trade groups*
Supply Chains	Catalogue information on existing supply chains delivering products and services into rural areas via practitioners and their networks. Create mechanisms for energy enterprises to develop and explore partnerships with organizations that have established distribution channels in rural areas.	*Governments, international development organizations, local and international business associations, development/relief agencies, entrepreneurs, local financial institutions*
	Exchange lessons learned about distribution models from those who have achieved success in energy and related areas.	*Entrepreneurs and businesses working in key rural areas*
	Conduct distribution channel mapping in target countries and regions that will benefit multiple partners.	*International development organizations, industry associations*
Human Resource Capacity	Invest in training and enhancing skills for technicians and entrepreneurs in the rural energy sector relevant to the needs of both businesses and communities.	*Governments, international development organizations, industry associations*
	Identify successful training programs and showcase, replicate, and expand these.	*Foundations, NGOs, SMEs.*
	Capitalize on available internet learning and network tools that exist but are not easily located (e.g., databases, market research studies, business models, resources, etc). Make these available where possible using other channels for entrepreneurs lacking internet access. Develop a central information hub for tools addressing practitioner needs to connect with other professionals around the world.	*Governments, NGOs, academia, specialized social networks, Facebook*

- Barefoot Power reaches grassroots markets by training self-help groups to sell solar lighting systems to their communities.

Cataloging training programs to support workforce development in off-grid energy will be critical to sector expansion and ensuring the sustainability of the energy solutions installed in communities.

Implementing Policy and Regulatory Frameworks

Achieving universal access will necessitate political commitment to establish effective policy and regulatory frameworks for the off-grid energy sector, advance inter-sectoral coherence, and send appropriate market signals. Enforcing these policy and regulatory measures in a sustained, stable manner will

also be important. Policy support is required to attract and keep investors at the global, regional, national, and local levels.

Over the last few years, progress has been made on the policy front, with 118 countries having put in place some type of policy target and/or support related to renewable energy (about half from developing countries, primarily focusing on grid connection).[15] Approximately 70 developing countries have established electricity access targets.[16] Several developing countries, including Bolivia, Bangladesh, Brazil, China, India, Pakistan, Tonga, South Africa, and Zambia have adopted policies to provide access to energy services in rural areas.[17] Kenya has declared its intention to be "kerosene-free" in terms of lighting before the end of the current decade.

Nonetheless, significant policy barriers persist in reaching universal energy access. Examples raised by the Practitioner Network include:

- National energy strategies/policies that do not address rural energy, clean energy, nor the Base of the Pyramid (BoP) market.
- Expensive and inefficient traditional approaches for grid expansion into rural areas.
- Uneven subsidy regimes that distort markets.
- Lack of incentives for off-grid energy sector services.
- Unattractive business climates for clean energy enterprises in the off-grid market.

Lacking clarity from governments on the policy and regulatory environment for off-grid renewable energy, private sector companies, investors, and entrepreneurs may consider the sector too risky for investment.

In establishing appropriate policy and regulatory frameworks, experiences of the Practitioner Network and others have identified a number of lessons to consider in addressing policy issues. For example, policy makers should send clear and long-term signals about future policy direction to ensure investor certainty and confidence, minimizing administrative procedures to contain costs. Energy access policies need to be addressed at the national, state, and local level, and in many cases (such as Sub Saharan Africa), integrated into regional policy and regulatory activities. Financial incentives can play an important role in leveling the playing field for renewable energy investments. These can decrease upfront capital costs through subsidies, reduce capital/operating costs through tax credits, improve revenue streams with carbon credits, and provide financial support via loans and guarantees. But they can also distort the market and encourage quantity without long term quality of service if not structured appropriately.

"Sustainable Energy for All is all about freedom from the bondage of fossil fuels."

— Honorable Henry Puna, Prime Minister, Cook Islands, speaking at the Small Island Developing States (SIDS) High Level Conference on Sustainable Energy for All in Barbados, May 2012

The elimination of incentives that hinder renewable energy products and technologies, such as fossil fuel subsidies, are important. Fiscal policy interventions to reduce or eliminate high import duties and discriminatory taxes on renewable energy equipment are also valuable; alignment among government ministries is important to help make this as effective as possible.

Policies should be open to renewable energy, not biased towards diesel-based systems. Integrating and mainstreaming renewable energy into national development plans, rural electrification policies, and low-carbon development strategies is vital. Similarly, tying renewable energy into cross-sector government agency programs such as health, agriculture, and water is important, as is working with those Ministries directly to support the inclusion of renewable energy in planning for delivery of these services. Development of rural electrification master plans that include renewable energy can help countries to systematically prepare rural energy strategies and policy recommendations; outline a comprehensive, multi-year electrification program; and delineate a financing plan.

[15] REN-21, 2011.

[16] *IEA*, United Nations Development Programme (UNDP), United Nations Industrial Development Organization (UNIDO), Energy Poverty: How to Make Modern Energy Access Universal, September 2010.

[17] UN Intergovernmental Panel on Climate Change, Special Report on Renewable Energy Sources and Climate Change Mitigation, 2011.

Pro-poor policies and regulations can help expand access to this target group, diversify service quality (or offer different levels of services), and make prices more affordable.[18] For poor customers, some sort of subsidy will typically be required, except for the lowest cost entry level solar lighting solutions.

Many of the Network participants bring experiences in advancing policy and regulatory measures on access issues. The Energy Research Centre of South Africa conducts policy and sustainable development research on issues such as carbon pricing, solar home concessions programs, and solar hot water heating for poverty reduction. Environment on Development Action in the Third World (ENDA-TM) operates in a number of developing countries on energy, development, and environmental issues, working with policy makers to advocate for marginalized people.

Throughout its activities, the Practitioner Network will work to ensure that decision makers engage with entrepreneurs, financiers, investors, and other key stakeholders in policy design, development, and implementation to ensure the effectiveness, efficiency, and equity of the outcomes.

Practitioner Lessons Learned in Policy Approaches for Off-Grid Energy

For micro- and mini-grids, a clear, uniform, and well documented operating process is needed to ensure reliability and safety. Government policy is called for to treat micro-grids (power generation under 40 megawatts), as authorized even when a franchised grid operator exists. Additionally, policies should ensure that micro-grids will not compete with larger utilities. Standardized power purchase agreements (PPAs) will help to simplify administrative procedures and enhance market transparency.

There is also a need for consistent, long-term policy to encourage open access and incentivize use of advanced technologies that increase capacity and enhance efficiency and reliability. Additional mechanisms such as pilot demonstrations must be created to bring together various industries, including power, information and communication technology, manufacturing, and government towards advancing this agenda and producing a blue print for smart grid implementation.

Mini- and micro-grids are operating in a number of countries throughout Asia, Latin America, and Africa. For BoP customers, effective subsidy instruments that have been deployed for mini-grid applications include rural electrification funds, bulk power subsidies, lifeline rates and cross subsidies, and subsidies to customers involving a diverse customer base with wide variation in ability to pay.

For stand-alone systems, favorable government frameworks that support SMEs are important for delivery of rural energy services and clean energy. Interventions can reduce barriers to private participation in rural energy delivery, increase fair competition, advance supportive policies, and promote "smart" subsidies that minimize distortions and target the poor.

For all the above, exemption of import duties on renewable energy products will reduce the upfront costs for companies helping them to get off the ground during the early stage of a company's set-up as well as during follow-on operations.

[18] Asian Development Bank, *Pro-Poor Policy and Regulatory Reform of Water and Energy Supply Services, Law and Policy Reform*, Brief No. 3, April 2010.

Table 4. Practitioner Priorities for Policy Support

Activity	Sample Interventions Identified	Key Partners
Policy Promotion for Clean Energy	Tie mini-grid and stand-alone systems into broader rural electrification policies and define roles of key players. Ensure effective policies for private sector and other service providers implementing rural electricity supply systems. Incorporate mini-grids and stand alone systems into regulatory frameworks. Ensure provision of appropriate cost-recovery tariffs for rural energy service providers. Incorporate enforcement provisions into policy/regulatory development and implementation. Develop rural energy master plan to guide policy making, strategy development, and financing.	*Government, entrepreneurs*
Level the Playing Field	Where possible, phase out fossil fuel subsidies to enhance competitiveness of cleaner energy solutions for off-grid applications. Simplify the regulatory environment for small-scale power generation (less than 25 kilowatts, kW power).	*Government, entrepreneurs*
Pro-poor Policies	Promote pro-poor policies, such as direct government subsidies, connection fee support, grants in the form of equipment, technical assistance or cash, low-interest loans, and/or cross subsidies.	*Government, entrepreneurs*
Fiscal Incentives	Identify fiscal incentives to advance clean energy solutions for off-grid applications. Reduce/eliminate value added tax (VAT) and import duties on renewable energy equipment and products, particularly those being used to deliver energy access.	*Government, entrepreneurs*
Dedicated Funds	Establish dedicated funds to support rural energy projects. Funding sources can include a surcharge on electricity consumption to consumer electricity bills (e.g., Systems Benefit Charge), carbon taxes, and/or government or donor funds.	*Government, entrepreneurs*
Policy Coordination	Coordinate off-grid energy policies at the national, local and regional level.	*Governments at national, local, regional levels, entrepreneurs*
Cross Sector Policies	Link renewable energy to cross-cutting sector policies and plans in relevant end-use sectors and across government Ministries, such as agriculture, health, water, and education, where they can address energy poverty and improve quality of life.	*Government agencies, entrepreneurs*
Capacity Building	Provide policy makers and regulators with information to effectively incorporate mini-grids and stand-alone systems into energy planning, policy development, and implementation. Provide energy service providers with training and guidance in establishing tariff structures and administrative controls.	*Government, entrepreneurs*

Facilitating Investment and Finance

Addressing challenges concerning access to capital, attracting investors, utilizing local financing mechanisms for businesses and consumers, developing innovative financing mechanisms, and accessing carbon finance are key requirements of practitioners worldwide. Further, when projects are powered by renewable energy sources, as they often are in off-grid energy markets, other barriers can exist such as high up-front capital costs and perceived technology risks due to a lack of familiarity by financiers with these options. Further, project developers may lack a track record and work in a policy environment that favors and/or subsidizes conventional energy sources.

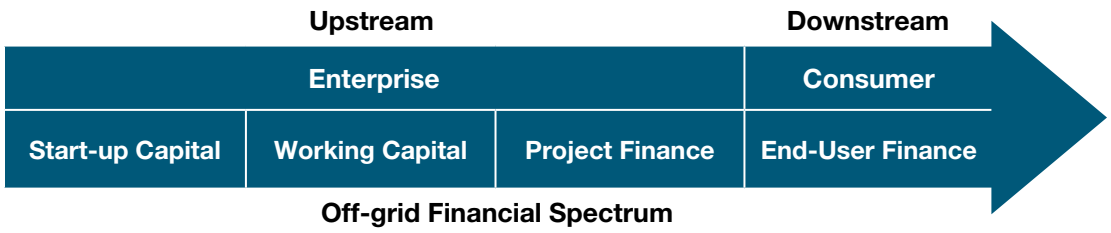
Most of the venture capital and private equity funds in this space are interested in scaling up companies with a few years of revenue, leaving limited funding options for early stage innovators. Small-scale entrepreneurs face additional challenges given their small project size, high capital costs of renewable energy systems relative to household incomes (despite low operation and maintenance costs), the level of due diligence required as a proportion of the deal size, uncertain legal and policy frameworks, issues related to currency risk where foreign capital is involved, and the lack of deep, existing retail and distribution channels that lend themselves to scale-up. As a result, some private investors have been reluctant to enter the sector except on a limited project by project basis.

Given this situation, development organizations (multilateral and bilateral) and public finance agencies (e.g., government agencies and national banks) play an important role in addressing barriers and facilitating investment for smaller-scale deals. First and foremost, a favorable policy environment for clean energy/access projects is vital.

A number of governments are incorporating off-grid renewable energy components into larger in-country grid connected projects, providing funding to local private or public financing institutions that are committed to support rural and renewable energy projects. Typically, such banks or funds develop a portfolio of projects; they do not provide financing to households directly but work with financing companies, concessionaries, NGOs, and microfinance organizations to bundle the demand for energy services and apply for project funding. In addition, public agencies are critical in supporting energy access projects through local utilities, as well as in leveraging private sector finance for energy access projects – e.g., through loan guarantees, partial loan guarantees, revolving credit lines, and carbon finance to reduce risks, increase returns, and encourage the private sector to engage in this market. Grants and other forms of technical assistance are used to support rural solar home systems and sustainable access to other modern energy services.[19]

Government banks at the national and local levels can also support lending for energy access projects. With the range of institutions potentially involved in financing energy access, capacity building will be important across the board.

For energy entrepreneurs, the off-grid finance spectrum involves upstream support in obtaining start-up funds, operating capital, and project finance, as well downstream financing for end users. Funding and financing tools need to be highly focused and represent the most appropriate type of capital for the target stage of the clean energy sector.



Off-grid Financial Spectrum

[19] REN-21, 2011

Building Financing Capacities for Energy Access

Capacity building needs to occur at all levels if efforts to rapidly expand financing for energy access are to be successful.

Philanthropists. Philanthropists need assistance on how to craft their support so that it encourages core development outcomes but at the same time promotes financial sustainability of the nascent BoP energy enterprises. Philanthropists need to help the energy enterprises anticipate the type of funding needed at later stages of growth and build capacity to attract that type of financing from the outset.

Investors. Both large and small investors need support in understanding the nature of BoP energy investment opportunities so that they can adapt their return expectations and due diligence processes to the realities of the typical BoP energy provider. Large investors, such as development banks, may be predisposed to supporting conventional energy projects because staff members are more familiar with large-scale, centralized energy sector development. Thus, staff need to be educated on the importance of finding ways to support smaller decentralized players that can reach remote off grid populations.

Financing entities. Financing entities need training to understand the risks and opportunities in energy lending, the differences between various clean energy technologies on the market, and the appropriate financing package for each type of technology. Banks and other financing entities also need to understand how to structure lending packages for end-user clients, recognizing the amounts clients pay for traditional energy products on a monthly basis and matching new loan requirements to those realities. Banks need to identify the key information points required to evaluate a client's capacity to repay an energy loan and streamline client documentation requirements accordingly.

Energy companies. Energy companies need to learn how to present themselves to potential financiers. They should be able to work out their current and long-term profitability, identify the right type of financing for their stage of development, and make a business case to investors including anticipated breakeven points and the real return expectations that can be anticipated. Energy companies need to know when to turn down funding which will undermine the company over the long-term. Finally, energy enterprises need peer-learning opportunities about financing mechanisms that work and data on the most supportive investors.

Governments. Governments need to be educated about policy measures that promote financing for universal access to energy, as well as unanticipated harmful impacts of detrimental policies and how to address them.

Enterprise Finance

- *Start-up capital.* This is needed to initiate a new off-grid business or expand an existing business into the energy sector. Funding is required to understand appropriate technologies, business models, and service requirements and package these in a way that addresses market needs and conditions. Energy service providers must build the infrastructure to meet consumer requirements – i.e., raising capital for a business start-up or expansion that is time consuming and costly, conducting market outreach and awareness to inform consumers about clean energy technologies

and their attributes, and covering the risks associated with new product and service offerings. Assistance is also essential to train innovators in business development and planning. Types of funding required include business development grants, seed capital, risk capital, and convertible loans – often provided by development agencies (multilateral and bilateral), social investors, angel investor networks, and others interested in social, environmental, and economic development via business models that may take time to achieve commercial returns. In many countries, there are still significant barriers to women entrepreneurs in accessing start-up capital.

- *Working capital.* As these early stage businesses become operational, they will typically require additional funding to manage growth. Between the promise of new solutions with evidence of success, and the "bankability" of well-established, profitable businesses, is a large and difficult chasm for most mid-stage companies. One of the largest capital demands for manufacturers, distributors, and locally based energy companies is to finance growth in working capital assets – accounts receivable and inventory. Leaders of mid-stage for-profit manufacturers and distributors of energy-related products argue there is a limited range of working capital finance for companies that have "proven success" on a small-scale, but are not highly profitable nor have a multi-year track record. Capital is also required for those companies serving as the import and distribution agencies for these vendors.
- *Project financing.* Capital is also needed for longer-term investment in infrastructure; however, few commercial lenders today are financing off-grid energy entrepreneurs in developing countries. Accessing debt and equity finance is difficult due to the lack of an operating and development track record that would provide comfort in the management team's ability to successfully deliver projects through to completion. To position themselves competitively, entrepreneurs require assistance in developing and documenting projects for financiers, including assistance in business plan development, risk identification and mitigation, competitive positioning, feasibility studies, and detailed project reports. Entrepreneurs speaking languages other than those in which business is generally conducted may be particularly disadvantaged.
- *Institutional capacity building.* Capacity building is needed at all levels if efforts to rapidly expand financing for energy access are to be successful. Both large and small investors need support in understanding the nature of BoP energy investment opportunities so they can adapt their return expectations and due diligence processes and avoid issues later in the investment process due to misalignment of expectations. Large investors, such as development banks that typically lend for larger scale conventional energy projects must understand the role of smaller decentralized projects/players in reaching off-grid populations.

The impact sought in delivering energy access for all is limited by the challenging "mid-life" phase, which comprises three key issues: availability of the right type of capital, awareness of players providing these types of capital, and capital affordability. Some of the Network members tackling these issues include Acumen Fund, which is making clean energy investments throughout the developing world; Simpa Networks, a venture-backed technology company that sells distributed energy options on a progressive purchase basis; larger financiers such as YES Bank in India; and international organizations such as the regional development banks that can provide financing and technical support for energy access through both governments and the private sector.

Eight19: Pay as you go in Kenya

Samuel Kimani lives in a township in Kasarani Constituency on the outskirts of Nairobi, Kenya. The township has very few amenities; there is no sewage or drinking water system in place, but grid connection is available for those who can afford it.

Samuel says, “It would have taken me a lifetime to save up for solar!”

Luckily Samuel did not have to wait a lifetime saving for the cheapest $50 system. His household was the first in the world to experience IndiGo’s pay-as-you-go solar energy system, which consists of a panel, two lights (12 LEDs each), and a battery unit capable of providing eight hours of light each evening, and mobile phone charging. Samuel purchased the system for an affordable $12 and activates it automatically with a $1 scratch card each week. The family’s single kerosene lamp, their previous source of light which filled the room with smoke and cost them $3/week, is now a piece of history. The two bright lights that have replaced it now enable the kids to study in the living room while his wife Mary prepares food in the kitchen. Instead of spending $0.20 to charge each of their three mobile phones at one of the many local kiosks he simply charges them at home, saving $1.50/week in the process. The pay-as-you-go revolution that is sweeping over Africa at scale is not about charity or about solar. It is about implementing a system that matches technology with the needs of the user, providing a new way for people throughout the developing world to pay for essential technology in installments. Through Eight19, BoP customers have the opportunity to access clean electricity for the first time in their lives, saving money in the process, and empowering individuals to work their way out of poverty. Furthermore, just as mobile phone networks leapfrogged landline infrastructure, Eight19 is laying the foundation for a decentralized energy system, without the wires or the carbon.

www.eight19.com

End-User Finance

One of the major challenges in scaling up the off-grid energy sector is providing end-consumers with access to appropriate financing to purchase energy goods and services, linked to their ability to pay. Microfinance Institutions (MFIs) can be part of the solution, and examples exist where this has been successful. Much more work, however, needs to be done for this sector to engage more effectively in energy lending. MFIs have also engaged in providing debt and equity and channelled significant grants and investment funds to build local institutions to serve the poor. Further, they can help reduce first costs for consumers by providing micro-credit and down payment financing, and support a variety of finance options such as micro-leasing and micro-rentals.

By way of example, FINCA International pioneered the "Village Banking Method" of credit delivery, providing financial services to the world's lowest-income entrepreneurs – those turned down by traditional banks – so they can create jobs, build assets, and improve their standard of living. FINCA programs reach the poor in more diverse countries than any other microcredit provider, with programs in 21 countries of Africa, Eurasia, the Greater Middle East, and Latin America, serving over 900,000 people – 70 percent women.[20] Faulu Kenya, a well-established MFI that has been supporting energy lending for a number of years, is expanding its activities through the design and launch of a new division that will provide loans for solar, biogas, fuel-efficient cook stoves, liquefied petroleum gas (LPG), and grid connection. The Sri Kshethra Dharmasthala Rural Development Project (SKDRDP), a 2012 Ashden Gold Award winner, provides affordable loans to families in Karnataka, South India, helping them buy life-enhancing renewable energy systems such as biogas plants, solar home systems, cookstoves, and family-scale hydro plants. Key to the success of this highly replicable program are self-help groups that assist people plan their household needs, save money, and make informed choices on what energy products they buy. To date SKDRDP has provided nearly 20,000 energy loans, benefiting around 82,500 people, with plans to scale up significantly in the coming years.

In addition to MFIs, encouraging a range of financing options for end-users will be important to dramatically increase financing volumes. These include:

- Provision of loans by local banks or entities that specialize in small-scale loans for solar and renewable energy systems, either at the household or village level.
- Financing by credit unions, credit cooperatives, and self-help groups to energy end-users. Some of these groups are already doing so and need support to expand their energy portfolios. Others need encouragement to better understand the risks and opportunities inherent in off-grid energy lending.
- Channelling of remittance flows for the purchase of energy products and payment for energy services
- Exploring innovations, such as mobile phone payments and linkages for renewable energy as it relates to consumer financing.

Another need is to create consumer outreach programs on clean energy technologies, their benefits, life-cycle costs of products and services, and available financing sources (including terms and conditions) in order to boost consumer confidence and increase credit uptake as it becomes increasingly available.

Advancing Mini/Micro-Grids

As noted in Table 1 (page 6), mini/micro-grids are projected to account for approximately 42 percent of the off-grid electricity requirements by the year 2030. This is necessary as current grid deployments are unable

[20] www.finca.org

Margin Money Financing Assists Villagers to Access Solar Loans in Rural India

Chitradurga is a district in India known for its hilly terrain. Kattehole, in Chitradurga, drew the attention of the Solar Electric Light Company (SELCO) as there was no recognizable road to approach the village and the 40 families that live there lack access to basic amenities like water, electricity, and sanitation. The remoteness of the village is evident from the four kilometer trek residents make each day to charge their cell phones. The irony is that Kattehole is located along foothills which have large wind turbines towering above, yet residents do not have access to the power these systems provide.

SELCO conducted initial demonstrations of solar technology and its advantages for the village. Although there was immense interest by the community, the cost was perceived as prohibitive, as proper financing was not an option for the poor families. SELCO approached its partner bank in the area, Pragathi Gramin Bank, which agreed to finance the systems provided a down payment of 15 percent of the system cost was made per bank regulations. Given that the livelihoods of the families center on growing vegetables and tending to goats, the margin money down payment was considered too steep.

Utilizing funding from the Renewable Energy and Energy Efficiency Program (REEEP) for the down payment, SELCO was able to overcome this barrier and financing was arranged for the remaining 85 percent of the loan to the beneficiary. This amount could then be repaid on a monthly basis, leading to affordable payments for the villagers. Today, 15 families enjoy the solar light in their home, enabling families to spend more time together after dark and encouraging the children to study.

www.selco-india.com

Table 5. Practitioner Priorities for Finance and Investment

Activity	Sample Interventions Identified	Key Partners
Enterprise Financing	Train financial institutions on risks and rewards in off-grid energy enterprise lending, structuring lending packages for end-user clients, and training loan officers on energy loans. Work with these organizations to develop risk management tools, co-invest with international financial institutions and others to diversify risk, increase financing effectiveness, design and promote tailored products in cooperation with the clean energy sector, and develop mechanisms to bundle small-scale renewable energy projects.	*Local financial institutions, local investors*
	Conduct early stage innovation funding that supports advances in technologies, business models, and financing approaches that enhance capacity and experience of entrepreneurs in delivering off-grid energy for the poor. Interventions involve hard–to-get grants and soft funding to assist in addressing all aspects of rural energy access, as well as business plan competitions specifically focused on energy access solutions and the inclusion of women entrepreneurs in the sector.	*International development organizations, foundations*
	Increase working capital (or operating liquidity) for energy access enterprises that are capital constrained in terms of growth capacity and/or unable to access regular private streams of capital due to high perceived risks in the environments in which they operate. Working capital loans provide companies with the liquidity to accept new business, grow international sales, and compete more effectively in the international marketplace; benefits are the ability to fulfill export sales orders, turn export-related inventory and accounts receivable into cash, and expand access to financing. Working capital ensures a firm is able to cover operating expenses and has sufficient funds to satisfy maturing short term debt. Managing working capital involves tracking inventories, accounts receivable and payable, and cash.	*International development organizations, impact investors, governments*
	Establish local business incubators to provide technical assistance and advisory facilities to assist off-grid energy service providers in project preparation capacity. Help create project portfolios and link viable projects to prospective investors.	*Entrepreneurs, trade associations, donors*
	Support off-grid entrepreneurs with pre-feasibility studies, feasibility studies, due diligence work, and business planning; create new capital approaches for enterprise development, such as support for early-stage seed capital funds; finance growth capital funds via blending arrangements that buy down risk and buy up returns for commercial investors; provide credit enhancements to share risks (guarantees) and buy down financing costs of commercial loans.	*International development organizations, social investors*
	Explore opportunities for carbon finance in off-grid energy projects.	*International development organizations*
	Create information portals and events for energy enterprises, focusing on financing. This would involve developing a database of funders interested in supporting early stage innovators, peer-to-peer exchanges, webinars, and more.	*International development organizations, entrepreneurs*
End-User Finance	Identify key end-user finance groups, develop training modules, and provide training and capacity building support to loan officers and management to promote off-grid energy lending.	*MFIs, credit unions, credit Cooperatives*
	Work with interested MFIs to add energy lending to strategic priorities. Ensure appropriate incentive structures for management and staff and strong processes/systems so energy lending can be effective and grow to scale.	*MFIs*

Table 5. Practitioner Priorities for Finance and Investment *(continued)*

Activity	Sample Interventions Identified	Key Partners
End-User Finance	Create a regional/global funding facility(ies) from which MFIs, local banks, credit unions, and cooperatives could on-lend. Create loan/risk guarantee funds to provide retailer/supplier credit and promote community-based financing solutions.	*International development organizations, MFIs*
	Identify and support remittance organizations—including goods remittance companies—as a source of financing.	*Remittance organizations*
	Conduct consumer awareness campaigns targeting the energy poor.	*International development organizations, MFIs*

to provide the energy services needed to keep pace in many developing countries.

The mini/micro-grid is a scaled-down version of a large-scale utility grid that is localized to a community, village, or isolated collection of energy users. It is comprised of locally based technologies that provide generation, storage, and load management – depending on priority. These grids are based on standard components and information and are cost effective and efficient, and, once deployed, adaptable to local market needs. A standardized system is beneficial to all stakeholders. Governments are able to offer additional services, enhancing citizen health, education, and safety. Utilities can improve cost effectiveness of the services they provide while expanding their service offering. Suppliers can integrate a broader portfolio of products and services. Customers receive services that are both more affordable and better aligned with their current and future requirements.

Electrical losses are significantly reduced in mini/micro-grids, given their close proximity to the load, as are maintenance costs. Typical generation sources include solar, wind, fuel cells, biofuel generators, hydropower, and geothermal. Newer micro-grids include power electronics that are adaptable to the intermittent nature of some generators and can employ smart-grid and smart metering systems from their inception. These help developing countries secure utility-scale energy services and showcase the potential of rural supply companies. They also advance environmental stewardship, reduce dependence on often imported fossil fuels, and help stem migration of rural populations to the cities.

Once income levels rise from the availability of local energy, other benefits accrue, such as improvements in health and education within the communities. Mini/micro-grids contribute to local economic prosperity, not only through productive uses such as powering water pumps and providing energy to local businesses, but also via local maintenance of the mini/micro-grid. Maintenance revenue would be included in the operating costs for the mini/micro-grid.

> "Developing countries can leapfrog developed countries' technology adoption by incorporating smart-grid systems and providing supply companies with an opportunity to demonstrate that their services offer true potential. The question becomes: how long will traditional electric utility grids remain relevant?"
>
> *— Terry Mohn, Chief Strategy Officer General Microgrids and Co-chair of the Practitioner Network Mini/Micro-grids Working Group*

Practitioner priorities in mini/micro-grid development include:

- Understanding plans by governments, power utilities, rural energy agencies, and others for extending or improving national/sub national grids to avoid targeting areas planned for grid extension. By obtaining more clarity on grid access

plans, mini/micro-grids can be developed in areas not considered viable for the conventional grid.

- Identifying low reliability or underserved energy areas. Systematic plans are required to improve or build a mini/micro-grid that can either integrate with the existing grid or operate independently. This includes defining needs for health and safety, reliability, air quality, planning for future customer requirements and load growth, and training for post-construction use to ensure that local operators and users operate and maintain the system properly.
- Establishing regulations to support development of mini-grids.
- Conducting feasibility studies for the planning of new rural communities as part of the zoning and permitting processes.
- Creating standardized power purchase agreements (PPA) to simplify administrative procedures and enhance market transparency.
- Promoting clean energy options in micro-grid development.
- Developing standardized templates that developers can use in project design and development.
- Using best available technologies to help with structuring customer payments, recognizing the need to balance household and small business/industrial customers to ensure the existence where possible of an "anchor tenant" to provide a stable source of revenue to support the installation costs.

Practitioners also recommended establishing new forms of bonding, loan guarantees, and subsidies to reduce the high initial capital costs of mini/micro-grids – which can be a major barrier to initial deployment – as well as combining energy production with other utility services such as internet and telephones. The appropriate integration of multiple technologies was identified as important, as was developing a template on micro-grid options for different types of communities, thereby helping practitioners in standardizing processes for these applications. Opportunities should be explored to permit mini-grid developers to take over in areas where a government or a large utility has installed rural distribution feeder lines that are not operational due to lack of generating capacity (e.g., in India). Finally, in planning and design of mini/micro-grids consideration should be given to potential inter-operability of the micro-grid with the electrical grid, when appropriate.

The Mini/Micro-Grid Working Group boasts over 70 members. These include major international organizations such as GVEP, the Alliance for Rural Electrification (ARE), Helios Solar Enterprise, and the Deutsche Gesellschaft für Internationale Zusammenarbeit (German Agency for International Cooperation or GIZ), which provide technical assistance, training, and financial support in the areas of mini- and micro-grid advancement. Additional members include individual companies such as General Microgrids which analyzes optimal resource options, assists in system design and build out, and provides secure control of generating assets; Horizon Energy Group, which has worked on micro-grid development for over five years in the U.S. and overseas; Sunlabob, which operates financially viable village-scale hybrid systems in developing countries that provide power 24 hours a day; and Husk Power Systems (see Textbox next page).

Standards

Technologies that fail due to poor quality or poor execution create a negative association in the minds of consumers and damage the market. These products undermine high quality or better-executed technologies and products. Standards help to ensure product quality and operability, increase innovation, reduce costs, ensure product quality, and enhance

Husk Power Systems (HPS) in India

India has a serious shortage of electricity, with people living in villages suffering the most. 125,000 villages lack grid power altogether. Even where the grid extends supply is unreliable and does not reach all households. When grid rationing takes place, villages often receive power only after midnight when 'priority' demands from cities and industry is low. This is of little use to rural households and businesses.

The state of Bihar in North-East India has a very low rate of grid electrification and acute power shortages. It is estimated the grid can meet only 10 percent of demand. HPS looked for affordable ways to address this electricity shortage and identified the potential for making producer gas from rice husks – a plentiful local resource – and using the gas for power generation at the village level. The first power plant that ran on 100 percent producer gas was commissioned in 2007. In 2008 HPS was registered as a for-profit company with a mission to provide renewable and affordable electricity to rural populations worldwide in a financially sustainable way.

The growth of HPS was helped by grant-funding from the Shell Foundation, which supported research and development (R&D), strategy development, and training, and $1.65 million in investment in 2009 from six social investors (Acumen Fund, Bamboo Finance, IFC, Draper Fisher Jurvetson, LGT Philanthropy, and CISCO). In 2010/11 HPS had 270 employees, with 80 percent of income from sales (mostly electricity, but also char products) and 20 percent from Government subsidies to new power plants. Power plants are installed where there is a reliable source of rice husk and other biomass residues within 10 kilometers.

HPS staff visits a village at the invitation of village representatives to assess its suitability for a plant and explain how the program works. If 400 or more households commit to paying a monthly fee for electricity, HPS will install a plant – rice-husk gasifier, gas engine, generator, and a 240 volt electricity distribution system – and connect the signed homes and small businesses. A village operating team maintains and runs the system, which supplies electricity up to eight hours each night.

www.huskpowersystems.com

Table 6. Practitioner Priorities for Mini- and Micro-Grids

Activity	Sample Interventions Identified	Key Partners
Planning and Implementation Support	Coordinate with central utility(ies) on grid expansion plans and implementation. Consider inter-operability of mini/micro-grid systems and utility grid.	*Conventional utility, government agencies*
	Collaborate with Rural/Renewable Energy Agencies (REAs) that are prevalent in Sub-Saharan Africa on their energy expansion plans and activities.	*REAs*
	Institute a regional mini-grid deployment plan with associated monitoring and growth management.	*Government agencies*
	Identify/develop opportunities where rural distribution feeders are substantially dark.	*Government agencies, community planners*
	Develop standardized templates for mini-grids: PPAs; electricity collection and distribution, power quality, and storage; energy efficiency and generation options; needs assessment; feasibility studies; implementation and training plans; and record keeping.	*Government agencies, financiers*
	Create universal design templates for energy efficiency and renewable energy generation options.	*Practitioner Network*
	Develop guidelines for system maintenance, operation, and training.	*Practitioner Network*
	When planning electricity requirements for the community consider a range of potential needs, e.g., households, health facilities, clean water, etc.	
Policy Support	Ensure policies and regulations accommodate mini-grids and do not compete with larger utilities. Regulations should favor new projects, not be a burden, incentivize development of micro-grids (including for smaller grid systems), and protect rural consumers.	*Government agencies, community planners*
	Promote the use of local, clean energy in mini/micro-grids. Provide exemptions from import duties on renewable energy products including micro-grid components.	*Government agencies*
	Create policy to allow micro-grid developer to "take over" dark distribution lines.	*Government agencies, community planners*

market share. Through product certification and labeling, consumers can boost confidence in the products they are purchasing.

For renewable energy technologies, which are rapidly advancing, international standards can help ensure that products are comparable in their quality across nations. Without proper standards, energy products have the potential to be unsafe, perform poorly, and/or fail quickly in a fledgling market. A regularly cited example of this is the U.S. solar thermal industry of the 1970s, where the lack of standards for equipment and installation is often blamed for a multi-decade setback in the widespread deployment of solar technology in the U.S. Conversely, standards that are set too high can limit the size and reach of the technology to only the few that can

afford it. Therefore, a key guiding principle of the Practitioner Network is to strike an appropriate balance between better quality/performance and affordability, while utilizing recent advances in technology where possible.

A number of NGOs and international organizations are working to ensure that electricity generation technologies suitable for off-grid applications do meet at least some minimum quality standards, to include both long term development programs and shorter term disaster relief situations. These entities recognize and draw upon the body of standards work currently underway and seek to leverage and harmonize these efforts in advancing electricity access.

As a result, a set of guiding principles for standards development in off-grid energy projects was agreed to by the standards working group:

- A standards framework must be sufficiently broad to cover all aspects of delivered energy solutions, in a range of settings and highly variable access to energy resources.
- In developing standards, it is necessary to understand end-user requirements and trends, work with technology providers to meet performance requirements, and factor in enforceability and associated costs for implementation.
- Standards should support established technologies that are cost-effective, proven, and leapfrog conventional practices due to lower costs and equal or better performance.
- In addition to equipment and products, standards need to address installation certification and workforce training at the local level.
- Any adopted standards should be sensitive to smaller players in the energy market. They should consider their resource constraints in obtaining proper product certification.

As the Sustainable Energy for All initiative seeks to ramp up energy access, it is important to identify gaps, overlaps, and disharmony among current standards organizations as they relate to the off-grid electricity sector, close these gaps, and educate industry actors on realigned standardization efforts. Global standards bodies, such as the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC), bring widespread dissemination of information and credibility to markets across the world. They have well-established procedures for consensus review and input available to regional standards organizations and countries, many of which have national standards bodies. Unfortunately, the cost of participation is prohibitive for many developing countries. As a consequence, for off-grid electricity services, these standards may lack the necessary inputs from the very markets they are intending to serve. Efforts need to

Table 7. Key International Standards Organizations in the Electricity Field

Product/System Standards	Institute of Electrical and Electronic Engineers (IEEE), International Organization for Standardization (ISO), International Electrotechnical Commission (IEC), GIZ, Photovoltaic Global Accreditation Project (PVGAP), American National Standards Institute (ANSI), Lighting Africa
Installation Certification	North American Board of Certified Energy Practitioners (NABCEP), International Commission on the Rules for the Approval of Electrical Equipment (IECEE), American National Standards Institute (ANSI), International Renewable Energy Certification Organization (IRECO)
Training Workforce	Institute of Sustainable Power (ISP), International Accreditation Forum (IAF), ANSI

be undertaken to bring them into the process and facilitate accelerated adoption in those countries.

Progress is being made in the standards area as they relate to off-grid electricity. For example, in the last few years, Lighting Africa has developed a comprehensive quality assurance program for off-grid lighting. Most recently, at the Clean Energy Ministerial in April 2012, a promising new international certification scheme for small-scale renewable energy – the International Renewable Energy Certification Organization (IRECO) – was introduced by prominent solar industry players from the United Kingdom (UK).

While standards are not always given the recognition of other focus areas such as financing and supply chains, they are equally important and highly interdependent. For example, financial institutions are looking for reassurance that products and systems will work as advertised; standards provide this level of comfort. Conversely, standards bodies need financial institutions and other organizations that are in positions of authority to demand quality products in their purchasing and investment decisions. An important next step would be to coordinate efforts on standards, financing, and supply chains in a target region/country to maximize leverage and results.

LED-Based Off-grid Lighting

Sponsored by the World Bank Group, the Lighting Africa program is putting in place standards for modern off-grid lighting, testing manufacturer products, providing specifications sheets for qualified products, and disseminating information on these products to governments, financial institutions, and others interested in bulk procurements and financing. This program is aimed at eliminating low cost, low quality products prevalent in the marketplace that are spoiling the market for improved lighting products and services.

www.lightingafrica.org

Table 8. Practitioner Priorities for Off-Grid Electricity Standards

Activity	Sample Interventions Identified	Key Partners
Consumer Market Assessments	Obtain reliable data on end-user requirements for off-grid electricity access products and services to support the standards development process. Provide inputs to manufacturers, distributors, and energy service providers.	*Consumer groups,*
Standards Database	Identify/document applicable standards for distributed electricity equipment, products, and services, as well as training standards. Incorporate into a standards data base for access by interested parties. Include assessments and case studies on how standards support affordability, quality, and availability of products and services in a given market.	*United Nations (UN) agencies*
Harmonization of Existing and Pending Standards	Harmonize global standards and associated certification and accreditation programs, working through credited international bodies. Harmonize test methods and evaluation metrics for a given technology type. Facilitate multi-level standards that allow for the use of different minimum requirements and performance targets in different contexts.	*Standards bodies (international, national)*
Standards Promotion and Application	Develop a business case outlining the importance of standards to help in securing funding. Encourage manufacturers to meet quality standards, distributors to stock and distribute the products, and customers to purchase standards-approved products. This should be linked with training programs for assembly, installers, and maintenance personnel. Incorporate standards into warranty and service terms offered by manufacturers and installers. Fund and facilitate participation of experts from developing countries in international standards bodies. Select a region/country to pilot an activity that links finance, supply chain, and standards activities.	*Trade associations, financial institutions, consumer groups*

Moving Forward

In addition to the working group priorities discussed in the prior section, a number of overarching activities will need to occur as the Practitioner Network continues its efforts to deliver quality energy services and solutions in developing countries. These fall into three areas – partnership building, advocacy on the critical need for universal energy access, and tracking, monitoring, and reporting of partner progress on the Sustainable Energy for All energy access objective.

Partnering for Success

A key focus of the Practitioner Network is to strengthen and integrate existing partnerships among practitioners under one global umbrella, while developing new alliances in strategic sectors to accelerate the uptake of off-grid energy services, contribute to economic and social development, help to achieve the Millennium Development Goals (MDGs), and foster collaborative and innovative solutions to modern energy access.

Strategic Partnerships

At present, a number of regional partnerships focus on energy access issues, however, the global market remains extremely fragmented. Existing networks in the energy access sector include the Global Village Energy Partnership, the Alliance for Rural Electrification, Lighting Africa, the Asian Development Bank's Energy for All Initiative and Energy for All Partnership, to name a few. The intent of the Practitioner Network is to build on, rather than duplicate the work of these existing networks, drawing them together under the auspices of the Sustainable Energy for All initiative in an action-oriented framework focused on the common objective of achieving universal energy access by 2030.

Cross-Sector Linkages

Beyond powering households and small businesses—the cornerstone of the Practitioner Network—modern energy services can support a range of social and productive applications for off-grid energy. In this context, the Practitioner Network has prioritized three sectors where the nexus with modern electricity services is particularly critical – health, agriculture, and telecommunications. Though this list is not exhaustive, and other sectors have been identified as important (e.g., water and education), these three have been specified for key near term activities. Other sectors will be considered at a later date.

1. *Health.* Safe, affordable, and effective health care is a priority for all. Yet for millions of people, many in Sub-Saharan Africa, unsanitary conditions prevail, and people lack access to proper health services, leading to widespread, preventable diseases. Better detection, response, and public information capabilities, as well as more accessible prevention and treatment programs, can help improve quality of life. Energy plays an important role in addressing health challenges:

   - Pumped water from clean sources and/or energy for purifying water reduces the spread of water borne diseases – a leading cause of infant mortality.
   - With increased access to electricity, health clinics in rural areas can power lights, water pumps, fans, refrigerators for drugs and vaccines, sterilizers, and life-saving medical equipment. An increasing focus on the energy efficiency of these healthcare appliances can also help to strengthen deployment in situations with highly

constrained power supplies. Energy also powers computers to access medical information and data and to store and retrieve records. Energy services allow more effective community education regarding health care.

- Providing energy efficient systems and practices helps hospitals reduce energy expenditures allowing more investment in other critical supplies.
- Energy services enhance amenities for health care staff, improving staff retention rates.

Priority areas for Network members include convening Ministers of Health to educate them on the importance of energy to achieving their objectives in rural health facilities and clinics; training health clinic, hospital, and community centers on maintenance and upkeep of energy systems to enable them to function better and longer; working with the World Health Organization (WHO) to establish basic energy standards for health facilities; and developing best practices in medical lighting and equipment to lower energy consumption by health care facilities, building on the extensive work that Network partners have done in this area.

2. *Agriculture.* Agriculture is the principal economic sector in many developing countries. This sector generates employment, ensures food security, creates household income, and contributes foreign exchange to every nation. The agricultural sector provides significant opportunity for economic growth as the main livelihood in rural areas. On a fundamental level, agriculture produces the food necessary for the basic nutrients to meet the health requirements of a nation and reduce hunger.

   For agricultural production, processing, and distribution, electricity is indispensable. Expanding energy access in rural areas can increase farm and labor productivity, raising returns across the value chain as well as helping to provide non-farm income through home-based businesses that can operate into the evening. Improvements in agricultural productivity can transform rural areas by raising incomes and reducing poverty. All aspects of agricultural production require some form of electricity for irrigation, production and application of fertilizers and pesticide, crop cultivation, harvesting, storage, food processing, and transport.

   Agriculture and forestry also have a variety of impacts on climate change. Raising yields on existing agriculture lands in combination with best practices will reduce pressures to expand into forests and pastures that provide essential environmental services. Additional improvements in energy use and efficiency that lead to additional GHG reductions, such as precise irrigation and fertilizer application, are critical to the sustainability of the sector. Use of modern renewable energy technologies can displace traditional biomass[21] as the primary source of energy for most rural and agricultural communities, avoiding significant environmental degradation, health impacts, and greenhouse gas emissions. In particular, modern bioenergy has an important role in providing energy access in remote areas and in transitioning rural communities to modern energy services. This may include the use of plant residues, animal wastes, and other feedstocks that will not compete with food production. Moreover, bioenergy is unique in that it can be adapted to local situations, based on feedstocks and technologies available.

   Recommended areas by the Network focus on the entire value chain, not only on farm practices, and include:

   - Engaging farmers in knowledge sharing networks (e.g., farmer field schools or cooperatives, including women), to encourage best practices

[21] Traditional biomass is defined by the IEA as biomass consumption in the residential sector in developing countries and refers to the often-unsustainable use of wood, charcoal, agricultural residues, and animal dung for cooking and heating.

and allow farmers to provide feedback and inform actions higher up the value chain. The focus should be to disseminate information on the potential of renewable energy in improving crop quality and yields, agricultural processes, and income streams, and provide capacity and technical assistance on energy access.

- Improving farmer access to financing and financing models based on income flows (e.g., during harvesting season) to increase access to renewable energy on the farm. Particular focus should be placed on microfinancing available to women, and weather-based crop insurance systems that enable farmers to reinvest in energy systems.
- Expanding the integration of electricity with agriculture production for food processing and household use.
- Removing barriers to adopting/implementing best practices in the agricultural sector across the supply chain, such as policies that promote fertilizer production and distribution and elimination of tariffs on clean energy equipment and services in the agricultural sector.

3. **Telecommunications**. Electronic commerce and information technologies (ICT) are essential tools for economic development. E-commerce helps farmers and local businesses to access timely market data, identify potential buyers and suppliers, reduce transaction costs, increase incomes, and facilitate trade. ICT enables industry and agriculture to make informed decisions about when and where to sell their products and to design and adapt products that suit customer needs. As international companies increasingly require their rural business partners to communicate electronically, enterprises in developing countries need to be able to quickly respond or be at a competitive disadvantage. For e-commerce and ICTs, reliable electricity supplies are a necessity.

   Additionally, many financial institutions operating throughout the developing world are now offering mobile banking services for account transactions, payments, and credit, including in rural areas. This provides an interesting model for financing of energy services by off-grid customers that will be explored by the Network. Both energy service providers and their customers are finding mobile phones to be instrumental in doing business in places like rural Africa, as well as providing needed data collection to support the delivery of health services. The Practitioner Network will work with partners in each of these sectors – government agencies, agricultural/extension services, health clinics, banking institutions and others – to highlight the energy linkages, demonstrate their potential and impacts, and develop models for further collaboration.

Advocacy

Over the course of Practitioner Network discussions, the need for increased advocacy on the significance of universal energy access was raised as a high Network priority, as the issue has not been receiving the attention and support required to achieve the 2030 objectives. Although several Network participants are engaged in various levels of advocacy as part of their day-to-day activities, these are generally ad hoc, tailored to a specific audience, and not coordinated with other practitioners. Further, renewable energy approaches are often out-funded and disparaged by incumbent energy providers, thus diminishing their effect. To achieve the desired targets and impact of universal access requires a well organized, structured, branded, and sustained advocacy effort over a number of years; this will be an important role of the Practitioner Network moving forward.

Solaris Multi-Mobile Solar Charger

In Western Kenya, Yvonne opens her shop each day by placing the portable solar panel outside to serve the queue of customers that are waiting for their phones to be charged.

Solaris offers a solar powered charging device that enables a shop/kiosk owner to set up a mobile or lamp charging facility for their community. The product consists of a 10 watt solar panel, battery storage, and multiple outlets to charge a range of devices. Yvonne was one of the first buyers of the product, and the success of her purchase was shown by the return on the investment in only two months. Furthermore, one Solaris system can serve up to 60 mobile phones, as demonstrated by the number of locals who said the service helped them stay connected. They no longer have to wait until their next trip to an electrified town to charge their phones.

Yvonne was approached at random on a sales run in November 2010. She quickly understood the concept and business opportunity. After seeing the Solaris product in operation, she produced her mobile phone to pay for the device with mobile payments. Within 30 minutes, she was running her new Solaris charging device!

Mobile phones in rural Africa are a necessity for growth, providing instant connections to banking, agriculture, health tools, and trade. Solaris is a highly scalable model that creates rapid impact—alleviating poverty in the most impoverished regions by connecting rural areas to the mainstream and providing dwellers access to global wealth. Yvonne's customers are able to manage their mobile finances, check crop prices, sell their produce before a harvest, and stay in touch with friends and family.

www.solaris.co.ke

Village Solutions for Global Change

The wind that blows across the harsh environment at the rural orphanage in Huacho, Peru, used to be an annoyance, but now it is a great resource that powers lights and appliances. Flor (pictured here) and the other six children who live at Asociacion Tarpuy use the wind turbine that spins on the sandy hilltop above their home. Green Empowerment and Soluciones Practicas installed the Peruvian-built wind turbine to provide power to this orphanage, but also as a demonstration system, moving the field of small wind forward.

With the support of Wuppertal Institute for Climate, Energy, and Environment, the project is part of a larger program, to improve the design and scale of implementation of wind turbines for rural electrification in Latin America. In tandem with the installation, the organizations hosted an International Symposium on Small-scale Wind Power, drawing together over 100 people from 10 countries to exchange expertise on using renewable energy for rural development.

This is just one recent example of how Green Empowerment uses renewable energy to improve lives and build the capacity of in-country partners. Green Empowerment provides villages in the developing world access to clean water, electricity through renewable energy, and sustainable solutions. Through a network of NGO partners, it works with rural communities and local/regional governments to address the connected needs of rural poverty, environmental degradation, and climate change in developing countries.

Green Empowerment coordinates needed technical, organizational, and financial assistance to support village leaders and communities motivated to improve their lives. With in-country partners, the organization has helped 170,000 people access schools and clinics with renewable energy, 22,000 people to turn on the lights in their homes, and 6,000 people to drink clean water. Additionally, it has coordinated multi-country networks and training workshops on a range of renewable technologies including biomass, wind, solar, and micro-hydro.

www.greenempowerment.org

Expected outcomes are positive changes in government policies and regulations to support advancement of modern energy services; transformation of community attitudes towards clean energy; fewer misconceptions regarding when they will receive grid power; increased quality and number of entrepreneurs delivering modern energy services in rural areas; increased breadth and depth of financial organizations and programs supporting clean energy in rural areas; increased consumer purchases of clean energy products and services; and greater accountability of energy providers and organizations for their actions in the area of clean energy service delivery.

Monitoring Success

In conjunction with the working groups, the United Nations Foundation will develop a framework for monitoring Network activities and documenting practitioner contributions to achieving universal energy access through the delivery of commitments in support of the Sustainable Energy for All initiative objectives, as well as other support activities undertaken. The Monitoring and Evaluation framework will specify information to be captured by the Network, establish results indicators, and create mechanisms for data collection, analysis, and reporting. This work will be positioned within the broader reporting mechanisms being set up within the Sustainable Energy for All initiative.

The member survey conducted in 2011 (summarized in Figure 1) was a first step in the tracking process. Additionally, case studies provided by Network members offer excellent insights into various approaches taken in the delivery of energy services and what this has meant to the lives and livelihoods of the recipient households and communities.

Routine collection of these materials, as well as others, contributes to information sharing across the Network and assists in outreach, advocacy, and fund-raising efforts on energy access.

Conclusion

Energy is critical to raising people out of poverty, advancing economic and social development, and achieving the Millennium Development Goals. Universal energy access is affordable, at a cost of about $30 billion annually – a small fraction of total energy infrastructure investments required by 2030, indeed less than the estimated current size of the kerosene lighting market. Current successful models can be expanded to the remaining 1.3 billion people deprived of modern energy and the benefits it provides.

The Energy Access Practitioner Network was born out of the recognized need for electricity access by communities and households in the developing world amid emerging global recognition that renewable energy solutions can be particularly effective in reaching isolated and low income communities. As meeting the energy needs of the rural energy poor is beyond the capabilities of traditional utilities, the Network is mobilizing a cadre of practitioners and partners to deliver electricity sustainably, even in remote, hard to access areas. Today, over 500 participants have joined the Network—with the number continuing to grow.

The Network brings together practitioners and partners from around the world to accelerate universal energy access:

- Represents a cross section of organizations involved in delivering rural energy services, from SMEs and large businesses to local banks and international development organizations
- Mobilizes a range of skill sets – technical, financial, and business
- Assembles knowledge of markets, technologies, and consumer needs
- Shares information on the latest innovations in delivering modern energy services.

Practitioners have noted that a key benefit of the Network is having their own platform for sharing experiences, streamlining activities, partnering on projects, and tackling common problems in the marketplace. The convening power of the United Nations Foundation, with its reach into the UN system, the private sector, the financial community, and others, provides access and clout they lack individually. ***The Practitioners are committed to scaling up their activities for poverty reduction in rural households and communities. The Network is providing the tools, support, and know-how to help achieve this goal.***

But they cannot do it alone. The Network requires the continued and expanded partnership of governments, international development organizations, NGOs, companies, foundations, communities and others to join their resources in making the energy access vision a reality.

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