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# POLICIES TO SPUR ENERGY ACCESS: VOLUME 1

## ENGAGING THE PRIVATE SECTOR IN EXPANDING ACCESS TO ELECTRICITY

**Terri Walters, Sean Esterly, Sadie Cox, Tim Reber**
National Renewable Energy Laboratory

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**Technical Report**
NREL/TP-7A40-64460
September 2015

Executive Summary PDF | Volume 1 PDF | Volume 2 PDF

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# About this Report

This report was written to support policymakers who want to accelerate energy access by engaging private sector participants in developing countries or regions. It focuses on **electricity access**; for the purposes of this report, the term "energy access" refers to access to electricity and related services rather than cooking fuels or technologies. The report focuses on the use of **distributed** (or decentralized) electricity options rather than grid extension. While its primary focus is off-grid energy access, it also offers policy information for including distributed electricity as part of the grid.

These policy issues are complicated and many issues are interrelated. The authors would like to remind readers that the Clean Energy Solutions Center offers governments access to expert assistance on these and other clean energy policy issues at no cost. More information is available at cleanenergysolutions.org/expert.

The report consists of an executive summary and two volumes that cover three types of information. The volumes can be read in conjunction with each other, or they can be read separately. The executive summary covers both Volume 1 and Volume 2.

## *Volume 1: Engaging the Private Sector in Expanding Access to Electricity*

**Section 1—Basics of Distributed Electricity Access**
Intended to provide background to those new to off-grid energy access, Section 1 of this volume provides a brief rationale for why governments should consider prioritizing distributed electricity access. It discusses the benefits of accelerating access and the role that small and medium-sized enterprises (SMEs) can play in providing those services. After highlighting barriers that SMEs face in engaging in energy access, this section introduces the role of government in opening these markets.

**Section 2—Policies for Decentralized Energy Access Markets**
Drawing from a wide range of existing programs and reports, this overview describes the key policies that countries are using to enable the development of the off-grid energy access market. Experience has shown that a holistic policy approach is most successful in fostering small and medium-sized enterprises to provide energy services to rural customers. This section addresses the government's role in each element of the market—from energy regulations to finance options and from business support to worker training. It also discusses the role of various ministries in expanding energy access and approaches for integrated actions across agencies and levels of government. Policies in this section are highlighted with real-world examples and emerging good practices, drawing on the case studies presented in Volume 2 and other examples from the literature.

## *Volume 2: Case Studies of Public-Private Models to Finance Decentralized Electricity Access*

Volume 2 uses case studies to examine five different models for off-grid energy access around the world, including Bangladesh, Ethiopia, Mali, Mexico, and Nepal. Each study examines a program, policy, or innovations in a market, and each case study assesses the policy decisions that led to the current market and their impact on SMEs in distributed energy access.

# Acronyms

| | |
|---|---|
| ADINELSA | Electric Infrastructure Management Company (Peru) |
| AEPC | Alternative Energy Promotion Centre (Nepal) |
| CCAC | Climate and Clean Air Coalition to Reduce Short-Lived Climate Pollutants |
| CEM | Clean Energy Ministerial |
| CERER | Regional Renewable Energy Centers for Rural Electrification (Peru) |
| CIMES | Intersectoral Committee for the Implementation of Synergies between Energy and other Strategic Sectors (Senegal) |
| CLEAN | Clean Energy Access Network |
| CPCB | Central Pollution Control Board |
| DOE | Department of Energy (United States) |
| ESCO | energy service company |
| ESMAP | Energy Sector Management Assistance Program |
| FONCODES | Cooperative Fund for Social Development (Peru) |
| IDCOL | Infrastructure Development Company Limited (Bangladesh) |
| IEA | International Energy Agency |
| IIED | International Institute for Environment and Development |
| IRENA | International Renewable Energy Agency |
| JICA | Japan International Cooperation Agency |
| LEAP | (Global) Lighting and Energy Access Partnership |
| LEDS | low emission development strategies |
| MFI | microfinance institution |
| MRFCJ | Mary Robinson Foundation for Climate Justice (Ireland) |
| NAMA | nationally appropriate mitigation actions |
| NGO | non-governmental organization |
| NREL | National Renewable Energy Laboratory (United States) |
| NRREP | National Rural Renewable Energy Programme (Nepal) |
| PPA | power purchase agreement |
| PREMER | Project for Renewable Energy in Rural Markets (Argentina) |
| PROMER | Project for Improving Rural Education (Argentina) |
| PRONAMACHCS | National Program of Watershed Management and Soil Conservation (Peru) |
| PV | photovoltaics |
| REEEP | Renewable Energy and Energy Efficiency Partnership |
| SE4All | Sustainable Energy for All Initiative (United Nations) |
| SME | small or medium-sized enterprise |
| SPPA | standardized power purchase agreement |
| UNCDF | United Nations Capital Development Fund |
| UNCTAD | United Nations Conference on Trade and Development |
| UNDP | United Nations Development Program |
| UNEP | United Nations Environment Program |
| USAID | U.S. Agency for International Development |
| USD | U.S. dollars |
| VOCTEC | Vocational Training and Education for Clean Energy |
| WHO | World Health Organization |

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# Introduction

Access to sustainable, reliable electricity is a daily challenge for one in four people on Earth. Currently, 1.2 billion people have no access to electricity, and another 800 million have no access to reliable grid power that is able to meet their basic energy needs (Desjardins et al. 2014). Despite current and planned investments in energy access, one billion people in developing countries are expected to still lack access to basic electric services such as modern lighting in 2030 (IEA 2014).

This report—*Policies to Spur Energy Access*, published in two volumes—focuses on the role public policies can play in creating opportunities for private-sector delivery of distributed energy access in developing countries.

According to the International Energy Agency (IEA), achieving universal energy access by 2030 would require an increase in funding of more than 400% over current annual investment—an estimated 40% of which is expected to be in distributed off-grid solutions (IEA 2011). Because that level of increase is unlikely from additional public sector and donor entities, the IEA concludes private-sector investment will be required to substantially increase energy access (IEA 2011).

Distributed (or decentralized) electricity technologies can often provide a quicker, more cost-effective path to electricity access.[1] Where policies enable markets for distributed electricity services, they offer opportunities for private sector participation. Governments can design programs to leverage public funds to engage private-sector investment, especially at the local and national levels. Public-private partnerships offer opportunities to close the access gap, but private-sector participation must be supported by an appropriate policy, legal, and regulatory environment. Rather than just focus on public sector delivery models, policies can be designed to support the private sector. In certain markets, the private sector may provide the best option for delivering energy access (Bardouille et al. 2012).

Because 80% of people without electricity access live in rural areas in Asia and Africa (IEA 2011), developing countries play a key role in the future of energy access markets. Issues such as government reliability as well as policy clarity and consistency are essential to attracting private investors. For example, investors in solar off-grid lighting ranked uncertainty in legal and policy frameworks as the largest barrier in providing capital to this market (A.T. Kearney 2014).

While opportunity exists to create enterprise-based electricity access markets, governments have a major role to play in establishing enabling policies and regulations, in building capacity, in coordinating resources beyond traditional energy authorities, and in catalyzing financing for market players. With proper public support, these energy access markets can ultimately be transformational while also becoming self-sustaining (Desjardins et al. 2014).

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[1] In this report, "distributed energy" and "decentralized energy" refer to electricity generation that is on-site or near the load it serves. A decentralized market utilizes distributed energy technologies to provide electricity services on an individual or small-group (minigrid) basis. Distributed energy may refer to a wide range of energy technologies, and it can refer to both off-grid and grid-connected technologies.

# 1 Basics of Distributed Electricity Access

This section provides a basic primer on why energy access, specifically electricity access, is important for developing countries. This section also:

- Outlines the role that decentralized clean energy technologies can play in accelerating universal access to electricity services
- Identifies key opportunities to foster and engage the private sector, particularly through small and medium-sized enterprises (SMEs) to deliver energy access
- Introduces the government's role in fostering this market through policy actions.

Policy options for accelerating electricity access are discussed in Section 2.

## 1.1 Development-Related Benefits of Energy Access

Access to modern energy, such as electricity and electric lighting, plays an indispensable role in enabling widespread socioeconomic development. The World Bank has known this for decades, acknowledging that "in modern times no country has managed to substantially reduce poverty without greatly increasing the use of energy" (Saghir 2005). Provision of modern energy services unlocks potential to **enhance economic development, public health, education, water and sanitation, gender equality and a range of other factors affecting development goals**. The cumulative effect of energy access enables citizens to better their own socio-economic livelihoods, participate in an increasingly global market, and ultimately contribute to economic development and prosperity domestically.

The United Nations General Assembly unanimously declared the decade 2014–2024 as the Decade of Sustainable Energy for All (SE4All) in an effort to underscore the key role of energy in sustainable development and to incorporate energy in the post-2015 development agenda.[2] While energy access was not explicitly addressed in the United Nation's 2015 Millennium Development Goals, there is a consensus among experts that ensuring access to clean, reliable, and affordable energy services is now a necessary component to achieving these goals. In fact, the following goal is currently included in the proposed post-2015 Sustainable Development Goals: "ensure access to affordable, reliable, sustainable and modern energy for all."[3]

Energy access may spur **economic development** in several ways, including:

- **Reduced Household Energy Expenditure:** Kerosene and batteries are costly, both in terms of cash expense and time spent obtaining the fuels. For example, in Bangladesh even a poor household may spend up to US$11 each month on kerosene and household members have to walk up to 30 kilometers every few days to purchase kerosene or charge a battery (Sovacool and

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[2] www.se4all.org/decade/

[3] According to the United Nations Development Programme, the members of the United Nations are now in the process of defining Sustainable Development Goals (SDGs) as part of a new agenda to further the work of the Millennium Development Goals. This agenda will be adopted by Member States at the Sustainable Development Summit in September 2015. See www.undp.org/content/undp/en/home/mdgoverview/post-2015-development-agenda/.

Drupady 2011). Thus, replacing these fuels with affordable electricity not only nets financial gain but may also free time for other productive purposes.

- **Enabling of Enterprise Development:** A range of business opportunities becomes available with energy access. It can enable power equipment for manufacturing and increase agriculture productivity through irrigation pumping and tools, such as huskers and mills. Additionally, home-based businesses such as bakeries or shops become more viable. Studies have noted that solar-electrified stores are able to operate longer due to improved lighting and show markedly increased revenues compared to non-electrified stores (Martinot et al. 2002). And, in some cases, novel types of micro-enterprise can be introduced, such as renting mobile phones or electric lanterns or charging batteries for a fee (Terrado et al. 2008).
- **Increased Connectivity and Competitiveness:** In today's increasingly globalized world, electricity allows one to access the global community and to compete, connect, and collaborate more effectively (Friedman 2008).

Energy access may also support **public health and healthcare** through:

- **Reductions in Respiratory Illnesses:** The World Health Organization estimates that respiratory diseases from indoor air pollution are one of the top four leading causes of death in developing countries (WHO 2004). While the burning of biomass for cooking carries the bulk of the responsibility, the burning of kerosene and other carbon-based fuels for indoor lighting contributes to poor indoor air quality as well. By eliminating combustion-based lighting practices, electric lighting can reduce exposure to indoor air pollution and its associated health risks (Zahnd and Kimber 2009; UNEP 2015). Burning kerosene indoors also carries an increased risk of burn injuries and house fires, which can be eliminated with electric lighting.
- **Operation of Basic Medical Equipment and Provision of Treatment at Night**: Without reliable power in healthcare facilities, many of the most basic life-saving procedures cannot be undertaken properly or when they are most needed (Text Box 1). The World Health Organization (WHO) estimates that roughly two-thirds of child mortalities in rural clinics could be preventable with even the most basic energy interventions that provide minimal lighting and device-operating services (WHO 2014a; Mills 2012). Additionally, women in least-

**Text Box 1. Solar Suitcase Saves Lives**

On Idjwi Island, the day Dr. Jacques Sebisaho brought a Solar Suitcase—a portable power unit—to his clinic, he used the solar-powered lights to safely deliver twins to a pregnant woman.

The following day, his community witnessed a cholera outbreak, forcing his team to work night and day to care for men, women, and children suffering from this disease. In the past, such an outbreak would have caused a 50% loss of patients; however, none of the 122 infected people they treated during the next month died. The Solar Suitcase was transformative because the team was able to offer around the clock healthcare to cholera patients.

*"We are witnessing what light can do in a community and how it can save lives in communities where night means death if (you are) sick or in need of emergency care after the sun goes down!" – Dr. Jacques Sebisaho, Democratic Republic of Congo*

developed countries are 300 times more likely to die from pregnancy-related complications than those in the developed world, simply because clinics may not have lights to safely deliver a child at night (UNICEF 2009).

- **Refrigeration of Vaccines, Medicines, and Blood**: Vaccinations and medicines delivered to developing countries are often rendered ineffective due to inadequate refrigeration—leading to an estimated 1.7 million child deaths from preventable diseases each year (WHO et al. 2009). Electric refrigeration in clinics allows more effective storage and distribution of these crucial vaccines and medicines.

Energy access may enhance **educational outcomes** by providing:

- **Improved Studying Conditions**: Bright, reliable electric lighting is widely credited with improving the ability of children to study in the evenings. In Nepal, for example, local schoolteachers reported noticing clear improvements in the performance of students with access to electric lighting at home (Zahnd and Kimber 2009). Supporting this anecdotal evidence, statistical studies have shown a link between electrification and increases in average study time and years of completed schooling in children (Khandker et al. 2009).
- **Better Classroom Technology:** Enhanced technology in classrooms can connect students with global peers and broaden the educational tools available to teachers—from computer education to distance-based learning and exchange.

Energy access also contributes to achieving **water and sanitation** goals. Addressing water scarcity and sanitation problems often involves increasing energy consumption, as electricity is used to **run water purifiers,** to **pump and distribute clean subsurface water** for drinking or irrigation, and to **operate water treatment and sanitation facilities** (UN 2014). However, energy production using traditional fossil fuels often adds pressure to already scarce water resources and exacerbates water concerns (UNW-DPAC 2014). Clean and reliable renewable energy can provide the necessary power to address these water and sanitation issues without adding stress to existing water resources.

Finally, electrification may also play a role in **women's empowerment and gender equality** across a range of mechanisms, including:

- **Time Liberation:** By permitting timesaving household appliances like grinders, mixers, and sewing machines, electrification can reduce the time women spend maintaining the home. This time can be spent increasing productivity, and it can support increased economic activity. Electrification can also reduce time spent on obtaining fuel or charging batteries—a task that often falls to women and can consume an entire day.
- **Girls' Education:** Girls in least-developed countries are often kept out of school because they are needed at home to help their mothers with home-maintenance activities. By reducing the workload at home, electrification can free time for girls to attend school.
- **Women's Health:** Women are far more susceptible to the health consequences of poor indoor air quality, as they spend more time inside cooking and taking care of the home. Thus, they stand to benefit most from reductions in indoor air pollution. Improved communication technology also leads to more effective dissemination of information regarding women's health issues and family planning. Finally, the effects of electrification on maternal mortality in rural clinics have already been discussed. In fact, the specific role of energy access in improving women's health has been identified as one of several high-impact opportunities by the United Nations' SE4All initiative (Section 2.4.2 discusses this issue in detail).

## 1.2 Defining Electricity Access

Many discussions of energy access distill a highly complex issue to a simple "yes" or "no" question, does a house have a power source? However, defining energy access this way fails to consider any information regarding the quality or usability of the power source. Ultimately, energy access is not simply about supplying energy but rather **ensuring people are able to power modern appliances that will improve their lives.** A house that is connected to the national grid may be classified as having gained energy access; but if that house only receives two hours of power in the middle of the day, the problem of delivering adequate electric lighting to allow children to read at night has not been solved.

The IEA and World Bank, supported by 20 other organizations, led the development of a new framework for tracking energy access that dissociates energy access from the mechanism of delivery and instead focuses on what people are actually able to do with their power (SE4All 2013). The Global Tracking Framework is a multi-tiered energy access framework that evaluates how a household uses energy access across several criteria: peak available capacity, annual consumption, duration of service, evening supply, and quality (Table 1) (Bhatia 2014). This framework will track energy access progress by country. Only once **all** the required criteria are satisfied—thus ensuring a standard level of reliability, adequacy, and accessibility of power—will a household advance from one tier of energy access into the next. Additionally, the tiers are associated with the types of appliances that each tier can provide. For this reason, the tiers can be used to assess not only whether a household has energy but also what energy services they can access.

**Table 1. Tiers of Energy Access as Evaluated by Six Primary Criteria**

| Criterion | Tier 0 | Tier 1 | Tier 2 | Tier 3 | Tier 4 | Tier 5 |
|---|---|---|---|---|---|---|
| Peak Available Power (W) | none | >1 Watt (W) | >20 W | >200 W | >2,000 W | >2,000 W |
| Consumption (kilowatt-hours/year) | < 3 | 3–66 | 67–321 | 322–1,319 | 1,319–2,121 | > 2,123 |
| Duration of Supply | none | >4 hours | >4 hours | >8 hours | >16 hours | >22 hours |
| Evening Supply | n/a | >2 hours | >2 hours | >2 hours | 4 hours | 4 hours |
| Quality | n/a | low | Low | adequate | adequate | adequate |
| Typical Applications (Cumulative) | none | radio, task lighting | general lighting, fans, televisions, light office needs | air cooling, food processing, and task oriented food preparation | refrigeration, water heating, pumps, expanded food preparation | air conditioning, space heating and full food preparation |

Each metric is independent of the mechanism by which the power is delivered. For example, a household may be connected to the grid, but if it receives less than four hours of electricity a day, it may still be classified as "Tier 0." This emphasizes the importance power reliability and adequacy.
(Source: World Bank/ESMAP, forthcoming)

### 1.2.1 The Role of Distributed Energy in Providing Access

While the long-term goal in many countries will be extending the electricity grid to all citizens, this can take decades and be extremely costly, depending on many factors. In many cases, distributed energy options can provide quicker solutions for populations with no access or limited access to energy services. There are a range of opportunities to provide energy access without grid extension.

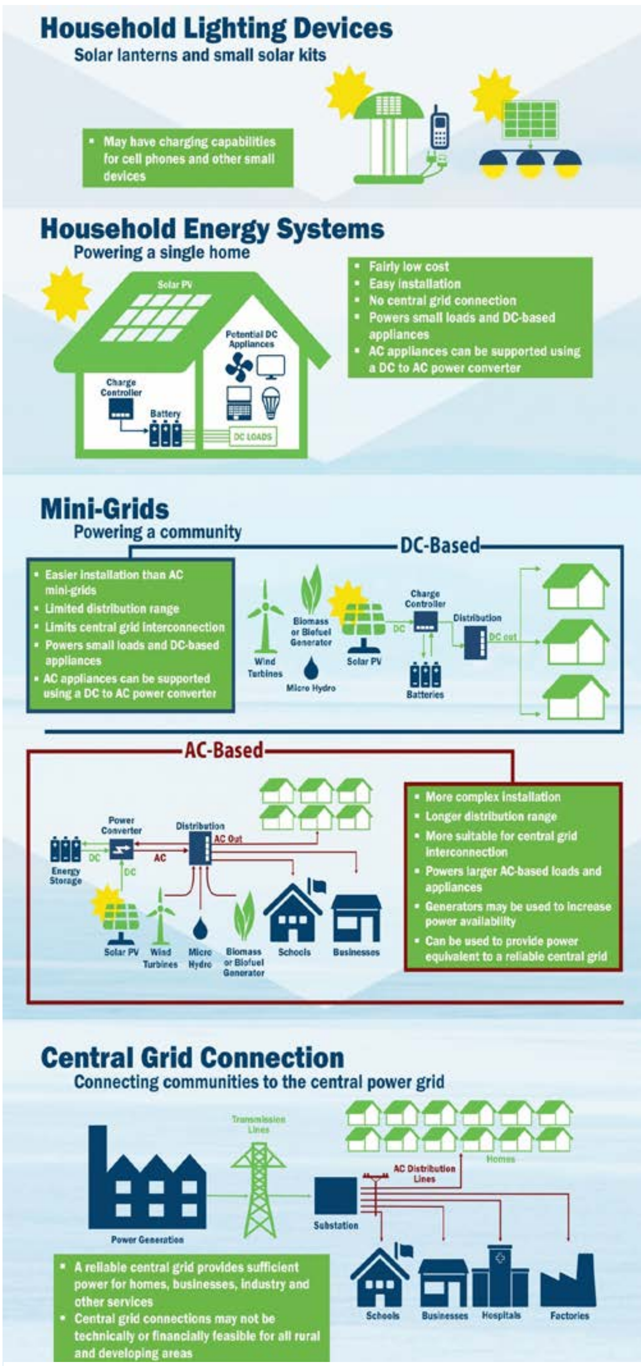


**Figure 1. Pathways to energy (electricity) access**

Source: www.cleanenergyministerial.org/Blog/pathways-for-energy-access-39363

Throughout the world, power systems are moving from purely centralized systems to integrate an increasing amount of distributed power. Innovations in technologies, policies, and business models have started to transform the power systems throughout the world (Miller 2015). A convergence of issues has created a major opportunity for affordable, replicable electricity access through distributed energy. Dramatic cost reductions in clean energy technology, particularly in solar electricity and batteries, coupled with new advances in energy-related wireless and information technologies, have created a burgeoning opportunity for entrepreneurs to deliver energy services directly to the market (Desjardins et al. 2014).

Distributed electricity projects can typically be implemented more quickly than grid extension and they can be handled by private entities in parallel with utility efforts. For example, since its inception in 2003, Bangladesh's solar home system program has installed household electrification systems in three million rural households, two-thirds of them in the last three years. In the same period, the country's rural electricity cooperatives have extended access to the national electrical grid to about 1.3 million households (see Volume 2, Section 1).

In remote or sparsely populated areas, distributed energy may provide the most economical option for electricity access in the long term. Generating power near the end users can help governments avoid building and maintaining costly power lines. In addition, transmitting power over long distances can result in both significant power losses and increased concern for reliability, as damage to the lines at any point can disrupt power for customers.

The IEA estimates decentralized energy solutions will be the pathway to energy access for *60%* of the 1.2 billion people still without electricity.

Source: IEA 2011

Distributed generation provides populations and communities with access to electricity and power that were previously unavailable to them through traditional means. Using a range of technologies and at varying sizes, unserved and underserved populations can gain energy access through several different avenues (Figure 1).

**Household lighting devices** and solar powered devices provide power at the level of the personal device. Lanterns and solar charging kits can have substantial impacts on daily tasks, activities, and home life for those without power. **Household energy systems** that are affordable and simple to install can provide off-grid power to families. These systems produce small amounts of power for primarily DC-based appliances. The power is generally produced with small-scale solar photovoltaics (PV) paired with charge controllers, and it is stored in battery backups. **Minigrids and microgrids** provide power to communities through a variety of energy generation sources, including solar PV, wind, micro-hydro, and biomass or biofuel generators at a range of sizes. This pathway to energy access can provide stability and income-generation opportunities for multiple families from one energy source. The energy can be either DC-based (which is best for small ranges and loads) or AC-based for larger applications (which can be a precursor to central grid integration). These can operate either in conjunction with a central grid or completely independently in an off-grid setting. **Central grid connection** follows the traditional energy model and provides homes, businesses, hospitals, and schools with reliable energy. This model is most cost-effective in dense populations; remote rural areas or regions with unreliable grid-connected power may benefit from pursuing microgrids either as a first option or to stabilize their community power (CEM 2015a).

In addition to energy generation, demand-side products such as off-grid (DC-powered) appliances and equipment are also an important part of the energy access equation. The appliances that consumers use with their power becomes an integral part of the energy access solution. When a consumer can access the same level of service for less energy, energy businesses can either reduce the amount of generation needed or increase the service provided for the same power system. For example, with DC-powered **super-efficient appliances**, a 25-watt solar home system with a battery can typically power a television, fan, radio, multiple lights, and a phone charger. This is less than half of the total consumption of one incandescent lightbulb. Considering the impact of demand-side programs in electrification plans can provide a highly sustainable model for development. Figure 2 shows how commercially available efficient appliances can cut solar power needs dramatically.

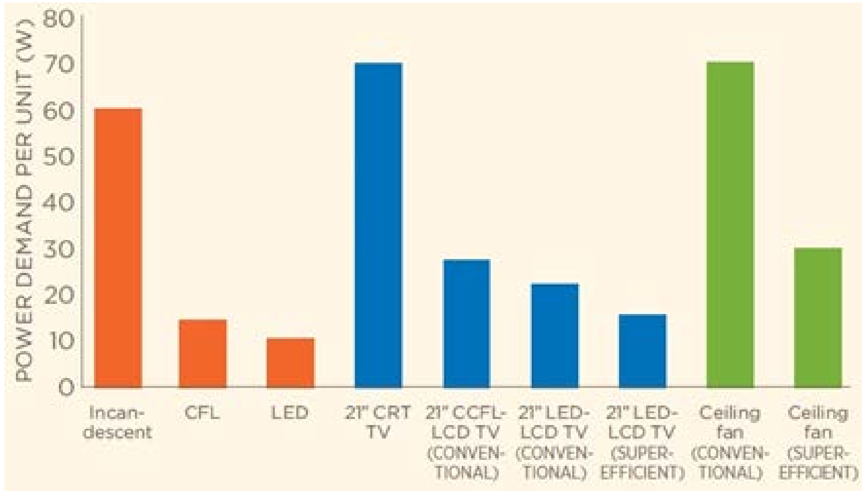


**Figure 2. Power demand of commercially available efficient appliances**

Source: Lawrence Berkeley National Laboratory, International Energy Studies Group

As discussed in Section 2.1, governments can plan to determine how to coordinate the development of off-grid distributed generation with the eventual extension of the electricity grid. A variety of policies and standards can be implemented both to provide market clarity to off-grid developers and to ensure the power generation can be incorporated into the grid rather than replaced by it.[4] This gives long-term value to those assets. And, if it is accompanied by clear, up-front transition policies, it can interest more private companies in providing these energy services.

### *1.2.2 Why Clean Energy: The Role of Renewables*

"Distributed energy" does not inherently imply renewable energy. In fact, distributed systems may be based on a variety of energy resources, both traditional and renewable. Overall, the use of clean energy technologies boosts sustainable and low-emission development goals at both a local and national level. The choice of resource can also have a significant impact on the performance, value, and ultimate efficacy of distributed systems, making a discussion of renewable versus traditional fuels relevant.

This comparison is especially apt for **minigrids**. Existing minigrids across the developing world are often powered by expensive diesel-powered generators. This leaves communities with ongoing fuel needs and leaves them vulnerable to price fluctuations and high transportation costs. In some cases, these added transportation costs can exceed the cost of the fuel itself, forcing remote communities to pay rates significantly above—in some cases quadruple—the average market price for fuels such as diesel and kerosene (Mainali and Silveira 2013, p.306; Zahnd and Kimber 2009). While renewable energy often involves higher up-front costs, it can provide off-grid communities with the reliable

[4] For example, super-efficient DC appliances, while often superb in purely off-grid applications, can pose a problem when it ultimately comes time to connect to the grid, which is more often than not AC. Hence it is important for policymakers and developers to carefully consider grid-interconnection issues when evaluating options. See section 2.1.2 for more information on grid interconnection.

high-quality energy service they demand while fostering local independence and reducing long-term operating costs.

Indeed, many nations have already begun the transition by moving to hybrid minigrids that typically incorporate 75%–99% renewables (GVEP 2011). Biomass, biogas, geothermal, wind, and micro-hydro all have potential to supply least-cost power for this type of hybrid minigrid, provided the available local resource is adequate (GVEP 2011). For example, Nepal and Sri Lanka have successfully employed micro-hydro minigrids to increase energy access in recent decades (Palit and Chaurey 2011; Gunaratne 2002), and in Mali, renewable-based hybrid minigrids have proven less expensive than diesel-only minigrids (see Volume 2, Section 3). Governments, too, stand to save significantly on fuel subsidy expenses when demand for diesel, kerosene, and other subsidized fuels is displaced by locally produced renewable energy (UNEP 2015).

As noted in Section 1.1, the definition of energy access is becoming directly tied to the energy services that access enables. This definition increases the emphasis on quality and reliability of power. Clean energy technologies, particularly solar photovoltaics, with their small modular nature, have already proven effective across the developing world in the form of solar-powered lanterns and solar home systems (i.e., "pico-PV") to replace kerosene and biomass for home lighting purposes.

System reliability can be bolstered by switching from fossil fuels to renewable fuels. Diesel generators for off-grid applications typically have a short service life, and they can be unreliable and prone to frequent breakdowns—disrupting power supplies and incurring added costs (Bastakoti 2003). Replacing fossil-fueled minigrids with hybrid systems that use multiple renewable energy sources improves minigrid resiliency and can reduce service interruptions, even if one component may be unavailable due to technical issues or resource limitations.

Communities as a whole may be strengthened by renewable-based minigrids through a host of additional intangible benefits. Developing and maintaining local renewable resources requires local capacity, which can spur investment in the local workforce and skill development. Money previously spent on foreign fuel imports may now be paid to a local cooperative or organization to pay salaries of local energy workers. Improved environmental performance of renewables and reduced exposure to petroleum-based fuels can provide strong public health benefits. The same environmental performance, coupled with the elimination of noisy, often smelly generators may also help boost tourism and increase community revenue.

Several of the primary benefits of energy access outlined in Section 1.1 are maximized only when access is granted through renewable energy sources:

- Cost-savings when fuels like diesel and kerosene are displaced by renewable power.
- Public health outcomes are improved with the limitation of exposure to petroleum-based fuels for lighting and electricity.
- Women's productivity increases when diesel or kerosene fuels no-longer need to be collected regularly.
- Modular power provides reliable access to a wide range of energy services.

## 1.3 Enabling Private Enterprises to Deliver Energy Access

In a public sector approach, government entities oversee extension of the electricity grid. In the privatized approach, enterprises and community groups primarily carry out the electrification (Tenenbaum et al. 2014). In certain markets, the private sector may provide the quickest model for closing the access gap if it is supported by adequate policies and support. Many other sectors, such as telecommunications and banking, have created innovative ways to use private entities to extend access. The convergence of energy and communications technology has opened new opportunities for the energy sector to do the same (Bardouille et al. 2012).

To date, the most effective model for providing distributed energy services to local consumers in a replicable and reliable model involves engaging small entities, such as private SMEs. With proper support and financing, small local enterprises can understand local markets and nimbly provide services that meet customers' needs. In turn, they can create local distribution channels and support services for their energy products which create local ownership and jobs and expand economic development opportunities in the areas they serve (Mills 2014b; Reddy 2015; Chaurey et al. 2012; Sovacool and Drupady 2011).

Throughout the world, small businesses are taking advantage of their small-scale and simpler decision-making processes to tap tremendous potential for flexibility and innovation. As an example, several countries are already seeing innovative business models transform energy access markets. By leveraging modern communication and mobile-money technology, energy service providers, such as M-KOPA Solar in Kenya and other countries, have developed "pay-as-you-go" models to allow customers to pay for energy services as they can afford them by using mobile systems for payments and mobile technology to monitor and authorize consumer energy use (Wilson et al. 2014). A number of private sector companies have attracted investment from private sources of financing. This brings an important new source of funding into energy access markets in developing countries.

While this represents an opportunity for smaller enterprises, there are also roles for larger companies in the distributed energy access market, which represents billions of people and major opportunity. Multinational corporations will likely be involved in providing the technology underpinning the energy systems and appliances that are used throughout the developing world. For examples, Philips Lighting has been active in off-grid lighting and a company executive currently serves as the President of the Global Off-Grid Lighting Association.[5] In some cases, large companies have created or invested in smaller enterprises. Working directly with customers to develop affordable energy services for each market and customer type as businesses expand their customer base is a decidedly "retail-level" business, but some small enterprises are working with established national businesses to leverage their retail base. One-size-fits-all models have yet to work well in this space, but some small enterprises are creating integrated business-to-business partnerships with national corporations – even with non-energy businesses. These partnerships can provide SMEs with access to the customer relationships, brand recognition and marketing power associated with established businesses (Desjardins et al. 2014). One example is One Degree Solar—creator of an all-in-one

[5] Global Off-Grid Lighting Association. See global-off-grid-lighting-association.org/about-gogla/.

personal solar electricity system that powers phones, radios, tablets, and lights[6]—which has partnered with Coca-Cola to distribute the solar product in Kenya.[7]

### 1.3.1 Barriers to Distributed Energy Enterprises

Entrepreneurs developing and implementing distributed energy access businesses face several critical barriers. Small-scale businesses can be at a disadvantage in navigating complex regulations in an electricity sector dominated by central power generation. In addition, small-scale pioneers establishing new markets can face difficulty securing affordable financing—particularly working capital—or accessing workers with the necessary skills in a new field. Table 2 provides a high-level summary of barriers in relation to the policy, capacity, and market and financial environments facing energy enterprises. Section 2 provides details on specific barriers to distributed energy and outline policy options for addressing them.

The government role also extends to consumer protection. While streamlining the market for SMEs to gain a foothold, governments should ensure these enterprises are providing quality products and reliable, affordable services to foster a sustainable market for energy services.

### 1.3.2 Government Roles in Enabling Market-Driven Energy Access

Governments have an important role in delivering basic services, such as energy access, to its citizens. The International Energy Agency estimated that achieving universal energy access by 2030 will require global investment of $48 to $86 billion U.S. dollars (USD) per year—a 5- to 10-fold increase over current spending levels (IEA 2011). The IEA has concluded that the growth of private-sector investment in energy access must lead the way and that this is unlikely to happen in the absence of regulatory reform and an enabling policy environment from developing governments (IEA 2011). Others that assume a more efficient pathway to universal access via decentralized clean energy still estimate that approximately $500 million in public investment will be needed in the next two to three years to finance both off-grid clean energy manufacturers and consumer finance providers (Crain et al. 2014). Private support for energy access will be funded through a variety of financial instruments and sources.

Policymakers have a major role in fostering the expansion of a market that attracts private participation. Programs and policies must be flexible in design to accommodate the full range of actors. Policy clarity and consistency are crucial to successful programs that enable a stable, sustainable market sector for SMEs, attract private investment to energy access efforts, and remove barriers to innovative business models.

Governments can identify and address barriers to market development. Governments can also tailor their own support—both in policies and in financing programs—to open the market to innovation, local solutions, and private financing. Proper government policies can create incentives and streamline regulations to stimulate a new energy access market, attracting private enterprises and financing. This can leverage scarce government resources to provide more energy services to more citizens more quickly.

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[6] One Degree Solar. See onedegreesolar.com.

[7] "Let There Be Light: Bringing Solar Power to Rural Retailers in Kenya." August 6, 2014. http://www.coca-colacompany.com/innovation/let-there-be-light-bringing-solar-power-to-rural-retailers-in-kenya.

**Table 2. Barriers to Distributed Energy Enterprises**

(Wilson et al. 2014, Singer 2014)

| | |
|---|---|
| **Policy Barriers** | |
| Non-conducive policies | Policies and regulatory frameworks that are focused on grid-based or larger energy projects can also hinder distributed energy market development. Certain policies, such as fossil fuel subsidies or policies that limit electricity services to utilities, can create an uneven playing field for clean distributed energy enterprises and can discourage investment in renewable energy technologies. |
| Uncertain policy environment | Uncertain or unstable renewable energy policy environments (e.g., tax incentives that are regularly changing) can deter enterprises from developing businesses or hinder business operations. |
| Political instability | Broader political instability can decrease international investment opportunities for distributed energy enterprises. |
| **Capacity Barriers** | |
| Too few business models and local leadership | Successful and leading distributed energy enterprises can provide lessons, good practices, and motivation for other enterprises. In countries where the market is nascent and advisors are few, enterprises may be less willing or able to develop quality business models and financially-sound business plans and proposals. |
| Lack of skills in workforce | Remote electricity access often involves technologies that require specific skills for installation, maintenance, and service. As access markets are in early stages, these technologies are likely new and experience with them is limited. |
| Lack of experience within local finance institutions | Until successful business models have been implemented in a region or country, financiers with little experience with these technologies or business models may be less willing to invest in them. |
| **Market and Finance Barriers** | |
| High perceived investment risk | Energy access businesses are often associated with greater investment risk as they often target poor and remote populations. As new technologies, like distributed renewable energy, may be perceived as higher risk or low return on investment by financiers. Loans often include requirements for collateral of physical assets or equity. |
| Near absence of “patient capital” | Enterprises need financing to move from concept, through feasibility studies and business plan to operations. This investment is often longer term as rural markets often require development. This can impede development of energy access businesses as investors often focus on shorter-term profit opportunities and established markets. |
| Lack of coordinating institutions | National and regional-level institutions are often needed to coordinate and channel finance to smaller-scale energy access projects via local banks and other institutions, but they may not exist or be engaged in the market. |
| Difficulty attracting small investment | Given the small financial scale of energy access projects, enterprises require capital in lower amounts that present a barrier to accessing finance. Small-scale financing leads to high transaction costs and interest rates. Willing regional or international investors also face challenges providing this financing without bundling or aggregation vehicles to create scalable packages. |

# 2 Policies for Decentralized Energy Access Markets

Intended for use by policymakers seeking to create or expand a sustainable market for decentralized electricity services, this report divides government roles into four interrelated policy areas that cover the broad range of government policy decisions that affect the market for distributed (or decentralized) electricity access services. The discussion in this section includes examples from countries using these policies. Sections 2.1 through 2.4 discuss a range of policy options for each of the four interrelated government roles, and each section briefly discusses the barriers that the roles address as well as the design details that impact energy access SMEs.

- **Establishing an Enabling Policy Environment**: Section 2.1 deals with the government goals, policies, and regulations typically considered in energy markets. Many of these topics will be familiar to energy ministers and energy regulators, but the topics will be discussed in the context of enabling private sector-driven energy access.
- **Catalyzing Finance**: Ultimately, the ability of a private sector-driven market to succeed will hinge on the ability of market actors to obtain patient, affordable financing in an appropriate scale and timeframe and for market actors to make a profit. This includes suppliers, service providers, and end users. Section 2.2 outlines the significant role of government in bringing investors to the market including engaging financial partners, reducing investor risks and providing targeted incentives and mechanisms to support a sustainable market.

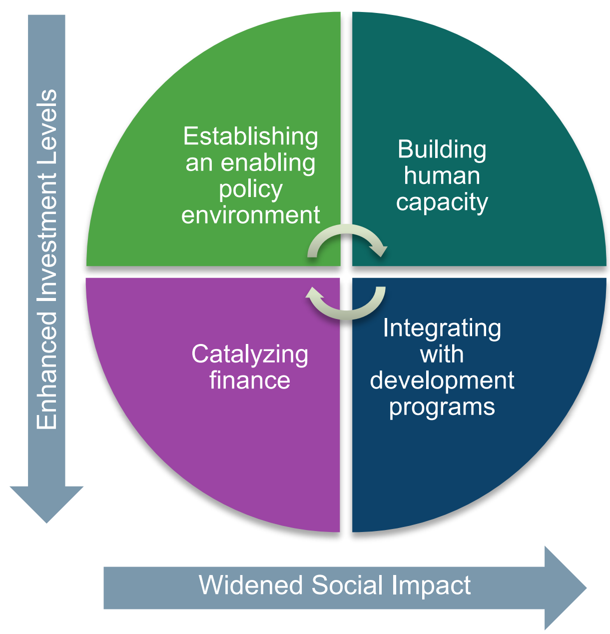


**Figure 3. Government roles to accelerate energy access**

All four areas are interrelated and must be addressed in concert with a coordinated effort.

- **Building Human Capacity**: As countries develop new markets, players in every aspect of those markets—enterprises, employees, technicians, financiers, customers, policymakers, and regulators—need to understand the market, including its risks and opportunities. Section 2.3 discusses government roles in expanding in-country capacity needed for a robust and sustainable market to function.
- **Integrating with Development Programs**: Energy access policies and opportunities expand well beyond the typical boundaries of the energy sector. Government policies on social protection, education, health, and climate-friendly development can all impact energy access markets. Section 2.4 discusses these impacts as well as the opportunities for leveraging development policies outside of the energy sector to support energy access markets.

Most of these discussions assume markets that are fledgling or not yet in existence. Many government roles will be less involved as the market grows. Ultimately, as finance is catalyzed, the market will mature and the actors will be better positioned to provide feedback to the other policy areas. For example, SMEs in the sector and consumers can provide feedback about needs in the broader policy environment and capacity building. Established SMEs may be able to work with other development programs to provide affordable or innovative solutions to development needs. This process will be iterative in a growing market. However, this overview focuses on policies for the early stage of market development.

## 2.1 Establishing an Enabling Policy Environment

Throughout the world, electricity markets have been developed based on the traditional model of central power plants and grids. Developing countries looking to incorporate distributed energy into their electrification plans, particularly for expanding access to electricity services for the underserved, may need to adjust some of their enabling policies to ensure they accommodate those technologies and business models. This section discusses the range of policies that can impact the ability for enterprises to emerge and flourish in the energy access market.

Cutting across all energy policy decisions, investors repeatedly note that the most important element in government policies for energy access is that they be **clear and consistent**. Political uncertainty and continual upheaval of policies elevates risks, not only to the success of individual SMEs or projects but also to the market as a whole. Government support must be trustworthy or it will fail to spur the desired investment and market development. Figure 4 summarizes the key policy elements decisions involved in establishing an enabling policy environment. Policies are grouped into three categories—planning and coordination, regulations, “doing business”—and are discussed in the sections that follow.

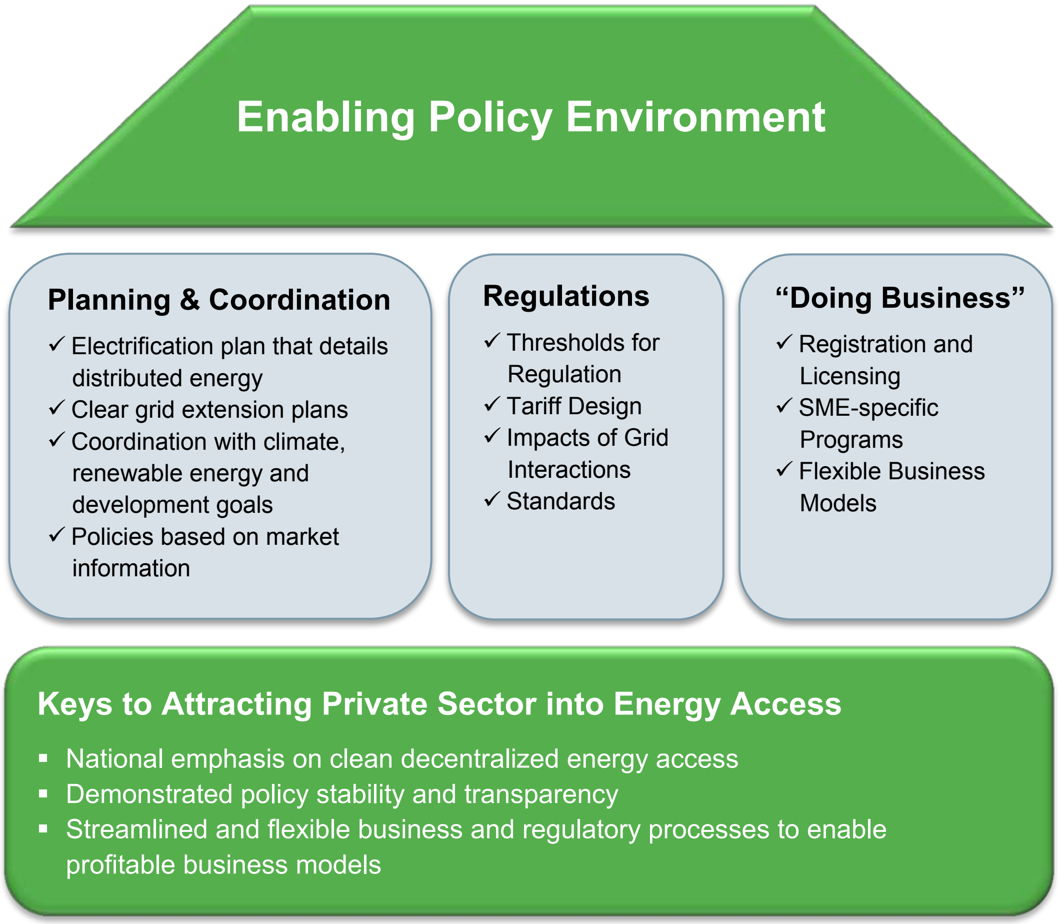


**Figure 4. Key factors in establishing an enabling policy environment**

### 2.1.1 Planning and Coordination

Overarching policies for planning and coordination of the electricity sector are the first element in enabling policies for off-grid energy markets. National electrification planning sets the tone for the government's policies and, if off-grid energy solutions are not specifically addressed, the plan can hinder enterprises from the start. National energy policies represent an opportunity to delineate the national energy strategy, including defining how energy access supports overall national energy goals.[8]

[8] Sustainable Energy for All (SE4All) has created the Country Action Agenda as a tool to set forth a national plan. For more information, see http://www.se4all.org/wp-content/uploads/2014/02/CARD.pdf

### *National Electrification Plans*

If a government wants to enable SMEs to provide off-grid energy services, its national electrification plan should specifically **include decentralized electricity options** as well as centralized grid plans (Singer 2014). National planning can also consider the opportunity to use grid-connected decentralized electricity to improve grid stability. In a typical centralized approach, the government, through the energy ministry, a national utility, and/or a rural electrification agency, provides electrification through extension of the national grid. In the decentralized approach, private enterprises and community groups primarily carry the burden of electrification. These two approaches can complement each other in accelerating energy access (Tenenbaum et al. 2014).

The Asian Development Bank has developed a framework for sustainable energy access planning to meet SE4All goals. This type of planning prioritizes energy demand at all economic levels, extends affordable energy access, and assesses both supply and demand side options and technologies (Shrestha 2015). Whether the inclusion of decentralized options is intended as interim or transitional access or as a permanent complement to the electricity grid, specifically incorporating decentralized options signals a government priority to enable this energy access market. For instance, India's target of 100 gigawatts of distributed solar by 2022 provides a clear example of how the government is choosing decentralized energy (Pearson and Katakey 2015).

One of the most important elements in a national electrification plan is providing **certainty about plans to extend the grid**. Such plans should include publicly available details about geographic areas to receive grid access and details about timing (Franz et al. 2014). While providing specifics can be difficult, as no one wants to hear that the grid will not reach them for 20 years, if ever; such specifics are exactly what are needed to enable off-grid businesses. A number of off-grid energy projects have been installed only to have an electrical grid connection reduce their value a few years later A market like this without strong options for connection and cost recovery for businesses will likely attract little if any interest from private companies and will make projects very difficult to finance given the risk (Samuel Booth, pers. comm., August 2015). Investors and businesses are looking for policy certainty; being transparent about plans for grid access in certain areas can actually offer those areas accelerated private energy options. Mexico provides an example of how specific grid plans can create an opportunity for new businesses to serve those needs (see Volume 2, Section 4). The Mexican national utility, Comisión Federal de Electricidad, created clear guidelines about where they planned to extend the grid and what areas would not receive electrification. Their guidelines were based on population and distance from the existing grid, and they were upfront in sharing those plans. With a clear market to target, Iluméxico, a successful private small business, was created to provide energy services to those outside the grid.

Another consideration in developing a national electrification plan is how to **coordinate the energy plan with other development goals**. Because these plans are often authorized or developed at a high level, they can address development needs that are beyond the energy ministry but intricately tied to energy access; such development needs include pro-poor policies as well as agricultural, health, education, and economic goals (Singer 2014). National energy planning ideally occurs in concert with economic development with an eye to long-term potential (Bardouille et al. 2012).

Nepal's off-grid energy policy is linked explicitly to pro-poor development goals (see Volume 2, Section 5). There, the National Rural Renewable Energy Programme (NRREP) aims to increase energy access for the poor through targeted subsidies, and to improve socio-economic development through a support component for micro and mini enterprises and other income generating activities**.**

Electrification planning also links closely with both climate development and overall renewable energy goals. As renewable energy costs have dropped, these technology options are often the most affordable option for off-grid electricity projects (Wilson et al. 2014; Volume 2, Section 3). Acknowledging the interrelation of these national goals with the electrification plans can provide guidance for ministries to coordinate their efforts and take advantage of shared interests in clean energy access.

Governments can develop **market information** at the national level to underpin planning efforts. Full analysis can assess the ability of energy access sectors to contribute to national goals. Basing policy decisions on direct market data can increase the likelihood of the policy's success. But, beyond government use, when market information is expanded and made available to the private sector, it can have significant impact on attracting businesses and investors to the market. Where a government can provide detailed market analysis and data on areas in need of electrification or areas of the grid that are available for interconnected projects, SMEs can move more quickly from concept to viable business model. Accurate independent data also bolsters SME business plans and reduces perceived investment risks (Franz et al. 2014). More information on this is provided in Section 2.3.1.

### *Coordinating Agency Roles*

To support SMEs in energy access, the role of each agency should be clarified and streamlined where possible. An enterprise-based market will involve small companies that likely will not have the ability or resources to navigate multiple government agencies easily (Wilson et al. 2014). Energy access policies can involve a wide range of government agencies beyond the energy ministry, including those at the state and local levels. Energy access is essential to achieving health, education, and poverty alleviation goals, among others, and the most effective policies will integrate efforts across relevant government programs and will leverage the unique capabilities of each (Table 3). By coordinating roles, support can be maximized to help encourage broader SME participation and creation of a robust energy access market. Establishing a "one-stop-shop" to help SMEs navigate what is likely a complex process can help ease the burden (Tenenbaum et al. 2014). Table 3 lists the types of government agencies that may be involved in or have programs related to energy access programs.

**Table 3. Government Entities with Impact on Energy Access Programs**

| Primary | Related |
|---|---|
| Energy/Infrastructure Ministry | Water Ministry |
| Finance Ministry | Environment Ministry |
| National Development Bank | Development Ministry |
| Rural Electrification Agency | Education Ministry |
| Energy Regulator | Health Ministry |
| Commerce/Economy Ministry | Agriculture Ministry |
| State and Local Agencies | |

The issue agency coordination is relevant to nearly all aspects of energy access policy, and it appears several times throughout this report. Further information on models for streamlining government operations, including establishment of "one-stop-shops" and centralized rural electrification agencies, is included in Section 2.1.3. Coordination of energy access efforts with finance ministries and government financial institutions is discussed in Sections 2.2.2 and 2.2.3. And, integration of energy access with other development and social agencies and programs is addressed in Section 2.4.

### 2.1.2 Regulatory Environment

Electricity and business regulations that are not specifically designed for off-grid or distributed electricity projects can often hinder or stop these projects – even if this is unintended. When policymakers are trying to enable a wider range of electricity projects to expand energy access, regulations should be reviewed to ensure they allow flexibility in the types of technology, the types of projects, and in business models.

Policies should address appropriate regulation at different sizes of projects, and required regulations should be dramatically streamlined to facilitate small projects. Because many regulations are intended for larger projects, a 100-watt project might inadvertently face the same technical and legal hurdles as a 100-MW power plant with the same associated economic burden. One-size-fits-all regulation design can effectively shut down the market for small systems.

The following sections cover some energy regulatory areas that are particularly important to the development of SMEs in energy access. Regulations that govern the types of businesses that can participate in the electricity market are covered in Section 2.1.3. Financial regulations are covered in Section 2.2.

#### Thresholds for Regulation

In keeping with reducing administrative burdens for SMEs in energy access, governments may want to set a threshold for regulation and decide not to regulate projects or transactions for energy systems below a certain size. For businesses that work with many small projects, streamlined regulations, or the ability to bypass them, can make a significant difference in the affordability of the service they can provide.

Some countries choose to let many energy access services operate in a completely deregulated environment. For example, Tanzania has completely deregulated small-scale energy projects below 100 kilowatts (kW). This reduction in government oversight reduces burdens for energy access SMEs, often microgrid and minigrid developers. Energy access SMEs credit this approach with creating a more business-friendly atmosphere and accelerating energy project development (Franz et al. 2014).

Decisions about whether to regulate these projects requires a balance between reducing burdens on small companies and maintaining levels of consumer protection. Governments may reduce the utility-scale regulations on small energy projects but still require basic practices for safety and reliability. For example, an enterprise selling small solar home systems might not be subject to regulation, but that same SME might be subject to certain quality standards and warranty requirements to qualify for financial incentives.

It is difficult to cite a specific size- or capacity-threshold for regulation, though Franz et al. (2014) suggested thresholds for low-regulation at 500 kW and no regulation for projects less than 100 kW. Specific thresholds will be specific to the region, country, and technology of the project, but a general guideline may be that if a new enterprise is not at risk of developing a local monopoly[9] then heavy regulation may in fact be harmful (Tenenbaum et al. 2014). In such a case, a form of low-burden regulation may be appropriate, guided by four principles: (1) minimize information required by the regulator, (2) reduce the number of separate regulatory processes and decisions, (3) use standardized and readily available documents, and (4) communicate and use related decisions by other government bodies (Tenenbaum et al. 2014). This form of low-burden regulation can reduce the costs of regulation born by SMEs and minigrid developers—who are often already operating on the edge of commercial viability—and facilitate their entry into energy access markets (Tenenbaum et al. 2014). However, one must be wary of opening up regulation too much, as a lack of oversight can in some cases encourage speculators (who have no real intention of developing their projects) and create a glut of applications that clog the system and prevent legitimate projects from coming online (Tenenbaum et al. 2014). Ultimately, transparency and consistency regarding who will be regulated and how is key to designing a successful regulatory process.

### *Tariff Design*

In a utility grid, the costs associated with serving a customer varies based on each customer's location and load profile. Utilities average the costs of serving a wide range of customers so that tariff rates do not always reflect the cost of serving each individual customer but rather the costs overall. Many countries have adopted national tariffs to ensure equity among customer costs. When minigrids or off-grid systems are adopted, policymakers must determine whether to enforce this national tariff on all electricity services, even those not connected to the grid. When national electricity tariffs in developing countries are subsidized by governments, grid consumers do not even cover the cost of utility operations, and this sets up a further disparity between grid-connected and off-grid consumers.

Allowing SMEs to charge tariffs that may be above national caps yet are related to the costs of the energy they provide is crucial to establishing a private energy access market (Bardouille et al. 2012). When enterprises provide off-grid energy services, they must be able to recover their capital and operating costs and make a profit or their business model is not viable. Even when SMEs charge tariffs above national rates, they often still offer cost-savings to customers. For example, when households do not have reliable grid power, they still incur energy costs—for kerosene, candles, and other energy sources—that are not capped by national tariffs as other power customers are. Thus, SMEs can often provide clean electricity access at or below prices that end users may already be paying while still charging a cost-reflective tariff (Wilson et al. 2014). Tariffs that are directly related to the cost of providing service can also reduce the likelihood of service providers overcharging consumers for energy access.

Policymakers can look at options to make tariff schemes more equitable, such as charging a small fee to grid customers to offset capital costs, connection fees, and other costs for off-grid customers. If doing so, policymakers must be aware that private SMEs are less interested in operational or per-kWh (kilowatt-hour) subsidies that depend on large utilities and government agencies. As these

[9] Local monopolies can be helpful to development, such as concessions described in a Section 2.1.2. However, in those cases, regulation may be appropriate to ensure service levels and maintain consumer protection.

subsidies can be cumbersome to manage and prone to delay, small business operating on a near-zero margin cannot sustain unreliable subsidies and continue to operate (Franz et al. 2014).

To encourage innovation, tariff structures should also accommodate flexible financing or payment models, such as "pay-as-you-go" models. This flexibility allows more poor customers to have access to energy, but it requires flexibility on the part of governments to enable these transactions. More information is included below in the Flexible Business Models section of Section 2.1.3.

### *Integration of Grid Extension and Off-grid Policies*

In certain localities, a government may want to encourage private-sector enterprises to provide energy services in certain geographic areas until the grid can be extended to provide service there. As noted above, it is important to provide public details on when the grid will extend into such areas. But, further policies on the transition of geographic areas from off-grid to grid access can encourage private investment in these areas. For instance, minigrids operated by private investors in Cambodia were sorely under-funded and poorly maintained for years because there was no policy in place regarding the transition from off-grid to grid access, and enterprises saw little sense in upgrading systems that may soon have become inviable or been scrapped (Tenenbaum et al. 2014). However, Cambodia has since enacted a policy to allow private minigrids that meet certain technical standards to connect to the national grid, spurring renewed investment in reliable minigrids that now serve as functional bridges until the national grid arrives in those areas (Tenenbaum et al. 2014).

Potential government actions to encourage private-sector energy services include:

- Provide **concessions** to developers to provide exclusive electricity service to certain areas
- Clarify **interconnection** and **tariffs** for connecting distributed energy projects to the existing grid
- Specify terms for how projects will **interact with the utility grid** once grid extension reaches an off-grid project.

All these will require cooperation between rural electrification agencies, utilities, and other agencies involved in energy access projects. Regulations designed in consultation with stakeholders will have a better chance of addressing their needs.

#### Concessions

When a utility identifies an area that will not have electricity in the near-term, concessions can be a useful tool to attract developers to specific areas that need energy access. A concession gives a developer exclusive rights to provide certain energy services within a geographic area—maybe a community or a region—for a specified amount of time. This guarantees the developer the right to provide energy service to that area and states that grid extension will not overtake their projects within a specified time without compensation.

Governments can define concession areas in advance (top-down model) or provide them in response to developer requests (bottom-up model). Concessions can be offered competitively or on a first-come basis. When concessions are offered in a competitive process such as an auction, governments should consider a decision process that hinges on more elements than simply the lowest cost. Reviews that assess the quality of the project, the skills of the developer, and the impact to the environment and community are more likely to select feasible projects with realistic costs. Another good practice in concessions involves the use of terms that allow the government to amend or rescind the contract if the developer does not provide the agreed-upon energy services within a certain timeframe (Bardouille et al. 2012).

The Mali government (see Volume 2, Section 3) has taken both a top-down and a bottom-up approach to encouraging private developers to build minigrids by providing two separate routes to approval. Although the government has designated clear areas for concessions, nearly all the developers chose the route of submitting unsolicited proposals as that provided fewer administrative burdens than competitive concessions. The overall program has been successful in attracting a wide range of minigrid developments and providing increased energy services.

As a final example, the Argentine government designed the Project for Renewable Energy in Rural Markets (PREMER), its rural energy access program, with concessions specifically designed for the private sector. However, the initial concession terms required too much capital cost sharing and tariffs that were too low to encourage private-sector participation. To increase participation, the program modified the terms of the concessions to accommodate the financial needs of private-sector participants and allow public sector participants where private-sector businesses were not available (Best 2011).

### Interconnection to the Grid

Interconnecting local distributed power systems can provide benefits to utility grids. Particularly in the case of minigrids, local generation can provide power to the grid, but it can be designed to avoid power disruptions to minigrid customers during times of grid power outages (Miller et al. 2015). In addition, distributed power options can actually strengthen grid function. According to the 21st Century Power Partnership, microgrids can increase utility reliability and resiliency. Distributed generation, such as microgrids, can also be used to provide key services such as peaking power, demand response, and ancillary services (Miller et al. 2015).

Cuba offers an example of using distributed generation to strengthen power systems. Cuba moved from 188 days of significant blackouts in 2004 to zero in 2007 by adopting a national power system transformation that moved from a centralized grid toward microgrids (Lovins 2010). Cuba's installation in 2006 of over 3,000 MW of decentralized power—along with investments in electrical systems infrastructure and energy efficiency—nearly eliminated blackouts (Guevera-Stone 2009). About 40% of Cuba's electrical generation is now from distributed electricity systems, one of the highest rates in the world (Avila 2008). This distributed approach, known as La Revolucion Energetica, has also allowed Cuba to better survive recent hurricanes.

Two key barriers impact the interest of developers in building projects that are connected to the electricity grid: the legal and technical ability to connect their distributed electricity to the grid and the ability to get enough revenue to make the project profitable.

Interconnecting to the grid allows a project to send power to and receive power from the grid as part of normal operations. **Interconnection policies** regulate the ability to connect distributed generation to the utility grid. Interconnection agreements cover physical equipment and operation requirements to enable the system to connect to the grid. They include provisions to ensure the project does not impair the safe operation of the utility grid.

Though traditional utilities may be new to the process of incorporating distributed generation sources into the utility grid, the process can and should be standardized. The standardized process should include specifics on how to apply, who is responsible for each stage of analysis and approval, which equipment and procedures are required to ensure safety, and other related issues (Tenenbaum et al. 2014). Including such details can provide clarity about the process and allow developers to make informed decisions about projects. Several countries have enacted or proposed standardized interconnection guidelines, including Tanzania, Kenya, Sri Lanka, and Thailand (Tenenbaum et al. 2014).

The second barrier, having enough revenue to run a profitable energy access business, is impacted by the cost of power from the utility grid. When governments or utilities are interested in engaging private-sector power producers to develop distributed projects or minigrids, governments often need to cover the incremental costs of the power production. This can be done with a variety of measures that range from tax credits to grants. A common policy is a **feed-in tariff**, which provides a guaranteed per kilowatt-hour payment to renewable energy developers for renewable electricity produced and "fed" into the grid. These payments are established in long-term purchase agreements that provide market certainty for developers.[10] Feed-in tariffs are one of the most widely adopted renewable energy support policies around the world. They can be used strategically to encourage deployment of renewable technologies in areas that may be suffering from poor levels of service and reliability. FITs can also provide security for mini grid developers who may eventually be interested in connecting to the grid. As of 2013, 98 national and subnational governments had implemented feed-in tariffs (REN21 2014).

### Project Interaction with Grid Extension

Whether grid extension reaches a particular area in two years or twenty years, governments can reduce investor risks and provide a more stable market if they provide clear terms about how off-grid projects will interact with the grid when it reaches the project. Once grid access is available, either previously off-grid electricity projects will be replaced by the grid or they can be connected to the grid and incorporated into the utility's systems. Incorporating these assets rather than removing them can increase flexibility and reliability.

To utilize off-grid distributed generation for future use on the grid, technical specifications and standards should be resolved prior to these projects being built. These may result in slightly higher project costs, and governments and utilities can decide how to incentivize those costs to gain future grid assets. Governments may want to both determine the size and type of projects that would be eligible for interconnection to the grid and pre-determine the requirements for interconnection. Again, these requirements should be clear and transparent to SMEs developing these projects to provide certainty for the future of the project.

Aside from technical specifications, the financial implications of incorporating local generation into the grid can significantly impact potential investors. If a project is replaced by grid access, the developer (or the end user) may have lost their investment in the energy system. Even if a project is connected to the grid, the economics of a project may not make sense. If grid power is available at a lower tariff than the minigrid customers were paying, this interconnection will result in either a loss for the developer or tariff disparity on the grid. Policies can directly address such issues, and they can clearly specify the ownership and cost recovery plan for off-grid energy investments as the grid expands. These might include the terms under which the utility will buy back off-grid investments

[10] See "Feed-in Tariffs: Good Practices and Design Considerations" at cleanenergysolutions.org/policy-briefs/fit.

during grid expansion or provide compensation for stranded assets. Provision of clear options and financial details for what happens when the grid reaches off-grid assets can create certainty and reduce risk for both developers and end users, and it can provide more interest in the off-grid market (Franz et al. 2014; Tenenbaum et al. 2014).

### *Standards for Energy Products and Services*

Perpetuation of a vibrant and financially viable energy access market hinges on provision of reliable products and services. If consumers do not receive the expected value for their energy investment—such as a solar lighting system that does not function properly or a minigrid that does not provide power when expected—or if investors encounter losses on projects that are not adequately designed, built or maintained, the market can quickly collapse.

Policies can address this in several ways. For individual energy products such as small lighting systems, the first step is to develop standards to increase **consumer protection**. Regulators can adopt quality standards for certain systems to improve the reliability of energy products in the market. They can go further by providing certification of certain types of technologies and even requiring warranties on energy systems as a condition of financial support. As a starting point, Lighting Global recently released a set of quality benchmarks intended to set a baseline level of quality, durability, and truth-in-advertising to protect consumers of off-grid lighting products (Lighting Global 2015), and the World Bank organization is developing a similar set of standards for off-grid solar home systems (Lighting Global 2014). Quality standards should also consider the ability of products to operate at conditions under which the products will be used, which are often much different from testing environments (Hande and Rajagopal 2015). Ultimately, standards must not be too burdensome for low-income end users.

Partner support may also be leveraged to promote certain quality standards. In Bangladesh (Volume 2, Section 1), the Infrastructure Development Company Limited (IDCOL) recruits its partnering organizations against certain eligibility criteria using a stringent screening process. IDCOL also sets the technical specifications of the product, certifies products and components, and stipulates required warranties for both equipment and after-sales service. A technical standard committee then approves the suppliers and the equipment to be used.

For minigrids, quality issues can become more complex: customers need reliable power that they can afford; private developers need to be able to develop and operate a reliable system while delivering a return on their investment; and, investors need to understand the risks associated with investing in a particular minigrid (Global LEAP 2015). Not all minigrids are intended to be equal—some might provide basic energy services while others might provide reliable, high quality power that is readily available in a model similar to the electricity grid. As illustrated by the case of Cambodia, mentioned previously in this section, clear policy regarding technical standards and procedures can actually boost investor confidence and lead to improved quality as well as increased investment (Tenenbaum et al. 2014). When designing effective quality standards for minigrids, it is important that regulators consider three factors: the cost of quality, their ability to monitor and enforce standards, and whether to regulate energy product inputs or outputs (Tenenbaum et al. 2014).

The **cost of quality** is of particular importance when focusing on energy access, as quality standards must not be cost-prohibitive to end users. Consumers will always desire the highest-quality products and services, but regulators must consider whether consumers can realistically afford such quality (Tenenbaum et al. 2014). Quality standards, such as regulations that prohibit power suppliers from connecting customers who lack properly certified wiring, frequently hinder widespread technology adoption (Bardouille et al. 2012). Hence, it is a difficult balance: sub-standard minigrids can offer lower tariffs and enable more customers to connect, but they may be insufficient to support productive uses of energy and cannot be connected to the grid when it does finally arrive (Franz et al. 2014). Some regulators, such as Peru's Osinergmin, have approached the issue by defining multiple tiers of quality so that energy products and services can be appropriately matched with end users' ability to pay while still meeting established quality standards (Tenenbaum et al. 2014).

Regulators must also design quality standards that are relatively simple to monitor and enforce yet are still effective. Regulating energy service outputs—e.g., frequency, voltage, and continuity of power supply—is the ultimate goal and will prevent regulators from micromanaging minigrids, but output-based regulation may initially be more difficult to implement than regulation focused on power supply inputs such as equipment and procurement standards (Tenenbaum et al. 2014).

To provide a basis for minigrid quality standards, the Global Lighting and Energy Access Partnership (Global LEAP) is working with partners to create a Quality Assurance Framework for Isolated minigrids, which is expected to be available in 2016. The framework will provide common terms to define tiered-levels of service from minigrids—that is reflective of increasing thresholds of power quality, reliability and availability—and will offer a common accountability and reporting framework so regulators, consumers and investors can validate the performance of minigrids.[11] An established quality framework such as this can provide the tools for market actors to measure whether customers with a guaranteed level of service they can afford, power suppliers with a guaranteed rate of return, and investors with confidence about their investments (Global LEAP 2015).

#### *Energy Efficiency*

A key factor in providing affordable energy services to those without access is the ability to provide those services with less power. If a television uses half the power, only half the power must be generated to provide that service. Where governments are interested in appliance manufacturing, programs to support the development and use of energy efficient appliances will support energy access goals. In addition, as efficient appliances become available for both basic energy services and for productive uses for income generation, governments can develop policies, standards, and incentives to increase their adoption. Policies that encourage the adoption of efficient appliances in conjunction with power systems can increase the reach of limited funds for energy access.

### *2.1.3 "Doing Business" Policies*

Governments have requirements for creating and operating a business. These can involve basic licensing and registration requirements, but they can also involve a range of policies associated with working with the energy or banking sectors. To foster SME development, these processes and policies need to be adapted and streamlined for small and medium-sized businesses.

[11] The "Quality Assurance Framework for Isolated Mini-Grids" is being developed under Global LEAP, an initiative of the Clean Energy Ministerial, by the National Renewable Energy Laboratory in partnership with Sustainable Energy for All and Power Africa. Additional information is available in *Promoting Energy Access through a Quality Assurance Framework for Isolated Mini-Grids*. For more information, see http://www.cleanenergyministerial.org/Portals/2/pdfs/GlobalLEAP-Minigrids-QA-framework.pdf.

Overall, SMEs will have a better opportunity to participate in the energy access market if they encounter business policies that encourage, rather than hinder, small businesses. For example, banking requirements for business loans that require collateral can prevent small businesses from participating.

### *Registration and Licensing*

Simply setting up and operating a business can involve a number of requirements. Small costs and extra burdens alike can discourage small businesses. Factors to consider are the costs associated with setting up an energy business—initial and recurrent—and licensing requirements, including requirements for insurance or capital. In general, these business policies cut across all sectors, but energy-related business policies in particular may have initially been developed with utilities or large power plant developers in mind and now need to be modified to accommodate smaller projects and developers.

When companies are forging businesses in a new market, business policies may not be in place to accommodate them. SMEs might be faced with learning complex rules or navigating reviews from multiple agencies. For example, several different legislative authorities in India control the setting up of not-for-profit businesses, and there is an entirely different set of rules for establishing for-profit companies. Text Box 2 (Section 2.2.2) details some of the regulatory complexities SMEs face in India.

Small businesses in the energy access sector are unlikely to have much experience with navigating government business requirements. Establishing streamlined processes for SMEs can support this market and reduce the resources spent on government compliance. Such business requirements should be assessed at both the national and sub-national levels.

### *Programs for Small Business*

While developing countries sometimes have programs to support the development of SMEs, these programs often are unaware of energy SMEs and do not recruit them. For example, Ghana had a $100-million SME development program in 2012, but energy was not a program focus (Christine Eibs Singer, pers. comm., August 2015). Expanding these programs can offer support on a range of development issues confronting energy SMEs.

As another option, establishing a "**one-stop shop**" for energy SMEs can help small businesses work across a wide set of agencies and processes and better understand the system. In the case of Mali (Volume 2, Section 3), the government established the Agency for the Development of Domestic Energy and Rural Electrification (AMADER), their rural electrification agency, as a one-stop shop for private minigrid developers. Regardless of where the regulatory functions were housed for other elements of the energy sector, all functions for minigrids were brought into AMADER, including solicitation and review of proposals, regulation of projects and tariffs, and funding of capital costs through a rural electrification fund.

Many countries have created rural electrification agencies, but their role in promoting off-grid energy access solutions has varied widely. These agencies can be important in providing a clear focus on increasing energy access rather than the wider energy issues that fall to a utility or energy ministry.

For example, the Rural Energy Agency in Tanzania works in collaboration with the Energy and Water Utilities Regulatory Authority, the energy and water sector regulator in Tanzania. The autonomous agency supports rural electrification initiatives—primarily minigrid projects—rather than directly regulating these initiatives. It is funded mostly by donor funds and the Tanzanian government. Agency activities include providing connection cost grants to developers for new customers, reviewing developer business plans, providing grants for market research, and building capacity of minigrid developers through business support efforts (Tenenbaum et al. 2014).

In other instances, such as in Mali (Volume 2, Section 3), rural electrification agencies may be responsible for the regulatory function of off-grid projects in addition to support and facilitation. Regardless of where, it is important that these functions be centralized somewhere—if not in a rural energy agency then perhaps at an energy ministry or in a newly created government entity. But, governments should look at the possibility to streamline the government licensing, approvals and regulatory process if they want to accelerate the participation of SMEs in energy access markets.

In some cases, a special purpose agency or one-stop financial shop may work best for energy access. In Bangladesh (Volume 2, Section 1), Infrastructure Development Company Limited (IDCOL) has been instrumental in providing a suite of services that complements and supports the delivery of energy access projects. For example, IDCOL's business model offers an entire package that incentivizes market creation, creating delivery networks, access to capital, quality assurance, after-sales service, as well as training and institutional strengthening support for partnering organizations and SMEs.

### *Flexible Business Models*

A common problem with distributed energy markets throughout the world is that electricity sector regulations are typically designed neither for SMEs nor to accommodate rapid innovation. Just as the telecom industry underwent a dramatic change with the advent of mobile phones, so too is the distributed energy market changing, particularly with the rise of energy access markets. Energy access is becoming more about what services it provides—the ability to have light, to run a fan, to charge a phone. Innovative models are already taking hold in this market, and enabling flexibility may allow new ideas for servicing this market that are yet to be envisioned.

Where governments allow SMEs to retain flexibility, the market can adapt to what users want and can afford. This can lead to innovative solutions to energy access problems. Governments interested in supporting SMEs in energy access should align their regulations to accommodate the limited resources of SMEs and allow flexibility in business models. For example, with many renewable energy options, the capital cost of the system accounts for most of the cost of energy. Higher upfront costs are typically offset by reduced fuel costs over the life of the project, but the initial cost of these cleaner technologies may still be out of reach for many consumers. To address this issue, rather than sell power systems outright, an enterprise might maintain ownership of the system and simply sell electricity or other energy services. Microgrids, developed to serve multiple customers, also fit within this model. Advances in mobile phones and smart controls have also allowed SMEs to create innovative models to provide flexible solutions for end users.

**Many of these models are often not included in traditional energy regulations.** The government's definition of a "utility"—and what entities are allowed to sell kilowatt-hours or other energy services—can represent a fundamental hurdle to flexible business models. If legal restrictions only allow utilities to sell power, either (1) SMEs are regulated as utilities, with the accompanying burdens, or (2) their business model is very limited, as they can only sell energy equipment and may be prevented from providing flexible solutions for end users such as those discussed above. In addition, non-energy companies may be wary of business-to-business partnerships in small-scale energy services if they entail the regulations required of utilities.

Regulations should allow for costs associated with upfront investments, such as connection costs for new customers, as well as flexibility in payment structures and ownership models. To maximize access to underserved populations and encourage innovation, regulations should be able to accommodate SMEs and a wide range of business models, such as:

- **Pay-As-You-Go:** Several SMEs leveraged the wide availability of mobile phones to enable a prepaid electricity service. This allows users to purchase and use electricity as they can afford it—much like they might do with kerosene. For example, SharedSolar provides pay-as-you-go electricity on its microgrids in Africa. Customers pre-pay for the service when they want, in incremental amounts without monthly fees. They can activate their service via text message. According to SharedSolar, this system helps increase uptimes for projects and allows more equitable distribution.[12] M-KOPA Solar,[13] operating in Kenya, Uganda, and Tanzania, offers both mobile payments and remote enabling of energy use. In this model, consumers can purchase energy a day at a time, and after a year of payments, consumers own their solar system outright.
- **Power Purchase Agreements:** In this model, the SME retains ownership of the electricity generation and the responsibility for ongoing operation and maintenance. The SME sells power to one or more customers through a power purchase agreement that specifies the terms of the purchase, but the SME only receives payment for power produced. This model provides incentive for the electricity systems to remain functional and can lead to longer-term reliability. An example of this type of project could be a minigrid project following the "anchor-business-community" approach to project development. In this example, the SME develops the minigrid to serve an anchor customer, such as a telecom tower or factory, and enters into a power purchase agreement (PPA) with that customer. Under this model, the minigrid can extend to other local businesses, with power to remaining customers in the community not viewed as primary revenue (Franz et al. 2014). And in this model, the PPA provides the basis for financing and project viability.

  For projects that provide power to a utility, a traditional PPA with a large power producer is often complex, project-specific, and may be hundreds of pages in length. Many developing governments have begun to implement simpler (often fewer than 20 pages), non-negotiable, standardized power purchase agreements (SPPAs) for widespread use with SMEs. As there may be several SMEs in a given market, each with little or no negotiating power with large utilities, pre-determined SPPAs provide a means to ensure fair power agreement terms for SMEs without subjecting utilities and regulators to undergoing dozens of separate PPA negotiations (Tenenbaum et al. 2014). Thailand, Sri Lanka, and Tanzania have all had success implementing this model of SPPA (Tenenbaum et al. 2014).
- **Business-to-Business Partnerships:** To increase consumer trust in new energy technologies or services, some SMEs have created models where they operate in conjunction with established non-energy companies within a market. This can take advantage of brand recognition and existing distribution networks to access a broader set of consumers (Desjardins et al. 2014). Regulations should consider the option of utilizing non-traditional energy businesses for distribution or retail use of energy without adding onerous regulations to the new organizations. In the Mexico case study (Volume 2, Section 4), Iluméxico has partnered with Telecomm-

[12] See sharedsolar.org.
[13] See solar.m-kopa.com/about/company-overview/.

Telégrafos to provide consumer finance. This decentralized government telecommunications agency uses its existing billing structure and existing nationwide network of local branches to provide billing and financial services to Iluméxico customers.

- **Lease or Fee for Service:** Rather than sell energy systems, some SMEs lease energy systems to customers, such as a solar home system, or they charge a fee for the energy services (SE4All Finance Committee 2015a). This model can reduce the upfront costs to a household and enable the SME to retain ownership either for tax purposes or to increase participation. In the Zambia "ESCO" project, the government purchases solar home systems and provides them to energy service companies (ESCOs) under long-term financing. The ESCOs install the systems on customer sites for a small connection fee, and they then charge a monthly fee for maintenance and operation of the systems. The ESCO repays the government loans over 10 years while maintaining the systems for consumers but retaining ownership of the equipment. As the monthly fees are less than avoided energy costs for kerosene and other fuels, consumers save money without the worries about owning a system (Wilson et al. 2014).
- **Community Partnerships:** Communities can be primary customers for energy SMEs, as many consumers place a priority on energy access to social institutions such as schools, community centers, and health clinics (Franz et al. 2014). Certain minigrid business models are community-based with community ownership and management of the grid (Franz et al. 2014). Other energy sector business models engage community leaders as partners to both enlist customers and collect fees. Providing local responsibility can increase the long-term prospects of the project, from safety of the system to financial payments (Yadoo 2012). For example, Nepal and Sri Lanka have both encountered great success in expanding energy access through community-based hydropower minigrids (Palit and Chaurey 2011; Gunaratne 2002). And in India, SMEs have used a variety of community payment models to collect payments—from a "joint-liability" model where the entire community contributes to pay the debt if one household defaults to collection of payments in public community meetings.

## 2.2 Catalyzing Finance

Providing stable and transparent policies and government support is particularly important to attract private financing. Because energy access markets deal with lower-income and remote populations, they are less likely to gain a foothold without government support to catalyze financing. As noted in other sections of this report, governments that create an enabling policy environment, build capacity within the sector, and leverage resources of development programs can foster a more robust market and attract financing.

But, even with enabling policies, energy access projects can face financing hurdles. In many cases, the projects are too small, the perception of risk is too high and the returns on investment are often too low for traditional financing options to move the market forward on its own. This section discusses government options and programs for catalyzing finance opportunities for the energy access market. Figure 5 summarizes the key policy areas for catalyzing finance: understanding market needs, enabling investment, and targeting financial support.

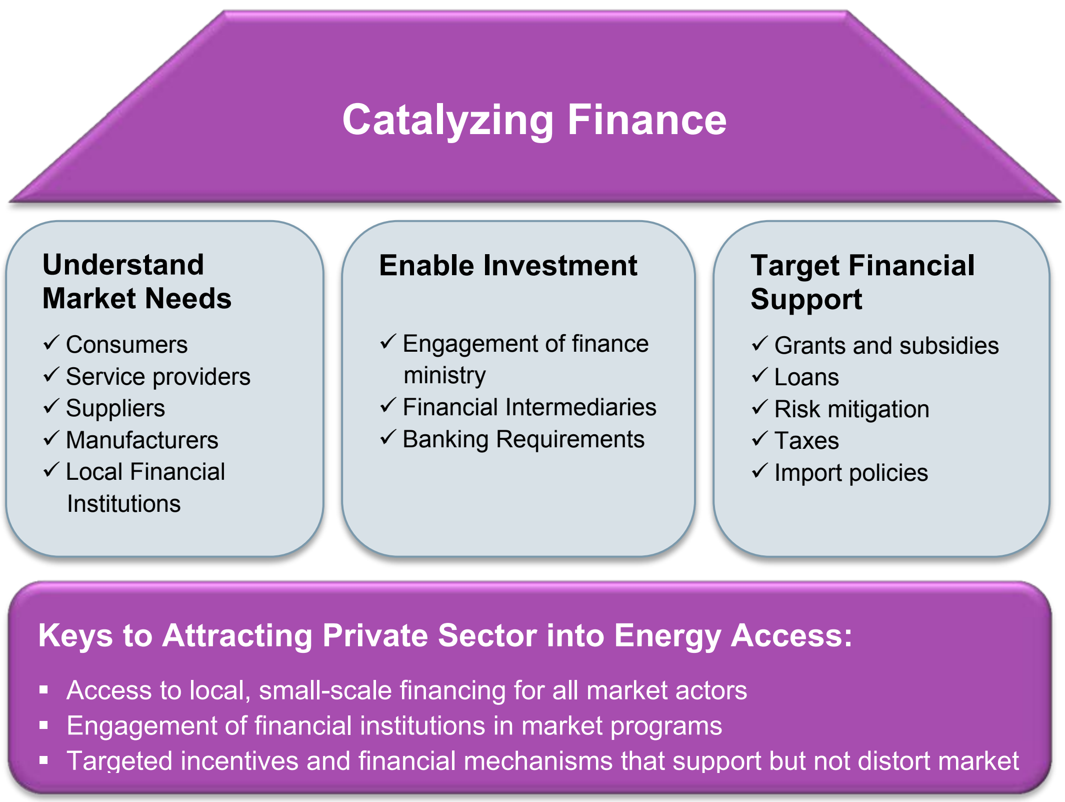


**Figure 5. Key policy factors for catalyzing finance**

Governments can use their funding and leverage international development resources to support the market. With these resources, governments can tap several financial mechanisms and models for finance delivery to support market development. In some cases, banking regulations can also be used to expand domestic financing opportunities.

**Private sector investment** can involve a range of investors from citizens using their savings to startup businesses to financial institutions at the local, regional, national and international levels. It includes funding available at the national and international levels, such as private equity, venture capital, angel investors, and social enterprise funds focused on energy access. When a government enables private sector investment in energy access, markets can draw on more sources of funding and develop more sustainably. In particular, engaging local in-country private financial resources can provide the basis for a long-term sustainable market.

Financing options for energy access can vary by the type of technology, type of financing mechanism used, and the source of the funds. Figure 6 shows the basic options available for this sector.

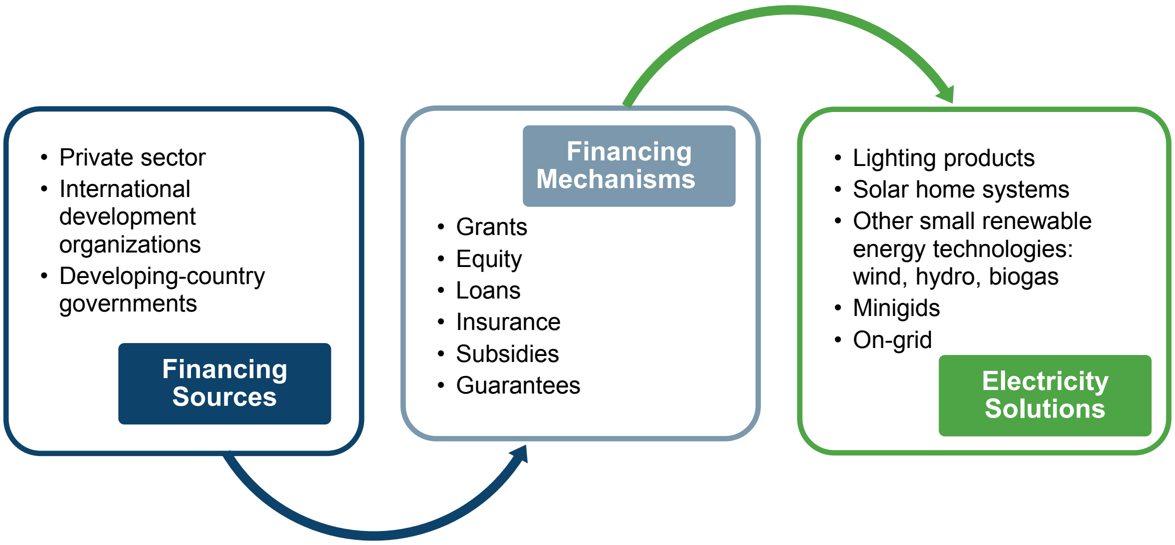


**Figure 6. Financing options for energy access**

Adapted from IEA 2011

An **inherent public function of a government** is to provide basic services to its citizens—and some would argue that basic access to energy, water, education, and health facilities always represent basic services. As each government works to shape its energy access market, it will decide it how to direct its resources toward providing energy services for those without them, especially to those who cannot afford them. These decisions are central to the development programs and energy planning decisions discussed in Section 2.4. But, governments can also target their resources to support the commercial market and attract private investment in the sector. Once a government designates resources for providing energy services, decisions about how to use those funds can directly impact the development of the market. Attracting private sector investors, from local businesses and banks to international funds, is possible but only with the right conditions and government actions to reduce risk and to increase potential for a sustainable market.

### *2.2.1 Understanding the Financial Needs of the Energy Access Market*

Before developing programs to support financing in the market, it is important to understand the financing needs of various market sectors. Overall, energy SMEs, manufacturers, and consumers struggle with access to affordable, reliable sources of financing. This is true at all stages of market development from start-up to development and scale-up. According to the SE4All Energy Access

Committee, this availability of capital is the biggest challenge to enabling business models to develop and scale-up to the level needed to reach universal access by 2030 (Singer 2014).

Governments can collaborate with stakeholders to understand their individual market needs. Financing requirements will vary by type of business, technology, and structure of each market, but the summaries below are intended to provide general financial needs by recipient.

### *Energy Enterprises*

Energy SMEs, as with most developing businesses, need different types of funding at different stages of the business cycle. For these businesses, capital is critical to fund operations and scale up to profitability. While capital is available, it is often inaccessible for small companies in an unproven sector with low-income consumers (Bardouille et al. 2012).

In early stages, businesses typically need some sort of concessionary financing to cover business development activities to reach a proof of concept (Bardouille et al. 2012). Figure 7, from the International Finance Corporation, shows the stages of business development with the accompanying financing needs. Funding is typically a mix of grant and equity financing. Grants can accelerate the ability of SMEs to attract venture and impact capital. Even investors willing to absorb high levels of risk have concerns with the limited "track record" in the energy access sector (Bardouille and Muench 2014).

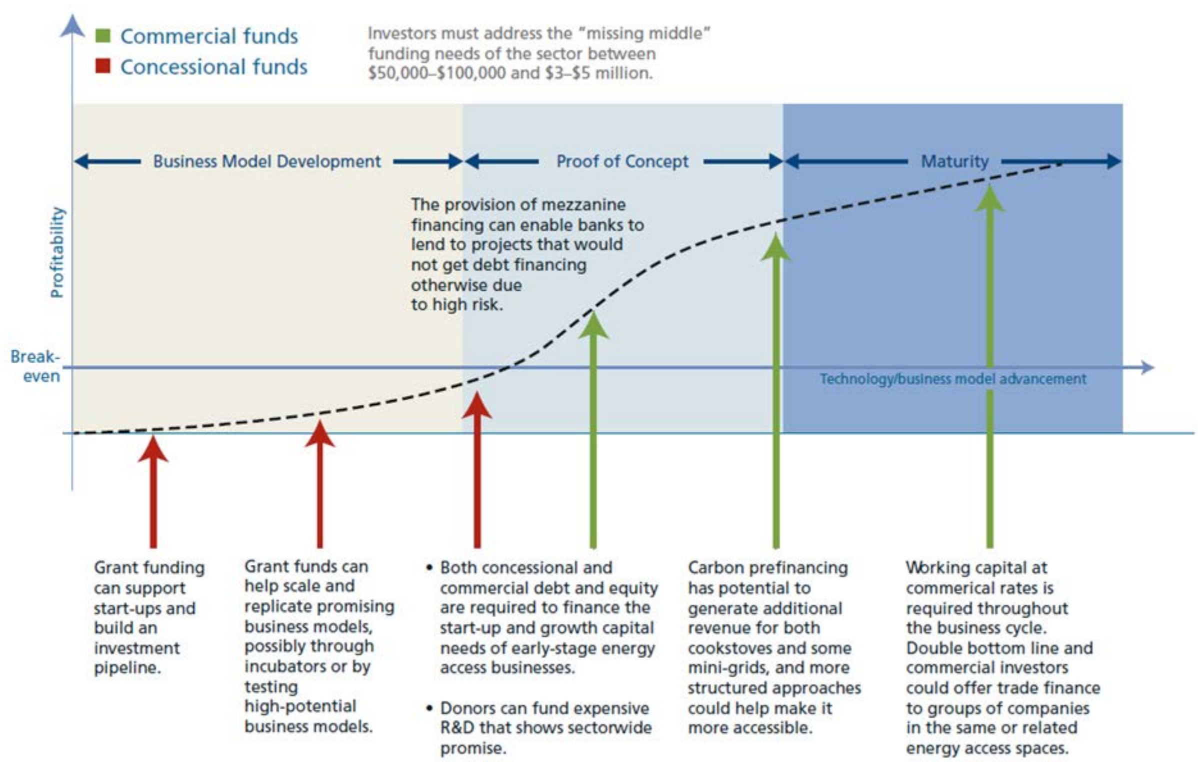


**Figure 7. Stages of SME business development and accompanying financial needs**

Source: Bardouille et al. 2012

Businesses in the start-up and growth phases need both debt and equity financing. While the potential high growth in this sector can attract equity financing, the scale of finance needed in the sector often does not align with available funds from venture capital funds or angel investors (Bardouille et al. 2012).

Access to capital is one of the biggest obstacles for energy SMEs in this market (Singer 2014). Debt financing is preferable for working capital to fund inventory and ongoing operations, but obtaining debt financing is particularly difficult, as this sector is in the early stages. Commercial banking institutions are less likely to support small-scale businesses without a proven history, given the risks and transaction costs involved. Even mature businesses need access to debt financing for expanding inventories, but they may have difficulty due to the scale of financing needed (Bardouille et al. 2012). In addition, many multilateral organizations or international investors do not traditionally provide funding at a scale that is small enough for SMEs to use (Singer 2014).

An SME requires affordable, patient capital to develop and grow a business into a profitable venture (Singer 2014)[14]. When the only available financing is too costly, it translates into higher-cost products that become less affordable for end users (Wilson et al. 2014). Ultimately these higher costs may prove to be prohibitively expensive for the poorest customers—those that the SME initially set out to serve.

Project financing is not a viable option for small-scale projects, given the transaction costs and inherent model of project financing (Bardouille et al. 2012). While minigrids could function under a model of project finance, the reality is they are typically far too small in scale to attract project financing. For this reason, even these are currently funded by corporate finance (Franz et al. 2014).

Examples of government support could include grants or subsidies to reduce capital costs or provide equity; grants for costs related to start-ups such as business plans, training, and market development; direct financing through concessionary loans or lines of credit for capital purchases or consumer financing; or guarantees to encourage financial institutions to finance SMEs in the sector. Government programs that establish or enable financial intermediaries to provide small-scale financial products can also be important in this sector.

When addressing financing needs in the sector, policymakers need to address the entire supply chain to ensure a sustainable market (A.T. Kearney 2014). Figure 8 provides a representation of the energy access market supply chain.

[14] Patient capital refers to long-term financing. In this case, the investor is willing to invest in a business over a longer period of time without expecting a quick return on investment.


**Figure 8. Supply chain of energy access market**

Adapted from A.T. Kearney 2014

Some elements of this supply chain have specific financing challenges:

- **Manufacturers:** In developing energy access markets, many products may initially be imported. These SMEs will need financing to research and develop innovative products and technology solutions. Funds are also needed to support product development from research and development through engineering. Once a product is established, SMEs will need financing for ongoing operations (A.T. Kearney 2014). Policymaker may choose to encourage enterprises to develop and manufacture products for the energy access market in order to expand the domestic economic opportunities. In this case, governments can financially support R&D and product innovations. Support can include grants for R&D and product development, concessionary loans for working capital, and guarantees or credit enhancements to attract private financing. Removal of discriminatory taxes and duties on manufacturing components can also help spur local manufacturing business. Such was the case in Barbados, where the removal of tariffs on solar water heater components allowed the development of a local solar water heater manufacturing industry, which has since begun exporting to the rest of the region (Bardouille et al. 2012).
- **Suppliers:** These businesses need access to capital to purchase equipment, and create and operate distribution networks. Lines of credit for purchasing needed inventory create flexibility. In addition, collateral requirements that recognize the renewable energy equipment as assets (rather than requiring fixed-assets for collateral) can advance the market (see Volume 2, Section 2). Reductions in import duties and removal of penalties designed to protect domestic production is important in these nascent industries (Bardouille et al. 2012).

  In many cases, suppliers need access to foreign capital to purchase clean energy technologies. The Ethiopia case study (Volume 2, Section 2) outlines the identification of a need for foreign currency by suppliers and how the Development Bank of Ethiopia provides that to suppliers via an agreement with international funders, including the World Bank.
- **Service Providers:** This element of the supply chain can encompass a wide range of businesses from providers of lighting products to developers of minigrids. The types of financing will vary by the business model and technology. The SE4All Finance Committee (2015a) provides these examples:
  - **Microgrids** face upfront costs, which are offset by lower operational costs; therefore, they typically need access to long-term credit.
  - **Solar home systems** and **biomass-powered** projects have a shorter repayment timeframe but need capital to scale up.
  - Distributors of **portable lighting products** need working capital and trade finance.

An additional need for energy service SMEs is that these businesses often need to provide financial instruments for consumers to afford the services and to create a workable business model as noted in the next section (Wilson et al. 2014).

### *Consumers*

Even though some energy products, such as solar lights, pay for themselves within months—and consumers enjoy significant cost savings after this—meeting large upfront costs for these products is difficult, as many rural consumers pay for energy services on a day-to-day basis. Whether it is provided by suppliers, manufacturers, or MFIs, consumers frequently need financing to participate in energy access markets (Desjardins et al. 2014).

Governments can provide grants to cover connection fees or reduce the capital costs of the energy products. In some cases, government subsidies can cover ongoing energy costs. As noted in the discussion below, governments should consider how to provide financial support to consumers in support of universal access without distorting the commercial market. The case studies for Bangladesh, Ethiopia, Mexico and Nepal (see Volume 2) show examples of government support to MFIs and SMEs to enable more affordable products and financing to consumers.

Importantly, **energy access services for consumers are not one-size-fits-all**. Many consumers, even low-income consumers, can afford energy services, particularly where these services offset existing energy costs for kerosene, diesel, or candles. However, for universal energy access to be achieved, many consumers will need access to financial products, and a portion of consumers will require ongoing subsidies or other financial support to afford energy services. Government policies that differentiate between customers can include incentives or subsidies for the poor without distorting the commercial market. Policymakers should consider the different abilities of consumers to afford energy services, including those unable to pay (who will need subsidies), those who will need some public support to participate in the commercial market, and those that can be served directly in a commercial market (Bardouille et al. 2012).

In Bangladesh, IDCOL has confronted this challenge. When it initially did not reach very poor consumers, IDCOL expanded its program to include smaller solar home system sizes (as low as 10 W). Since the grant provided per system was fixed, this provided a larger percentage of support to poorer consumers that chose very small systems. However, as the grants are phasing out, the reductions are having a larger impact on the poorest consumers (Volume 2, Section 1).

### *Local Financial Institutions*

While local financial institutions are a natural partner in this market, they may have limited experience or comfort with modern energy technologies. They also typically offer short term, high rate loans that do not work well with many capital-intensive renewable energy projects such as solar home systems and minigrids (Franz et al. 2014). To engage in new markets, financial institutions need the opportunity to increase their understanding of these projects and technologies while minimizing the associated financial risks.

Microfinance Institutions (MFIs) are playing a wide range of roles in some energy access markets. They can provide financing to consumers to allow the purchase of clean energy systems. In other markets, such as Ethiopia, MFIs have expanded to work with suppliers to provide or install energy systems directly. With the extensive rural networks of MFIs in Bangladesh, IDCOL has used MFIs to assess household energy needs and install and service solar home and irrigations systems (see Volume 2, Section 1).

Because MFIs often do not have asset-backed financing and have limited experience with energy technologies, they face obstacles in serving the energy market (Christine Eibs Singer, pers. comm., August 2015). While some MFIs have been innovators in energy access markets, in other cases, MFIs are less able or willing to stray from their current business model (UNCDF 2015). For example, without concessionary finance, MFIs may not be interested in providing consumer finance in the energy access market. The small size of loans, coupled with the high transaction costs in this market, is often unattractive to MFIs (Desjardins et al. 2014). MFIs are one approach to energy access financing, but policymakers will need to assess the potential in their own markets to determine what role MFIs might offer in energy access financing.

Governments can encourage local finance institutions to finance SMEs and consumers in this market through concessionary lines of credit, refinancing programs, and equity sharing. In some cases, such as in the IDCOL model, governments can leverage the network of MFIs in remote communities to engage them as partners and investors in expanding energy services.

#### *Utilities*

In some cases, utilities have leveraged the resources of SMEs to extend grid access, strengthen the existing grid with interconnected projects, or extend energy services to those without access on behalf of the national utility. Such actions can expand private sector participation and investment in the electricity sector while maintaining a central electrification role for the utility.

Private companies can support the utility sector through new management approaches and expanded access to capital. In fact, such approaches have been documented to allow private concessions to reduce costs and to increase connections more quickly than public utilities (Bardouille et al. 2012).

### 2.2.2 Enabling Investment in Energy Access

Governments have a role to play in creating the financial infrastructure and networks that will provide financing to the private sector in energy access. An important step is to **engage the finance ministry** in the challenges and pursuit of financing this sector. Finance ministries have a vested interest in how energy impacts overall development and national budgets. For example, the increased use of solar lighting reduces the need for kerosene subsidies. Engaging finance ministries in energy access can leverage a wider range of government tools to enable financing and can engage the banking sector.

For example, in Bangladesh (Volume 2, Section 1), the Sustainable and Renewable Energy Development Authority, which was developed to coordinate support of renewable energy development, is jointly led by the Ministry of Finance and the Ministry of Power, Energy and Mineral Resources. In addition, IDCOL is hosted by the Ministry of Finance, although it is overseen by an independent board that includes the finance and energy ministries as well as the Ministry of Information and Communication Technology.

When a government enables private sector investment in energy access, markets can draw on more sources of funding and develop more sustainably. In particular, programs that focus on engaging local private financial resources can provide the basis for a long-term sustainable market. Private sector investment can involve a range of investors from citizens investing savings to start up a business to financing provided through local, regional, and national financial institutions. It also includes the investment community from angel investors, social enterprise funds, and multinational investment funds focused on energy access.

### *Use of Financial Intermediaries to Reach Markets*

Another barrier to finance availability in the energy access market is the lack of financing channels. Large investors do not typically operate at a scale of finance that relates to the funding needs of SMEs, microfinance institutions, or consumers of energy access services (Wilson et al. 2014). Governments can create intermediaries to accept large amounts of funding from multilateral or bilateral development organizations or foundations. These intermediaries manage the funds to support and develop the energy access market and enable transactions in amounts and terms needed for SMEs and microfinance for end users. This provides funding opportunities for the local private sector to participate in the market.

In addition, financial intermediaries can provide a central means to coordinate donor support and government funds to leverage private investment. Activities can include not only the disbursement of funds but also the oversight of other market activities such as market analysis, education and training, and the disbursement of incentives (Singer 2014).

The case studies in this report for Bangladesh, Ethiopia, Mali, and Nepal (see Volume 2) all show programs in which governments have used existing organizations or created new entities to serve as financial intermediaries to translate large amounts of funding into the small-scale needs of end users.

Intermediaries can combine a range of funding, including government funding and resources from international development organizations, to create financing programs for energy access. These case studies demonstrate public-private partnerships that involve disbursement of funds through national development banks, commercial banks, a rural electrification agency, and a special-purpose entity.

Figure 9 shows the function of the Alternative Energy Promotion Centre (AEPC) as a financial intermediary. It is funded by government of Nepal and development partners. The funding is delivered through commercial banks as either subsidies or credit. Money delivered as credit enters a revolving fund in order to increase overall investment, and banks are provided low-cost credit to invest their own financing.

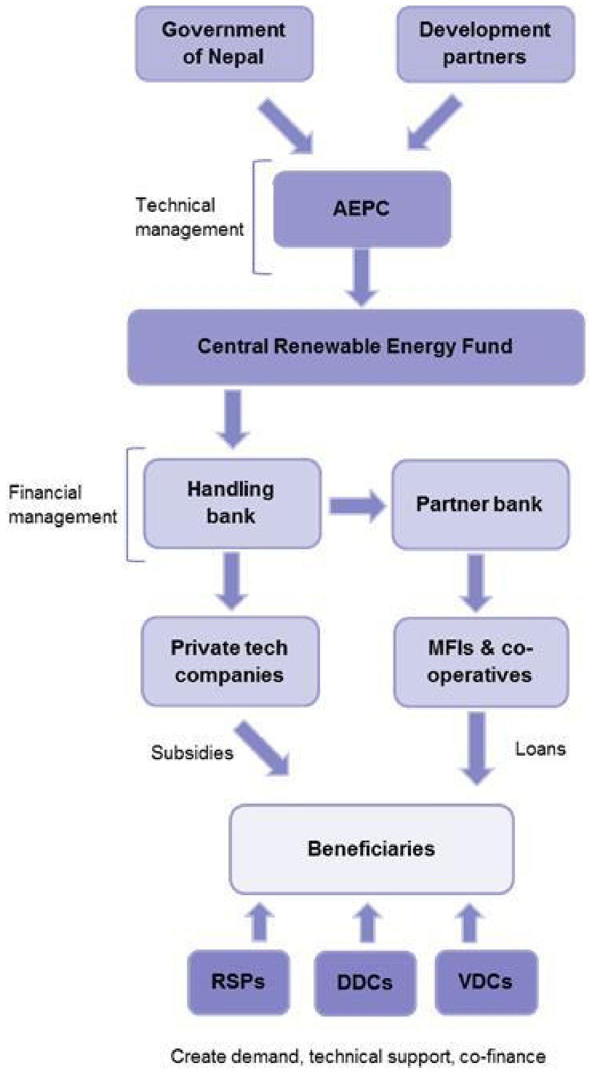


**Figure 9. Financial flows under the Nepal Rural Renewable Energy Program**

Source: Policies to Spur Energy Access, Volume 2, Section 5

In Bangladesh (Volume 2, Section 1), IDCOL was established as a non-bank financial institution. It operates as a direct financial intermediary that combines funding from the government and other multilateral and bilateral donor funding. IDCOL provides funding to leverage investments from SMEs and MFIs in the sector to provide energy services and financing to consumers.

In Ethiopia (Volume 2, Section 2), the Development Bank of Ethiopia serves as a financial intermediary to leverage funds form the World Bank and the government to provide low cost financing to suppliers and MFIs to ensure the supply of technologies and provide consumers with available financing on these technologies.

The case studies show the value of including all ends of the value stream in the purview of these intermediaries. If a segment of the market is missing, expansion in some areas or technologies may be constrained. Intermediaries may need to engage partners with local presence, and combining financing with technology standards and verification of providers can reduce losses (Volume 2, Section 1).

### *Banking Regulations*

Through banking sector regulations, governments can create requirements to open banks to finance actors in the energy access sector. As a basic practice to enable finance in the sector, banking policies should not discriminate against SMEs. For example, collateral requirements designed for large enterprises should be appropriately scaled to the scale of business and finance (Singer 2014).

Governments can expand the finance opportunities in this sector even more with requirements for banks to offer financing to this sector. Regulators can specify that banks—whether national or local—must offer financial products to the sector. Doing so can help build experience in the sector with these products and can enable finance to flow into the sector. These programs can be particularly effective when developed in conjunction with training programs for the financial community, as noted in Section 2.3.3 (Guay et al. 2014).

The case study of Bangladesh (Volume 2, Section 1) details how the banking regulations obligate and encourage banks to lend to renewable industry. In 2011, the central Bangladesh Bank introduced a comprehensive circular on "policy guidelines for green banking," which requires every bank to allocate a specific budget for green finance. This includes direct or wholesale lending for renewable energy projects, solar home systems, and solar irrigation pumps. Banks are expected to set achievable targets and strategies, and to disclose these in their annual reports and even to establish a "green" branch in the second phase. Compliant banks also receive preferential treatment for these loans, including access to refinancing at a rate of 5% with the ability to lend these funds at 9%–11% to businesses and MFIs in the sector.

Governments should also assess the impact of restrictions on foreign investment in the energy access sector. Because a wide range of financial sources—including social enterprise investors and crowdfunding—involve foreign funds, these restrictions can reduce the ability of energy access businesses to easily access capital. Text Box 2 highlights India's experience with banking regulations that restrict foreign investment.

**Text Box 2. Foreign Investment Regulations in India Impact Energy Access Financing**

While banking regulations can be designed to support clean energy access, in some cases, existing regulations can unintentionally impact financing for energy access services. India has a vibrant off-grid energy market, but they still have banking regulations in place for security purposes that limit SMEs from utilizing foreign social investors, crowdfunding and other international investment (Mukherjee 2013). As domestic finance is often expensive and resources are limited, many SME's in India rely on foreign donations and investment for all or part of their capital and operating expenses, especially at start-up. However, such foreign money is subject to regulations from multiple agencies, including the Foreign Contribution Regulation Act. The act regulates foreign donations as a potential national security threat and places stringent rules with strict penalties on recipients of foreign money (Gazette of India 2010). The extensive paperwork, documentation and approvals required, in addition to a ninety-day waiting period, pose a significant hurdle for SMEs—especially those still in the initial start-up phase. Some international organizations have tried to circumvent these regulations by partnering with local organizations that have already been approved to receive foreign funds, but this introduces a new layer of operational requirements by which the organizations must abide that are often just as costly and burdensome.

In addition, the Reserve Bank of India mandates that loans from foreign sources to MFIs must remain in the country for at least three years before being paid back. This creates added risk and a large disincentive for foreign investors and lenders. Kiva-India (www.kiva.org), which acts as a lending platform in the country, has raised awareness of this mandatory holding period and has sought to address the barrier by holding on to loans for the entire period before sending repayments back to lenders. Still, Kiva warns its users that "lenders assume the risk that repayments may be delayed due to regulatory difficulties transferring funds out of India", which only increases the uncertainty for potential foreign lenders.

Where restrictions on foreign investments are included in national banking regulations, policymakers may want to consider their impact on the electricity access market funding and determine whether exceptions for social enterprises are appropriate (Lopicich 2015).

### 2.2.3 Targeting Financial Incentives and Mechanisms to Support Market

To expand private sector participation in energy access, the market needs to be able to support viable business models. Government incentives will likely be required to ensure barriers to new market development are offset. For businesses to engage in the market, they need to receive fair compensation for the cost of providing services. Consumers need to be able to afford these services to create a market, and they may need access to affordable financing so they can participate in the commercial market. In cases with very poor consumers, governments may need to offer additional incentives to enable universal participation. Fiscal policy can support energy access markets through a range of mechanisms, including subsidies, concessionary loans, and reduced taxes and import duties, but rules and incentives should be clear and reliable to improve investor confidence (Franz et al. 2014).

#### Grants and Subsidies

Government subsidies should be targeted to support the development of a private sector market rather than to provide giveaways or negative incentives that distort the market. Subsidies can be used to reduce lending costs for investors, to offset higher costs of early SMEs in developing a market, or to bring down initial costs for end users unable to afford energy services at commercial rates (Singer 2014). Often, subsidies that are needed to foster development of a new market may be phased out as the market becomes more efficient.

In some cases, subsidies can be tied to performance—such as performance- or output-based subsidies. These tie the amount of subsidies to specific outcomes. These subsidies could be based on systems sold, customers connected, or energy produced. These types of subsidies have the advantage of rewarding actual market performance. If these subsidies are to be used leverage other investors, they need to be clearly defined and easy to access, generate relatively low transaction costs, and be reliable in their disbursement. If they are not, they may suffer from a lack of investor trust and fail to attract the type of private sector investment they are targeting (Franz et al. 2014; Reiche and Teplitz 2009, p.51).

Our case studies provide examples of the use of grants or subsidies in energy access programs. In Bangladesh (Volume 2, Section 1), IDCOL provided a subsidy to reduce the cost of each solar home system sold. This subsidy level is the same for all systems, which effectively provides higher proportional subsidies for smaller systems used by poorer consumers. The subsidy has been gradually decreased, with intent to phase it out; it has already been reduced from US$90 to US$20. In Mali (Volume 2, Section 3), the rural energy agency AMADER, provides subsidies to developers to buy down the upfront capital costs of minigrids.

A tariff can be designed to subsidize a renewable energy system through mechanisms such as feed-in tariff (see Section 2.1.2). A feed-in tariff is an output-based subsidy as it is based on power generated by a distributed generation system and delivered to the grid.

In some cases, an ongoing subsidy may not foster a sustainable market. A government must decide whether one-time assistance, such as a grant to cover interconnection costs or reduce capital costs of equipment, better supports the market development than an ongoing subsidy.

### *Pro-Poor Subsidies*

As noted in the section on understanding the financial needs of consumers (Section 2.2.1), not all consumers will need long-term subsidies. But, the bottom-of-pyramid consumers are likely to continue to need financial support to attain energy access services even once the market is established. Using pro-poor policies to subsidize the initial costs of energy goods and services can differentiate between general market subsidies and those needed for the most vulnerable (Singer 2014). Many energy policies are not designed to differentiate need. Figure 10 shows that most subsidies are not actually targeted to the poor (Guay et al. 2014).

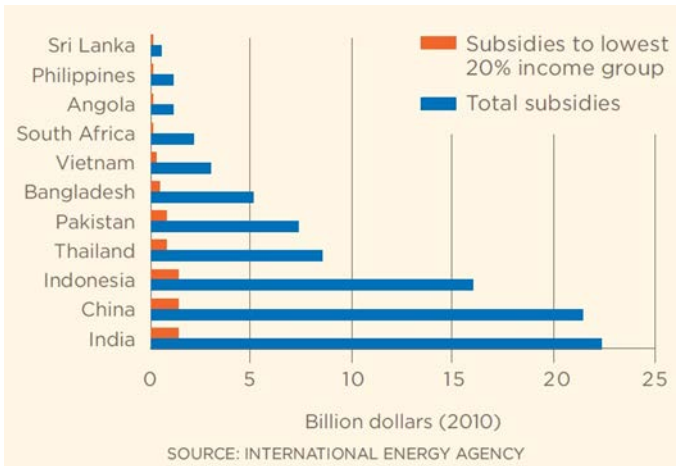


**Figure 10. Subsidies targeting the bottom 20% compared to total subsidies for 11 nations**

Source: Guay et al 2014

Nepal (Volume 2, Section 5) has a targeted subsidy model to promote the uptake of renewable energy technologies for the poor and vulnerable. However in the past this subsidy has not been implemented consistently. Often beneficiaries that are not the poorest (but do not have energy access) have benefited from subsidies in order for local governments and non-governmental organizations (NGOs) to show AEPC that their subsidy targets are being met. In response to this inequity, AEPC is updating its subsidy policy to improve targeting to those who need subsidies the most (refer to Volume 2, Chapter 5 for details).

### *Concerns with Giveaway Programs*

Some forms of subsidies can distort markets, so governments should be careful to ensure that any subsidy is providing more benefit to the market than negative impacts to market signals. For example, when governments give away energy products, they can undercut businesses trying to sell them. Even the promise of a giveaway can disrupt the market, as consumers are unlikely to purchase energy services if others got them for free or if the consumers think they might also be able to get their own energy products (Bardouille et al. 2012).

Giveaways of products also ignore the long-term support needed in the market, as those products will not come with the service or support that would have been available from local businesses. The UN Foundation cites repeated examples of health clinics that received donated solar systems that subsequently fell into disrepair due to lack of either knowledge about the energy technologies or available services for them.[15]

### *Fossil Fuel Subsidies*

The International Energy Agency (IEA) estimate that in 2013, consumer subsidies for fossil fuels amounted to US$548 billion, while subsidies for renewable energy amounted to US$121 billion (Bridle and Kitson 2014). While fossil fuel subsidy reform can be controversial, these subsidies distort the energy access market and can provide financial incentives for market actors to remain with limited, unhealthy energy products such as kerosene or diesel (Bardouille et al. 2012). When products such as solar lanterns or minigrids that use clean sources of electricity compete with subsidized fossil fuel costs, modern energy products may be judged as too expensive and thus higher-risk investments. These effects can reduce clean energy choices in not only the short-term, but they can also impact the long-term development of the clean energy market.

To support energy access markets, governments should resolve negative incentives and market distortions provided by energy subsidies (Bridle and Kitson 2014). One path is to phase out fossil fuel subsidies and begin to price energy to fully reflect local and global costs, as suggested by the IEA's World Energy Outlook and the Global Energy Assessment (SE4All 2013). While policymakers may consider moving subsidies from fossil-fuel technologies to clean energy technologies, doing so may disrupt markets. The UN Environment Program (UNEP) suggests the most effective way to mitigate the economic effects of reduced subsidies is to redirect funds to well-targeted social programs (Mills 2014a). Redirecting funds to resolve market distortions for clean energy technologies by improving financing and reducing import duties are potential options. One example, reducing kerosene subsidies by US$1 million could offset import duties for 250,000 solar lighting systems and provide a revenue neutral options for governments to shift markets to cleaner products (Mills 2014a).

### *Loans*

Access to affordable capital is one of the largest barriers for SMEs in the electricity access market. When affordable financing is unavailable to market actors, governments can provide financial tools to expand access to financing. Government have chosen a range of mechanisms, including direct lines of credit to market actors (such as in Ethiopia) or concessional financing to financial intermediaries to increase the capital available to providers and end users. In many cases, governments provide **concessional loans**, also referred to as "soft loans" that provide more favorable terms—including lower interest rates, longer terms, or reduced requirements to qualify—than financing available in the market provides. In many cases, the governments in the case studies for this report have provided concessional **loans to financial institutions** to reduce their costs of capital and encourage them to provide financing to off-grid renewable energy technologies via market rate loans. This has the dual benefit of increasing available capital while expanding the experience of local financial institutions in a new market.

[15] Jem Porcaro (United Nations Foundation), personal communication, April 10, 2015

The National Rural Renewable Energy Programme (NRREP) in Nepal (Volume 2, Section 5) uses a "handling bank" to manage funds. The handling bank provides concessional loans to seven partner banks to deliver credit-based finance for investment in off-grid renewable energy technologies. The partner banks, in turn, provide concessional loans at a higher interest rate to cooperatives and microfinance institutions at the district and village level, which use the money to provide market-rate loans to their members to invest in renewable energy technologies such as village-level micro-hydropower systems.

A similar method for increasing participation of financial institutions is to provide **lines of credit for on-lending**. Rather than receive an upfront loan, the financial institutions can draw down on their line of credit as they provide financing to end users for energy access projects. This method is used by the Development Bank of Ethiopia, which leverages funding from the World Bank to provide lines of credit to microfinance institutions (MFIs) that fund energy access projects at market rates (Volume 2, Section 2).

In Bangladesh (Volume 2, Section 1), MFIs finance solar home systems for households, and they are able to refinance the bulk of those loans at a concessional rate through the Infrastructure Development Company Limited (IDCOL), a government-owned financial institution set up to encourage private investment in infrastructure and renewable energy. This allows the MFI to immediately pay suppliers for solar home systems while extending market rate loans to households. Additional subsidies by IDCOL reduce the overall cost of the system, although they are now being phased out, while the refinancing program for MFIs remains.

Governments also have enabled **direct financing** to businesses and end users in the energy access market. For example, The Development Bank of Ethiopia also extends direct loans and credit to renewable energy suppliers (in addition to the lines of credit it provides to MFIs, as discussed above). Specifically, they have provided credit to allow suppliers to import renewable energy technologies, such as solar lighting products, into the Ethiopian market.

In Mexico (Volume 2, Section 4), most of Iluméxico's customers take advantage of a 12-month loan to purchase household renewable energy systems. In this case, consumer finance is offered through Telecomm-Telégrafos, a decentralized government telecommunications agency that also provides basic financial services.

### *Risk Mitigation*

Governments have several tools to reduce investor risk in order to increase their participation in the market. In particular, governments can provide credit enhancement programs to catalyze investor participation in new programs, expand access to capital by actors in the market, and enable more affordable patient financial products. Strategies to enhance credit in the market include **loan guarantees** that insure a portion of extended credit against default.[16] While specific guarantee mechanisms can vary, governments that reduce risks on investments can accelerate the involvement of the private financial sector into supporting energy access infrastructure (Bardouille et al. 2012; A.T. Kearney 2014).

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[16] Risk guarantees can take several forms, such as loan guarantees, loan loss reserves, debt service funds, or subordinated capital. For simplicity, this section refers to them collectively as guarantees.

National programs can minimize financial risks with clean energy projects and increase the capacity and willingness of the financial community to engage in off-grid energy access. In the Nepal case study, the NRREP shifted from a purely subsidy-based model to a mixed subsidy and credit based model. The main rationale for the shift was the desire to incentivize commercial banks to enter the renewable energy market. Policymakers assumed that commercial banks could provide better financial management capacity; extend financing for renewable energy to a wider geography; leverage their own funding to increase overall investment in rural renewable energy; and help commercialize the sector so that in the long-run it does not rely on donor or government support.

When the bulk of energy access products are imported into a country, suppliers often need access to foreign capital to purchase clean energy technologies. In the Ethiopia case study, the Development Bank of Ethiopia provides a line of credit in **foreign currency** to private companies importing energy technologies. Regardless of the method of credit—whether in domestic or foreign currency—this sector faces additional risks and volatility with fluctuations in foreign currency that is beyond the control of the bank. Governments can assume the risks or provide products to mitigate these risks to reduce market impacts.

Another government option for risk mitigation can be programs to **aggregate** small, similar projects to provide a larger project scale to attract better financing terms or to qualify for additional support, such as through climate funds (Tenenbaum et al. 2014; Glemarec 2012, 91–92). One alternative is a "top-down" aggregation strategy that allows investors to invest in a portfolio of smaller, more specialized funds focused on a specific technology or region (Tenenbaum et al. 2014).[17]

### *Taxes*

Tax policy can support energy access markets. Tax impact to SMEs on income, profits, sales, and property should be assessed to ensure they are not paying more than comparable businesses in grid electricity or traditional energy products. Specific tax incentives, such as investment or production tax credits, can stimulate these markets (Franz et al. 2014). For minigrids and larger projects, accelerated depreciation can reduce costs in the first years of a project. Because equipment in energy projects will need to be replaced at the end of its useful life, this depreciation is appropriate even for equipment that was supported with grants (Franz et al. 2014). A particular tax, import duties, warrants additional consideration, as discussed next.

### *Import Policies*

Governments interested in fostering SMEs in energy access should review and revise import regulations and duties to ensure they are transparent and do not favor traditional energy sources over modern clean energy technologies (Bardouille et al. 2012). Reducing taxes and duties on imported clean energy technologies can have a positive impact on the use of these technologies (Jha 2013). Several countries have noted marked increases in markets for solar lanterns with the reduction in

[17] While aggregation holds significant potential, global experience with these programs is relatively limited. Policymakers may need to experiment with potential programs and may want to seek technical assistance on policy design.

import penalties on these products (Bardouille et al. 2014). Reducing import duties and tariffs can reduce downstream costs and provide more affordable products and energy services.

Many countries around the world have import policies specific to renewable energy to level the playing field with fossil fuel. Mali (Volume 2, Section 3) eliminated the value-added tax on imported renewable energy technologies to allow them to compete with diesel generators in minigrids. Bangladesh (Volume 2, Section 1) introduced fiscal incentives for investment in the renewable energy sector. These include tax holidays for 20 years, reduced levies on import of renewable energy technologies, and reduced taxes on local manufacturing and assembling of renewable energy equipment.

## 2.3 Building Human Capacity

When off-grid energy access is approached on a project-by-project basis, without developing the domestic capacity to support the market, the projects are not supported in the long term and the market is not sustainable.[18] This fuels concerns that these energy options are not a durable or worthy of investment. Figure 11 summarizes the key factors for building human capacity. The policy areas—business capacity, workforce development, and education of market participants—are discussed in the sections that follow.

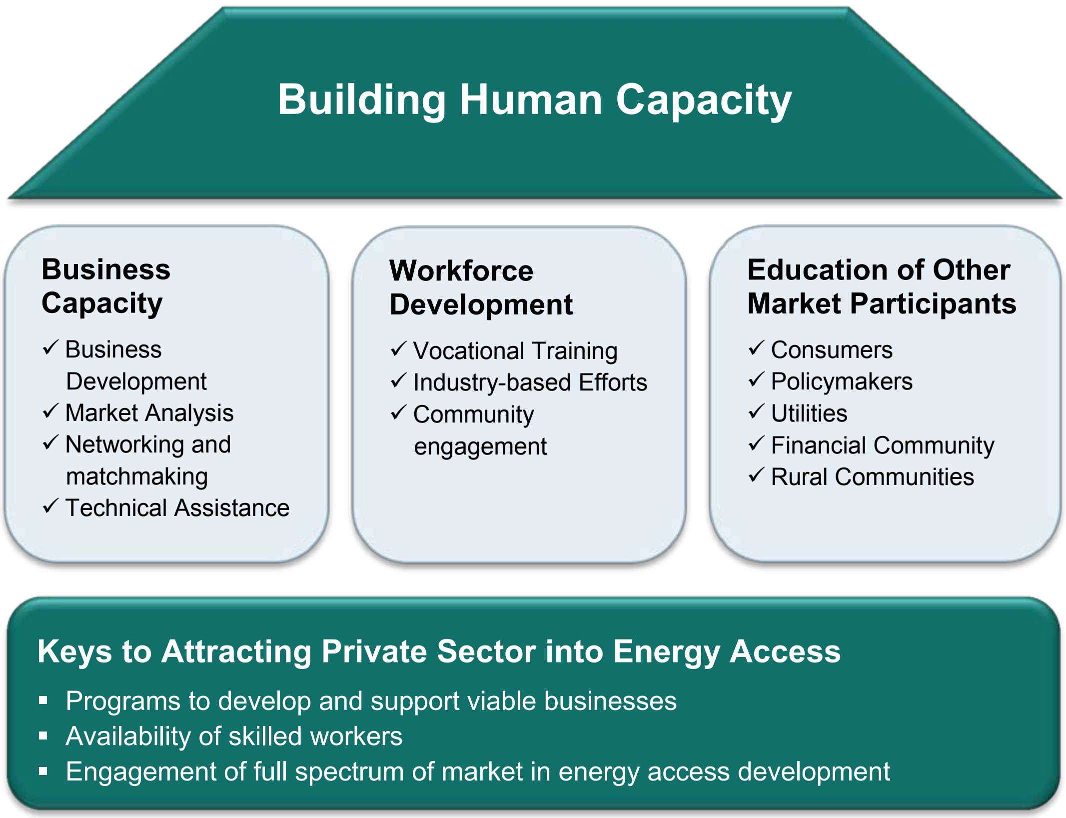


**Figure 11. Key policy factors for building human capacity**

Programs that focus on the people involved in the market can be as important to the success of that market as the technologies themselves. Building the capacity of businesses at all market levels is critical, including operations, sales and marketing, finance, servicing, research and development, and community involvement. This new market provides an immense opportunity for new businesses and jobs if properly developed (Hande and Rajagopal 2015; Mills 2014b). Building training mechanisms to develop and retain a skilled workforce to meet these jobs is also critical to a sustainable market. In addition, programs which educate the enabling environment—from policymakers to utilities to local banks to communities and end users—can support sound decisions and realistic expectations.

[18] This information comes from interviews with several market stakeholders, including companies in the market ("Micro-grids: Best Practices around Technology Challenges," a webinar on microgrids held 9 December 2014, cleanenergysolutions.org/training/micro-grids-best-practices) and a conversation about health clinic experience with staff at the UN Foundation.

Another strategy in building capacity is to track and disseminate information about what is working and not working in the market. When developing a program or policy, policymakers can consider opportunities to **track results and quantify the impacts** of these programs and technologies. Actual impacts on financing, access provided, or other development goals can be very useful for market participants, policymakers, and investors.

### 2.3.1 Building Business Capacity

Successful enterprises can bring energy services to areas without them and fill a fundamental need. But, as with any business venture, success depends on far more than a good idea or technology. While business support programs are not new, they are particularly important for the energy access market, where the market track record is nascent, the technologies are newer, and the end users are remote and often have very limited financial resources. Governments can establish or support business support programs that provide assistance in several key areas, including business development support, market analysis, and technical training.

#### *Business Development Support*

Programs that support enterprises as they develop new businesses can increase their likelihood of success. Enterprises in the energy access market face high hurdles to successfully reach their market. End users have limited resources and are risk averse and new business models are difficult to assess in brand new markets. According to the Shell Foundation (Desjardins et al. 2014), investors view these businesses as too high of a risk until they:

- Understand the true needs, wants and decision-making processes of their target customer
- Prototype (and iteratively improve) their technology to produce a range of high-quality, durable and affordable products and services that appeal to customers
- Adapt their business models to overcome gaps in the value chain, such as the lack of existing routes-to-market in low-income areas
- Build the systems, talent, and assets to demonstrate viability and attract growth capital.

While a new business can start to provide energy access and connect households within the first years, profitable enterprises often take a multi-year horizon (Bardouille and Muench 2014). The Shell Foundation also noted that **true pioneers in the energy access sector could take 6–10 years and require US$5 million–US$20 million in donor support to reach profitability** (Desjardins et al 2014).

Energy access companies often need assistance with developing the right business model and team. Companies need programs that provide not only financing but also advisory services that build business knowledge and skills (Bardouille et al. 2012). Governments can create or support business development programs for enterprises to improve their ability to attract financing—both in donor support and from investors. Support can include assistance with developing robust business plans, setting up businesses, identifying market needs and opportunities, addressing supply chain needs and gaps, and understanding financing needs—both for their business and for end users. Programs can help businesses understand that the team hired for the business is as important as the technology and that bringing on the right mix of skills and talents can attract investment (Desjardins et al. 2014).

Business incubators and peer-to-peer support can provide advice on best practices and assist enterprises in understanding their market to make better business decisions. These can also facilitate business-to-business networking to leverage the skills, products, and distribution resources of existing businesses and markets. Examples of some business development programs are discussed in Section 2.1.3.

### Market Analysis

Government involvement with analysis of the existing and potential market for energy access businesses provides clear benefits. Whether a government develops market data itself or financially supports its development by others, providing in-depth analysis across the market can reduce a major burden from private businesses and can increase investor confidence (Singer 2014). In addition, many sources of information are easier for governments to access than they are for small private businesses.

Market analysis can involve a range of information, including a detailed assessment of renewable energy resources—from solar and wind data in specific locations to data on water resources available for hydropower production. Additional analysis can assess the current energy usage and costs to off-grid customers for kerosene, diesel, candles, and other traditional services. Specific information on the extension of utility grids can be used along with geo-coded census data to assist businesses in identifying the potential customer base for energy access services by specific area. Analysis can also identify existing energy infrastructure and needs.[19] For example, the Shell Foundation attributes the success of its energy access initiatives in part to detailed market knowledge it gained through failed pilots and projects in its early stages (Desjardins et al. 2014). While the Shell Foundation may be in a position to absorb initial failures, an upstart SME would likely be unable to recover should it meet with similar failure. Providing accurate market research up-front can help avoid initial failures that would be otherwise lethal for a new SME.

### Technical Assistance

In many cases, off-grid electricity projects can involve new technology and distinct technical issues. Businesses need to have the technical skills to design, install, and maintain robust high-quality projects. While workforce development programs (Section 2.3.2) can help provide skilled labor for businesses, businesses in emerging sectors can benefit from access to technical assistance. Technical assistance programs allow businesses to call on expert assistance when they encounter a problem.

Policymakers and donor agencies can consider support for technical assistance programs that ideally offer both business and technical support to assist SMEs as needed to navigate obstacles and continue toward success. The concept of providing technical assistance to new businesses has a proven record of accomplishment in the energy access market from non-profit social investors. An early player in this field, E+Co, was a non-profit financial institution that focused on financing SMEs providing clean energy access to poor customers. Beginning in 1990, E+Co provided nearly US$40 million to over 250 enterprises, one of which was SELCO Solar—a social enterprise that has provided over two

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[19] New Ventures India (founded by the World Resources Institute) has begun work on this topic by combining a range of census, infrastructure, banking, and other data to identify geographic “micro-markets” for clean energy access in India. See http://www.nvindia.biz/resources-micro-markets-for-clean-energy-access.html for details.

million solar systems to customers in India since 1995.[20] E+Co changed its business model in 2012, and the challenge of financing technical assistance was one reason they cited (Wilson et al. 2014).

Social investors, such as the Small-Scale Sustainable Infrastructure Development Fund,[21] have models to provide both start-up funding and business support to innovative enterprises in low-income markets (S3IDF 2015). In addition, some international working capital funds for energy access, such as the responsAbility energy access fund and GroFin, have included business support programs for their clients to increase their likelihood of success. In GroFin, loan recipients receive extensive business support assistance as well as access to expertise in business operations and supply chains (Desjardins et al. 2014).

Governments have already recognized capacity building as a critical step in creating successful businesses in the energy access sector. In the Bangladesh case study (Volume 2, Section 1), IDCOL's business model for solar home systems incentivises market creation, creating delivery networks, access to capital, and quality assurance, after-sales service. It also provides training and institutional strengthening support for partnering organisations, including private sector businesses. In Tanzania, the Rural Energy Agency offers grants to support market research in the rural electrification sector, and it provides assistance with business plans and specific projects.

### *Support of Business Innovations*

Building the educational environment can expand the human capacity to foster and lead energy enterprises (Singer 2014). To facilitate energy access, several institutions are designing policies and programs to support technology and business model innovation. Strengthening the country's broader educational environment is a critical element of these initiatives, as it often supports the development of energy companies and builds the capacity of technicians, engineers, project developers, financiers, and other key actors to deploy innovative energy access technologies.

One notable example of a dedicated institution supporting energy access innovation is India's SELCO Solar Incubation Lab. SELCO, which is primarily funded by NGOs and international foundations, provides a robust model of engaging businesses to explore new energy access innovations and business models. Through collaboration with community-based organizations, technology suppliers, financial institutions, and academia, the Solar Incubation Lab provides support to various actors engaged with energy access. Essential services include supporting design of innovative and affordable energy access products; facilitating small enterprise development through enterprise and business incubation; performance testing of new technologies; and supporting dissemination of products to rural communities. SELCO's contributions have played an important role in supporting a broader innovation ecosystem to expand energy access in India.[22]

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[20] See www.selco-india.com/about_us.html.
[21] "Social Merchant Bank Approach." http://s3idf.org/our-approach/social-merchant-bank-approach/.
[22] See www.selco-india.com/incubation_lab.html.

### 2.3.2 Developing the Workforce

Remote electricity access often involves technologies that require specific skills for installation, maintenance and service. As access markets are in early stages, these technologies are likely new and experience with them is limited. Therefore, the ability to develop a strong and skilled workforce is critical to ensure successful and sustainable business and market outcomes.

To support energy access businesses, governments can implement training programs and design curriculum to develop and enhance energy access service and technology skills. Workforce training support can also decrease costs for energy access companies that often operate in challenging business environments and may experience barriers detailed in Section 1.3.1 (Hande and Rajagopal 2015).

Training programs often draw from domestic and global experience to support successful outcomes and a strengthened, effective workforce. For example, the International Renewable Energy Agency's (IRENA) International Renewable Energy Learning Partnership[23] supports knowledge sharing and creation of a robust renewable energy workforce by providing in-person training courses and online webinars focused on various energy sector topics, including effective business models.

Common training approaches are described below.

- **Vocational Training**—Integrating energy-focused curriculum and activities with existing vocational training and apprenticeship programs can provide an opportunity to deliver new skills through existing networks. Vocational training prepares workers for trade-specific careers and creates opportunities for both employees and employers. In nascent energy access markets, vocational training can support the development of skilled technicians, operators, installers, and enterprises through established networks of training institutions. The U.S. Agency for International Development (USAID)-sponsored Vocational Training and Education for Clean Energy (VOCTEC)[24] supports multi-tiered global training focused on solar PV operation, wind policy, enterprise development, and solar opportunities for women, among other topics.[25]

  Policymakers can work in conjunction with industry and education partners to establish guidelines for clean energy training and even establish criteria to accredit training institutions that offer in-depth energy training. Where national and/or local training organizations are not yet established, internationally accredited organizations can partner with local entities to train the trainers and build a skilled workforce. For instance, Solar Energy International—a training organization accredited by the Interstate Renewable Energy Council—partners with NGOs, universities and government agencies in Kazakhstan, Mexico, Nicaragua, and South Africa to transfer solar energy operation, maintenance, and business development skills through a train–the-trainer program.[26]

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[23] See irelp.irena.org/AboutIRELP/aboutIRELP.aspx

[24] VOCTEC is led by Arizona State University in conjunction with Appalachian State University. It operates in 19 developing countries.

[25] See voctec.asu.edu.

[26] "Solar Energy International: Developing World Outreach Programs." http://www.solarenergy.org/developing-world-outreach-programs/.

- **Industry Partnerships**—Industry organizations can support energy access workforce development. In particular, industry members have a vested interest in workforce development and often have created tools to do so. In particular, industry partnerships can create effective standards for certification and are often well suited to provide training on key energy access business topics such as technology quality standards, repair and maintenance services (e.g., use of warranties, networks of service providers, and locally-available spare parts), and effective business models.
- In India, the Clean Energy Access Network (CLEAN) is a bottom-up, practitioner-led network that was developed to tackle common challenges facing the clean energy market with a particular focus on SMEs and underserved areas.[27] CLEAN supports clean energy access through development of training guidelines that can be broadly applied, identification of training gaps, and engagement of policymakers to support mobility of the energy access workforce. They are also working on certification of clean energy practitioners.[28]
- **Community-Based Support**—Community-based training supports workforce development and income generation opportunities at the local level. Community-level train-the-trainer and mentorship programs can establish a positive cycle of success and opportunity for poor communities. Tostan, an NGO with various projects in Africa, provides a community-based training model that has been successful in a number of communities. Under the Solar Power Project, Tostan sponsors female rural community members to attend six-month solar electrical engineering courses. Following the training, the women install solar units on homes in and around their communities to provide electricity, lighting, and charging stations. To support broader positive impacts, the women provide solar PV installation training to other women in their community and neighboring villages.[29] Community-based training efforts can help ensure initiatives meet the needs of the community and grow locally.[30]

> "Stimulate market research to gain more accurate information on the changing energy needs of poor people as they move up the energy ladder. **Disaggregate the bottom of the pyramid**."
>
> Recommendation of the SE4All Access Committee, June 2014

The Mexico case study (Volume 2, Section 4) provides another example of a community-based training model. The off-grid energy service company, Iluméxico, created several service centers, called ILUCentros. Beyond servicing energy systems, the ILUCentros serve as hubs for community development by offering workshops in local schools on workforce skills, sustainability, community empowerment, and gender equality. Funded by the sale of complementary products and maintenance plans, the ILUCentros also provide local employment opportunities, with two to three employees per center. This example highlights an innovative approach to supporting both energy access and community development.

[27] Presentation by Ashis Kumar Sahu, CEO, Clean Energy Access Network (CLEAN) during a Clean Energy Solutions Center webinar titled, "The Current State of Energy Access in India", which was held April 29 2015, cleanenergysolutions.org/training/energy-access-india
[28] See thecleannetwork.org/focus-area/skills-and-training.aspx.
[29] As of April 2015, 452 solar panels had been installed by 58 trained solar engineers.
[30] See www.tostan.org/program/solar-power-project.

### 2.3.3 Educating Market Participants

In order for a market to function most effectively and sustainably, all the various actors in the market must understand the key elements of the market and understand their role in it. This is true for all levels – from end-users to importers, from policymakers to bankers. Educating the various sectors can help reduce the level of perceived risk. When new technologies or business models are involved, a lack of understanding increases the perception of risk.

People are less inclined to invest in the unknown. While some risks are higher for new markets, proper education of certain actor in the market, in terms that most relate to their work, can increase not only the willingness to work with the new market but also the ability to effectively do so.

Below are primary categories of market actors and a short description of information that can help them more effectively foster or participate in an off-grid energy access market.

- **Consumers:** A basic tenet of SELCO Solar, a highly successful India energy service company, is that the poor can afford and maintain sustainable technologies and that social enterprise such as rural electrification can be run as commercial businesses (SELCO 2015). However, poor consumers can have high sensitivity to risk, are unlikely to purchase services from companies they do not know, and are unlikely to purchase technologies they do not understand (Desjardins et al. 2014). Government efforts can increase consumer awareness and trust in these ventures though a range of efforts, including implementing consumer awareness programs and campaigns, adopting quality standards, requiring warranties to access government incentives, or simply enabling energy service companies to partner with existing trusted businesses in other sectors.

  Beyond supporting basic energy services, governments can increase awareness of potential business potential that energy access can open. Training programs or business support for **productive uses** of energy, such as agriculture, water pumping, motors, and a range of new equipment can support these economic opportunities in rural areas. Including productive uses in energy projects can increase their long-term success (Yadoo 2012). In addition, government can increase consumer awareness of the potential and value of **high-efficiency appliances** designed for off-grid use.

- **Policymakers:** Governments can facilitate awareness of energy access options, including technology solutions and business, and finance models among policymakers at all levels of government. This can support practical sustainable policy development and informed design of market interventions to enable the private sector (Singer 2014). Beyond that, better policy decisions are possible when they are based on market data that includes information on citizens without energy access, clear grid extension plans that include costs and timing, the availability and costs of various off-grid energy options, and potential business models that can serve the sector. Education on current public-private programs in other countries can be helpful, as can interactions with market stakeholders. In countries where energy services have always been provided by the government, additional education may be beneficial on the pros and cons of engaging the private sector in the market. There is also a demonstrated need to educate policymakers regarding the feasibility and benefits of renewable options to increase energy access, including providing evidence of how such a low-carbon path can help advance social well-being while meeting energy and climate goals (New Climate Economy 2014).

- **Utility Officials and Regulators:** Whether utilities are privately or publicly owned, the utility officials and regulators will (1) need to understand the government's goals related to off-grid energy access and (2) need to be educated on the potential for minigrids and other small power producers to provide energy access. Importantly, they need to understand the role of transparency in their planning and that upfront collaboration can resolve future issues with grid extension into these project areas. Often, utility officials can be slow to embrace newer technologies, as they worry that unknown projects might pose a risk to grid stability. Demonstration projects and technical support can increase their understanding about these proven technology options, resolve technical concerns, and bring them in as valuable stakeholders in the future of this market.

- **Financial Community:** The financial community—including investors, donor agencies, national or local banks, and MFIs—is critical to both the short-term and long-term viability of energy access markets. Where financiers lack understanding about projects, particularly ones that can be complex and technical, they will increase the assessed risk, and they will either choose not to participate or they will increase the cost of financial products. In addition, many of the energy access businesses and consumers are not traditionally considered bankable due to lack of collateral or financial history (Bardouille et al. 2012).

  Governments can design awareness programs to specifically engage financial institutions. Training programs to educate banking staff on the best products and processes for this market can increase their effectiveness (Guay et al. 2014). The financial community can use targeted information products and programs, including specific information useful to this sector, can include market analysis and proven financial and business models. Peer-to-peer training can provide perspective from experienced members of the financial community, and demonstration projects that actively engage the local financial community can build understanding. Technical assistance during due diligence can help financial institutions determine which energy projects are technically viable. The Frankfurt School – UNEP Collaborating Centre for Climate & Sustainable Energy Finance is developing programs to expand the capacity and engagement of the finance sector in climate projects.[31]

  At the smallest scale, several programs, including IDCOL in Bangladesh and the Development Bank of Ethiopia (Volume 2, Sections 1 and 2), as well as multiple SMEs in India (discussed in Section 2.3.1), make use of MFIs and MFI-like collection methods for end user-financing and sometimes SME financing as well. When MFIs are willing to engage in the energy market, specific programs to increase MFI capacity can expand financing options. IDCOL's one-stop shop model includes training support for partnering organizations. The MFIs are trained by IDCOL to conduct household assessment of energy needs and affordability, install the systems, and provide after-sales service.

- **Communities.** When a local community has a sense of responsibility and ownership in a project, it can increase the long-term prospects for an energy project (Yadoo 2012). Several SME business models involve communities as partners in projects. Communities can play a number of roles in enabling successful electricity services, including serving as owners or management, increasing local participation, providing ongoing maintenance, and even providing added impetus for customers to pay. A number of non-profit organizations are working to engage communities and assist local economic development through energy access. For example, the Rockefeller

[31] For more information, see fs-unep-centre.org.

Foundation has established a Smart Power for Rural Development initiative to electrify rural villages in India to spur economic development.[32]

Experience across Nepal, Kenya and Peru has indicated that project models that ensure communities fully understand the opportunities and responsibilities of a system and establish a sense of ownership within the community are far more likely to encounter long-term success (Yadoo 2012). In fact, in Nepal, many projects seek full community consensus even if it means delaying the rest of the project (Yadoo 2012). Despite its importance, the community factor is overlooked on many projects, as sponsors and financiers rarely include room in budgets for raising awareness and fostering community engagement, and contractors and developers are selected for their technical prowess rather than their ability to engage the community (Isoun 2014).

One model to ensure community buy-in is to simply educate communities about electrification technologies and then step back and wait for them to self-organize and take the initiative to ask for help, thereby ensuring that communities receiving assistance are at least committed, organized and proactive enough to apply for it. The World Bank Energy Sector Assistance Program in Nepal had great success with approach (Yadoo 2012). In communities where there is strong sentiment but leadership may be lacking, outside facilitators can work with communities to help them through the process.

Community education is critical not only for getting a project initiated and off the ground, but also for ensuring its longevity. Extensive experience with solar-powered water projects in Nigeria has shown that even the most technically-sound projects are likely to fail if the local community is unable to sustain the project after commissioning (Isoun 2014). This does not, however, mean that local communities must always be trained in the advanced technical details of how to manage a complex, off-grid project. Rather communities can be educated on basics such as how the system works, how to maximize its benefits, how to perform preventative maintenance, how to identify and report problems, and where to go for help when required (Isoun 2014).

While community relations mostly occur at the business level, government policies can increase awareness of the potential for these projects and foster legitimacy. Governments can work with SMEs and communities to identify successful models and provide model language for contracts. Adoption of quality assurance standards can also provide a framework to engage communities and developers on clear terms of service. It is important, however, that if and when communities are engaged, it is done through the proper channels, taking care not to upset local hierarchies and leadership structures.

[32] For more information, see www.rockefellerfoundation.org/our-work/initiatives/smart-power-for-rural-development/.

## 2.4 Integrating Energy Access with Development Programs

Development programs, often led by ministries of development, health, education, agriculture, and environment among others (henceforth referred to as "social protection" ministries), can provide a valuable vehicle to implement energy access programs, attract and leverage development-focused funding, and learn from longstanding community programs and partnerships. For this reason, countries around the world are leading cross-ministerial energy access efforts to alleviate poverty, improve health and education, support greenhouse gas emission reductions, and respond to disasters. Figure 12 summarizes key factors for integrating energy access goals and development programs. The factors— engaging across ministries, leveraging funding, and learning from experience—are discussed in the sections that follow.

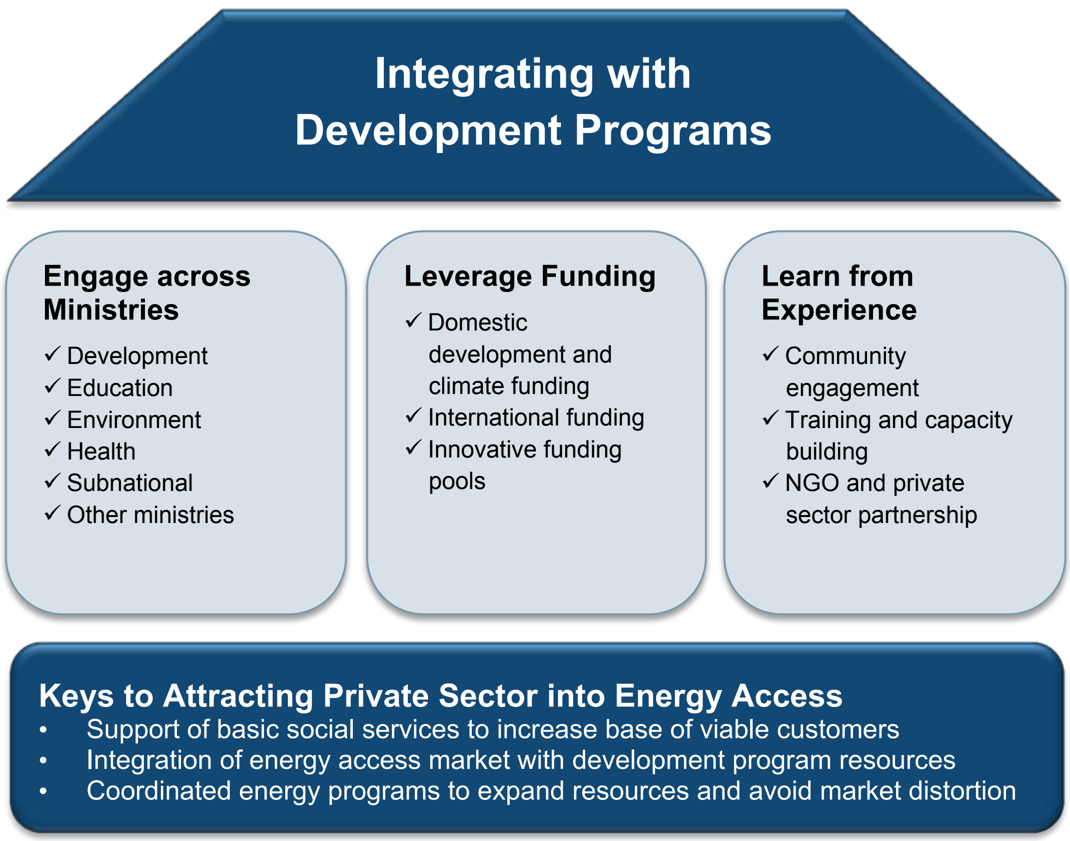


**Figure 12. Key factors for integrating energy access and development programs**

While several innovative and well-established market-based approaches to support energy access are described in this report, provision of basic social services, which is often inherently linked with energy access, is also a critical need in many parts of the world. This section focuses largely on government-supported programs to improve health, education and other social services for the poorest communities in the world. Energy access furthers a range of government development goals, so leveraging funding from the various development ministries can expand the government's ability to support the energy access market. The networks from the broad range of development programs provide more market capacity and potential support to developing energy access markets.

Subnational governments also play an important role in energy policies, so coordination among national and subnational levels of government is critical to address jurisdictional issues and resolve barriers. For example, when Argentina designed its PREMER concession program (discussed in section 2.1.2), several states still had policies in place preventing private sector businesses from engaging in the energy sector, which precluded those states from initially participating in the program (Best 2011). Similarly, when AMADER was given power to grant licenses and concessions to mini-grid developers in Mali, many villages felt their authority was being infringed upon and put up fights that hindered the process (Volume 2, Section 3). Coordination of national with state and local agencies could have obviated these issues from the beginning.

A key partner of Iluméxico in Mexico (Volume 2, Section 4) was the Oaxaca State Department of Social Development. Iluméxico was able to leverage both energy programs at the federal level with this state-level development agency to provide solar home systems to unelectrified rural populations in that state.

Renewable energy or hybrid technologies are increasingly cost-effective options to support energy access for health, education, and other social development needs in rural areas over the long term. This is especially true in remote areas where diesel costs are often very high in relation to difficult transport routes, and where grid extension may be uneconomical (USAID undated). To reduce costs to poor communities, several governments are using renewable energy technologies for integrated energy access-social protection initiatives supported by collaboration across energy and development-focused ministries.

In Sections 2.4.1–2.4.6, connections between energy access and key development programs are highlighted, with innovative examples bringing life to the discussion and providing lessons to support successful integrated efforts. Ultimately, energy access and development programs can be effectively linked and support mutually beneficial outcomes through common good practices presented in the concluding section.

### *2.4.1 Poverty Alleviation Programs*

Energy access is a critical element of poverty reduction efforts, and governments are increasingly viewing poverty in light of energy challenges. The International Institute for Environment and Development (IIED) has proposed that linked energy access-poverty alleviation efforts can be targeted in relation to levels of poverty, bankability of communities, or both (Wilson et al. 2014). While many poor populations can benefit from market-focused efforts described in other sections of this report, the poorest populations are often considered pre-bankable. Therefore, while programs to support these populations should ultimately support bankability, the primary focus should be on providing basic social services, such as health and education. For this reason, governments can take a two-tiered (or multi-tiered) approach to addressing energy access based on poverty level.

#### *Provide Direct Government Support*

To alleviate poverty, the poorest populations (e.g., subsistence-based/pre-bankable)[33] will often benefit most from not-for-profit social service programs supported through government and donor funding. For example, the Iluméxico initiative (Volume 2, Section 4) has leveraged municipal-level

[33] Energy access opportunities for bankable populations are covered in Section 2.2.1 and are not considered in this section.

government social protection funding from the state of Oaxaca to support deployment of solar home systems. The initiative achieved this outcome by specifically linking their work with poverty reduction goals and focusing efforts on the areas prioritized by the government of Mexico for energy access efforts to reduce poverty. As illustrated in this example, energy access programs linked with poverty reduction can provide a valuable opportunity to leverage development program funding.

### *Leverage Development Ministry Expertise and Funding*

In working with the poorest communities, leveraging expertise of social development ministries and their local partners is often extremely valuable. Rural social protection programs, such as health and education, are deeply engrained in several countries and have a long history of relationships with local communities and key NGO partners. Thus, lessons and knowledge from these programs can be leveraged to inform energy access efforts. Further, accessing development-focused donor funds can also greatly benefit linked poverty reduction-energy access efforts (MRFCJ 2013).

### *Integrate Efforts across Ministries and Developing High-Level Strategies*

To provide higher-level framing for poverty alleviation efforts, governments can integrate energy access with poverty reduction strategies and establish inter-ministerial committees to implement crosscutting programs (MRFCJ 2013). For example, to support effective implementation of Senegal's Poverty Reduction and Rural Electrification Strategies, the Senegalese government established a multi-sectoral committee, the Intersectoral Committee for the Implementation of Synergies between Energy and other Strategic Sectors (CIMES)**.** The committee, which brings together the Ministries of Energy, Water, Health, Education, Tourism and Agriculture, and other agencies, supports coordination of action across the energy and development-focused sectors. More specifically, the committee focuses on electrification of "basic socio-economic infrastructure" such as clinics, schools, and water-pumping stations (Sarr 2009). The committee also works closely with the private sector, NGOs, communities, and donors to effectively coordinate programs and leverage expertise. In particular, CIMES has focused on assessing energy gaps and renewable energy opportunities to meet Senegal's development goals and, based on this assessment, incorporation of energy access actions with the National Poverty Reduction Strategy (REEEP 2014; UNCTAD 2010). As another example, Peru's Master Plan for Rural Electrification by Renewable Energy is fully aligned with broader national poverty reduction goals, and it presents a robust model of cross-ministerial support. To implement the plan, several ministries (Table 4) developed ministerial decrees to mandate engagement and send a strong signal of ongoing support for rural electrification (JICA 2008).

Critical energy access programs focused on poverty reduction, health and education can ultimately support communities in moving from subsistence to a market and credit-based system. However, before this transition occurs, grant and subsidy-based energy access efforts supported through development and social protection programs are often most appropriate. Training and capacity building are also critical to supporting knowledge, operating and maintaining the technologies, and enabling sustainable social service infrastructure for clinics and schools that serve rural communities (Wilson et al. 2014).

**Table 4. Key Institutions Supporting Peru's Master Plan for Rural Electrification**

Source: JICA 2008

| Organization | Role in Rural Electrification |
|---|---|
| Ministry of Energy and Mines | Primary responsibility for energy supply at the central government level |
| Ministry of Education | Electrification of schools |
| Ministry of Public Health | Electrification of health posts |
| Electric Infrastructure Management Company (ADINELSA) | Operation and maintenance of not profitable projects implemented by the government |
| Cooperative Fund for Social Development (FONCODES) | Electrification requested by poor villages |
| National Program of Watershed Management and Soil Conservation (PRONAMACHCS) | Electrification of agricultural villages |
| Regional governments | Primary responsibility for programs at the regional level |
| Power supply companies | Electrification based on extension of existing grids |
| NGO | Electrification using the funds from government or international organizations |

### 2.4.2 Health Programs

Electricity is critical to providing basic health services. However, many health facilities around the world remain without electricity. Notably, 30% of health facilities in Sub-Saharan Africa and 46% of those in India lack electricity (Practical Action 2014). Alongside the lack of access to energy is the problem of unreliability in energy supply when available. Even when health facilities are connected to the grid, many suffer from frequent power outages (WHO 2010).

Energy services play a critical role in influencing the quality, accessibility, and safety of essential health services, especially for women and children, who often bear the brunt of inadequate primary health care services (Say and Raine 2007; Taghreed et al. 2005). In the absence of reliable power in health facilities, many of the most basic life-saving interventions simply cannot be undertaken safely or at all, posing a barrier to the attainment of universal health coverage as well as key health-related Millennium Development Goals.

Energy access is particularly important to the health of mothers and children. Unlike many other medical procedures, childbirth cannot wait until morning. Worldwide, over 289,000 women died from pregnancy- and childbirth-related complications in 2013 (WHO 2014b). While there is still insufficient data to draw an absolute correlation, it appears many of these life-threatening complications could be averted through initial interventions providing minimal lighting and appliance operating services (Mills 2012). The United Nations' SE4All initiative has identified the key role of energy access in advancing women's health as one of a handful of high-impact areas in which energy access can make a difference, and it is leading a joint effort with the UN Foundation and WHO to make measureable progress in this area.[34]

Another important facet of energy provision relates to the ability to refrigerate vaccines, blood, and medicines. Many diseases, such as pneumonia and measles can be prevented through immunizations, yet they still kill approximately 1.7 million children each year,[35] predominantly in developing countries. A significant share of vaccines delivered to developing countries is ruined due to poor cold chain services (WHO et al. 2009). Health centers with reliable power and functioning refrigeration facilities keep vaccines and other vital medicines from losing their potency permanently.

Power and in particular, electricity is required to provide basic amenities, such as lighting, ventilation, communications, and computer systems. Electricity is also required to safely manage medical waste (e.g., non-incineration methods) and operate essential medical devices, including emergency surgical, laboratory, and diagnostic equipment. Access to clean and hot water in health care facilities also generally depends on access to energy for water pumping and water-purification systems.

There are also clear linkages between access to energy in health care facilities and the functionality of information, communication, and technology services. Anecdotal experience and an initial literature review also suggest that access to energy in health has crosscutting impacts, for example on health clinic hours of operation, health service costs, and retention of health workers. Where it is difficult to attract and retain trained medical staff in the field, reliable electricity can provide highly valued services such as light and communications. In addition to these health-related services, electrified health care facilities can also serve as broader community centers to provide health education, battery charging, and communication services (Figure 13).

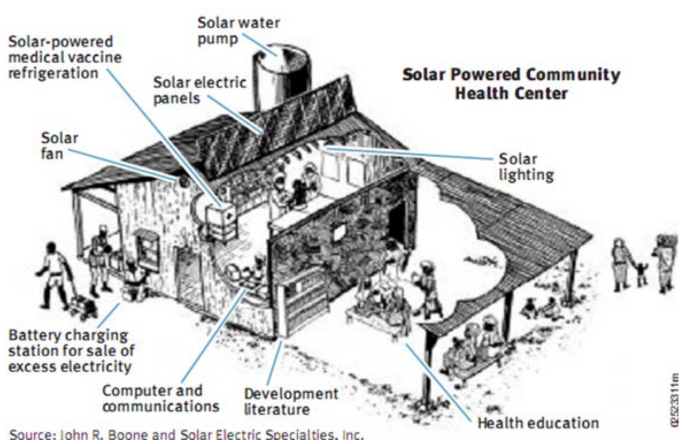


**Figure 13. A multi-purpose electrified rural health facility**

Source: Margaris 2008

[34] For more details, refer to http://www.se4all.org/hio/energy-and-womens-health/

[35] "International Parliamentarians Commit to Immunization." April 3, 2012. http://www.gavi.org/library/news/gavi-features/2012/international-parliamentarians-commit-to-immunisation/.

### Partner with Health Ministries for Clinic Electrification

Ministries of health are often leading partners for rural clinic electrification efforts, and they can leverage on-the-ground capabilities, partnerships, and long-standing relationships to support successful outcomes. Funding is key to these efforts, and ministries of health can contribute funding rural electrification efforts, as these programs impact health outcomes. In some cases, they can also attract development funding for clinic electrification efforts to support both energy access and health care needs. For example, Haiti's[36] Ministry of Health partnered with the USAID to assess energy needs of clinics and hospitals, implement sustainable systems, and train technicians on system maintenance.

### Train Health Clinic Staff and Designate Personnel within Health Ministries

As a key aspect of the program described above, Haiti's Ministry of Health Project Management Unit, in partnership with USAID, has focused on delivering ongoing trainings to support sustainable system maintenance. Capacity building is provided through a comprehensive and tiered approach that starts with training hospital staff and/or local partners on basic system operation and maintenance as well as distribution of system user guides and basic supplies. For technical problems that require more extensive intervention, experienced energy technicians at the national or regional level are also designated as contact points to ensure system sustainability. Training resources through the program are also made publicly available to support global learning.[37]

As evidenced in the example above, strong government institutions such as ministries of health as well as rural energy agencies and power utilities are essential to ensuring public health facilities gain access to the energy they need. Unfortunately, in many cases, the capacity of such institutions is limited. For example, health sector institutions from the ministry of health to health clinics are typically not well staffed to manage and service power systems. Health clinic managers and administrators need to be equipped with the tools and knowledge to assess and improve their own systems to (1) ensure sustainable financial and operational maintenance of energy systems and (2) implement good practices in the procurement and effective use of electric medical devices on the demand side (WHO and The World Bank 2014; Lighting Global 2014).

Energy access programs led by or in partnership with ministries of health can build on local knowledge and partnerships from long-standing and deeply engrained development programs while also leveraging significant international development funding. However, focusing on building capacity of leading and engaged institutions is also critical in supporting sustainable energy access outcomes.

## 2.4.3 Education Programs

With more than 50% of children in developing countries attending primary schools without electricity (Practical Action 2014), expanding energy access is critical to supporting educational goals and priorities. Electrification can benefit education by extending operational hours of schools, which can in turn allow more students to be served and encourage smaller class sizes, more preparation, and meeting time for faculty, an alternative study location for students without

[36] Haiti faces both significant electricity reliability issues and high diesel fuel costs for back-up power generation. And, critical health care challenges are often exacerbated by the aforementioned energy situation, especially in rural areas.
[37] See www.poweringhealth.org/index.php/resources/materials/training-material.

electricity at home, and use of the school for other educational purposes in the evenings. Further, school electrification can support use of technologies, such as computers (often critical for professional advancement), provision of meals to students, and improved classroom work environments through temperature control (Practical Action 2014). Ultimately, improving education also supports income generation, which can support, in turn, market-based energy access approaches described in other sections of this report.

### *Partner with Education Ministries for School Electrification*

Rural school electrification programs often provide an opportunity for ministries of energy to partner with ministries of education. Joint programs can benefit from leveraging funding from each ministry toward common goals and sharing valuable on-the-ground knowledge and expertise For example, under Argentina's Project for Renewable Energy in Rural Markets, partnership with the Ministry of Education's complementary Project for Improving Rural Education (PROMER) provided an additional source of funding to support school electrification as well as installation of energy efficient appliances (e.g., computers and televisions) following electrification. In addition, the program leveraged on-the-ground relationships and knowledge to support community engagement and successful outcomes (Best 2011).

### *Train Teachers, Communities, and Students*

In addition to advancing traditional education, electrifying schools provides opportunities to expand hours of operation. During expanded hours, school facilities can be used for vocational training of adults and training on operation and maintenance of energy technologies used at the school and in the community more broadly. Electrifying schools also provides an opportunity to educate students and communities on the basics and benefits of renewable energy, through hands-on demonstration and workshops.

For example, under the Master Plan for Rural Electrification by Renewable Energy, the government of Peru designed a cross-sectoral program to advance social progress through electrification of schools and clinics, while also building capacity and awareness of renewable energy technologies in rural areas. Through the education component of the program, the Ministry of Energy and Mines led implementation and technical assistance to electrify schools using renewable energy technologies while the Ministry of Education built knowledge and awareness of renewable energy technologies within communities. The electrified schools served as a location for renewable energy seminars and training, and they provided hands-on experience for local communities to learn about technologies. Regional Renewable Energy Centers for Rural Electrification (CERER) were also developed under the program to provide capacity building on economic, technical, and market aspects of renewable energy technologies to universities, suppliers and other stakeholders. Figure 14 provides an illustration of key players and roles of various institutions in implementing the program.

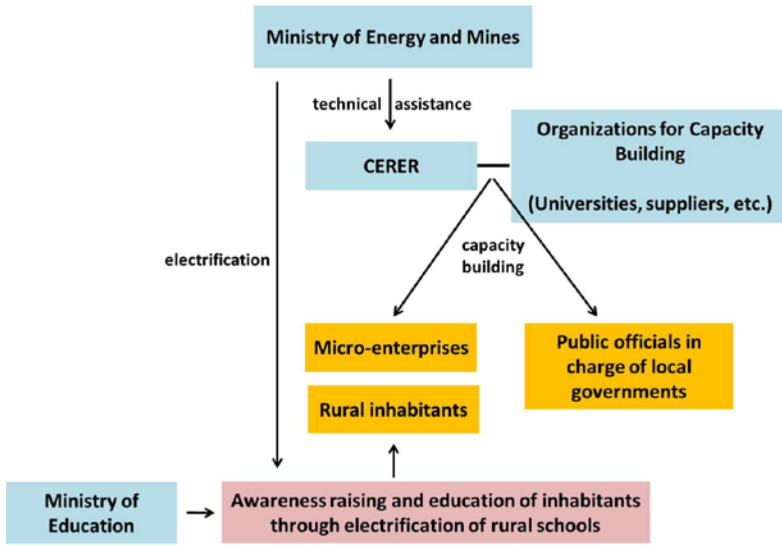


**Figure 14. Government of Peru's Rural School Electrification Program**

Source: JICA 2008

### *Leverage Education Program Experience*

Energy access partnerships between ministries of energy and ministries of education can also leverage knowledge and lessons from previous programs in rural areas. For example, Peru's Ministry of Education's Huascarán program electrified 34 schools with PV systems used for lighting, computers, radios, and audio-visual equipment to improve education. Under the program, Ministry of Education funds were used to replace batteries every six years, and teachers and parents of students were trained to operate and maintain the PV systems. The successful program provided valuable lessons for the Ministry of Energy, including the value of engaging teachers and community members on use of the systems and the need for ongoing operation and maintenance support to ensure sustainability. Through the program, teachers and parents of students were trained to perform daily operation of the PV systems as well as provide ongoing maintenance. To further support sustainable outcomes, the Ministry of Education also funds system battery replacement every six years. The Ministry of Energy's School Electrification Program is implementing similar measures to ensure positive outcomes.

## *2.4.4 Environmental Programs*

Energy access programs can be crucial in supporting broader environmental objectives such as improving air and water quality, and reducing greenhouse gas emissions. For this reason, ministries of environment often partner with ministries of energy on integrated energy access-environment programs. Further, ministries of health are also often engaged in these programs, as indoor air quality and water quality present significant health implications. As presented in the sub-sections below, coordination across government agencies at the local and national levels is critical in supporting integrated environmental and energy access programs.

### *Integrate with Air Quality Programs*

Approximately three million people globally rely on biomass and coal for cooking and heating their homes. This leads to significant health issues, with over four million people dying annually from respiratory illnesses associated with air quality, particularly women and children, who often spend more time inside the home (WHO 2014c). Energy access programs often seek to address these issues by providing alternative renewable technologies for cooking and heating, such as clean cookstoves and clean renewable electricity systems.

Ministries of energy, environment, and health, among others are partnering to tackle these challenges by linking energy access, health, and environment programs. For example, the government of India's Ministry of Environment and Forests partnered with various ministries, including Energy and Health, at the national and subnational levels to design monitoring guidelines to inform building and energy technology requirements to reduce indoor air pollution (CPCB 2014). And, international institutions focused on energy, health, and environment are supporting linkages by raising awareness and providing valuable resources and funding for integrated activities. For example, the United Nations Sustainable Energy for All initiative partnered with WHO and other institutions to develop a tracking framework that integrates and measures progress across energy access indicators related to health and other areas. The Climate and Clean Air Coalition to Reduce Short-Lived Climate Pollutants (CCAC) also partnered with the WHO under the CCAC Health Task Force to support increased health institution and stakeholder engagement with air quality initiatives, including those linked with energy access (WHO 2014c). As evidenced in these examples at both the domestic and international levels, integration of air pollution and energy access initiatives is bringing together various ministries and institutions to tackle linked challenges using multi-disciplinary approaches.

### *Integrate with Water Quality Programs*

Critical links between energy and water present both challenges and opportunities. Energy is required for water treatment, to ensure safe consumption and discharge wastewater back into the environment. On the other hand, certain types of energy used for electricity also require significant inputs of water, which is becoming scarcer with global climate change (UNW 2012). Further, water used for irrigation of biomass to cook and heat many homes around the world, as described above, is also straining scarce water resources (UNW-DPAC 2014). The World Bank Group estimated that in 2012, 2.8 billion people were in areas of "high water stress," providing strong justification to support linked energy-water efforts that reduce water use (World Bank 2012).

Energy access programs that support use of low-water consumptive technologies, such as PV and wind, can reduce demands on scarce water resources while also providing power to ensure clean water and safe water discharge. Such programs often bring together ministries of energy, health, environment, and development, among other stakeholders through coordinated efforts that support cross-sectoral benefits. For example, various local and national government agencies, as well as other private partners, supported a project in the rural community of Villar de los Navarros, Zaragoza, Spain to provide off-grid electricity and pump water to municipal water tanks, addressing both water and energy security needs.[38] As another example, through Indonesia's Pro Poor Public Private Partnership, a mini-hydro plant was developed in the rural community of Cinta Mekar to support both energy access and water sanitation services. Coordination across local and national government agencies as well as partnership with NGOs, the private sector, and the United Nations provided the

[38] "Study Visit: Propelling Water with Photovoltaic Energy for Water Supply." 2014 UN-Water Annual International Zaragoza Conference. Preparing for World Water Day 2014: Partnerships for improving water and energy access, efficiency and sustainability. January 13–16 , 2014. January 16, 2014. http://www.un.org/waterforlifedecade/water_and_energy_2014/technical_visit_photovoltaic_water_pumping.shtml.

foundation for successful outcomes.[39] Integrating energy access with water needs through coordinated efforts can support improvement of rural communities at several levels by capturing synergies and efficiencies across the energy-water nexus.

#### *Leverage Climate Finance*

Social and economic development goals provide the foundation for low emission development, green growth and other climate-related programs in several countries. Energy access efforts that support poverty reduction, and health, environmental, and other social and economic goals are often integrated with broader climate objectives and programs. For example, Ethiopia's Climate Resilient Green Economy Strategy explicitly prioritizes low-carbon energy access. And, India's Integrated Rural Energy Program links efforts with greenhouse gas mitigation and natural resource management, among other priorities. Policies and actions considered under low emission development and green growth efforts are often prioritized in relation to possible energy access benefits, as well as other critical development goals (GGBP 2014).

Given efforts to integrate climate and energy access programs, climate finance is providing an increasingly significant source of funding to support energy access efforts. Thus, climate finance instruments such as Nationally Appropriate Mitigation Actions (NAMA)[40] and low emission development strategies (LEDS), among others, can be leveraged to support energy access efforts. For example, the United Nations Development Program (UNDP) launched the Millennium Development Goal-Carbon program to catalyze climate finance for rural electrification powered by renewable energy technologies. To achieve this goal and attract international climate finance, the program is supporting design of rural renewable electrification NAMAs in several Asian and Pacific and African countries. Further, UNDP also published a guidance paper (Hagan et al. 2014) on rural electrification NAMAs to support global efforts to leverage climate finance for energy access. Several countries, including Ethiopia, China, Colombia, Yemen, and others, are also planning and implementing energy access efforts under their broader LEDS and LEDS-related programs with domestic, bilateral, and multilateral climate funding.[41] Experience linking energy access with LEDS and NAMAs could also inform integration of energy access priorities with the Green Climate Fund and provide a significant source of global funding for ongoing low-carbon rural electrification efforts (MRFCJ 2013).

### 2.4.5 Disaster Relief Programs

Poor communities are often most at risk and least equipped for disaster and emergency situations. In the aftermath of disasters, provision of energy is often critical for these communities. During disasters, small-scale solar lighting and charging technologies can improve safety and allow for access to real-time information, which is crucial in supporting aid and rescue efforts (Qazi and Young 2014). At the same time, disaster recovery often provides an opportunity to improve community resilience through distributing and implementing critical technologies.

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[39] "Case Study: Community-Based Energy and Water Development Initiatives. Pro-Poor Public Private Partnership (5Ps) in Cinte Mekar, Indonesia." 2014 UN-Water Annual International Zaragoza Conference. Preparing for World Water Day 2014: Partnerships for improving water and energy access, efficiency and sustainability. January 13–16, 2014." http://www.un.org/waterforlifedecade/water_and_energy_2014/escap_5p_indonesia.shtml.

[40] Developed under the United Nations Framework Convention on Climate Change, NAMAs are projects, policies, plans, or programs to support mitigation of greenhouse gas emissions with domestic funding, international funding, or both.

[41] See ledsgp.org/activities/all.

### *Develop Integrated Plans for Energy Delivery and Disaster Relief*

Policymakers can also take actions supporting preemptive deployment of energy access technologies to enable improved disaster resilience. For example, Namibia has experienced several floods in recent years, including floods that led to the declaration of a national emergency in 2011; in response, the government of Namibia has prioritized enhancing disaster preparedness and resilience (Elephant Energy 2011). To address challenges associated with energy access during flood disasters, regional governments in Namibia, in partnership with Namibia's Red Cross operation and the NGO Elephant Energy, prepared a Flood Relief Energization Plan that focused on distribution of small-scale lighting technologies to the most vulnerable populations (Elephant Energy 2011). To inform this effort, a baseline energy survey (Figure 15) was conducted in several villages to understand energy use and support development of a detailed distribution plan for small-scale solar technologies that could be used during floods and other disasters.

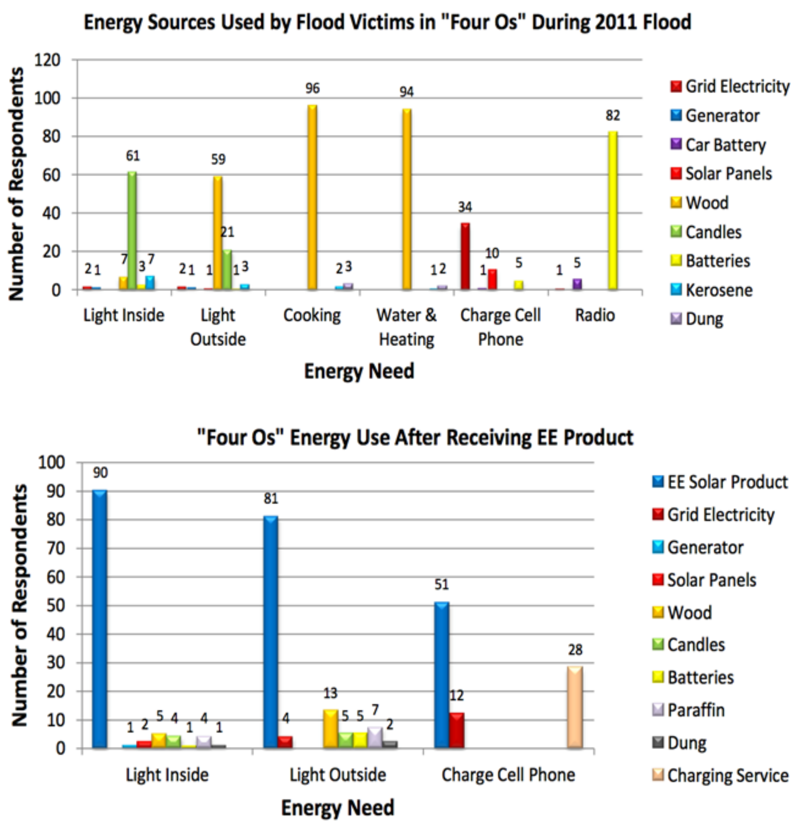


**Figure 15. Results of Namibia's Flood Relief Energization Plan survey**

"Four Os" refers to communities where technologies where distributed.
Source: Elephant Energy 2011

The example of Namibia highlights the value of working with NGOs such as the Red Cross that have vast experience and are deeply involved with community efforts to support successful integrated energy access-development programs.

### 2.4.6 Agricultural Programs

While energy poverty can indeed be found in urban areas, energy access today is largely a rural problem, with an estimated 84% of those suffering from energy poverty living in rural areas (IEA 2011). In such settings, agriculture—oftentimes subsistence agriculture—is the principal means of livelihood. With existing networks that are set up to operate in rural communities, agricultural ministries and programs are well poised to leverage expertise and resources in partnership with energy access efforts.

#### *Improve Irrigation Practices through Energy Access*

Farmers in remote areas are often dependent on electric pumps to bring subsurface water to the surface during dry, summer months. However, inadequate and intermittent power supplies may limit farmers' ability to pump sufficient water to adequately irrigate their crops, leading to sub-optimal yields. Farmers in parts of India, for example, require 8 hours of consistent power each day to keep their crops watered in the dry season, yet many receive only 2 hours each day due to scheduled load-shedding programs, leading to chronic under-watering.[42] Farmers often use diesel generators to provide the needed pumping power, but diesel fuel has several costs as described in Section 1.2.2. Distributed, solar-powered irrigation systems are a viable, cost-effective alternative that can enhance irrigation in remote communities and boost agricultural yields. Such systems are gaining widespread traction and can be an integral part of agricultural development programs

#### *Power Communities with Biogas*

Within the energy access context, agricultural communities also have a distinct advantage—easy access to bioenergy. Farm waste such as manure and plant residues, as well as food waste from homes, can be used to generate onsite "biogas" that can power generators. Small-scale biogas production of this nature has the added benefit of producing organic fertilizer that can reduce costs associated with purchased fertilizers. On a larger scale, agricultural waste from large processing facilities can also be used to power nearby minigrids and supply local communities. Experience in Indonesia has found that residue from palm oil mills can provide a secure and cost-effective fuel for minigrids (Hirsch et al. 2015), and in India, sugarcane plants often use leftover sugarcane bagasse to provide power to nearby communities. In considering the role of agricultural programs in advancing energy access these large-scale, corporate applications can often serve as an attractive, high-value target that is easy to incentivize with proper tax and tariff designs.

Connections between energy access and agricultural output extend well beyond matters of irrigation and biogas. Access to modern communication media can provide up-to-date information regarding market trends and prices, or the newest agricultural practices, which can give farmers the needed edge to increase their output and revenue, while timely weather reports can help farmers better plan and manage their crops. When power supply permits, use of larger agricultural machinery can help enhance farm productivity through use of pumps, motors, mills, grinders, saws, refrigerators and more. All of these issues are often high priorities for agricultural ministries and development agencies, and hence can be leveraged along with energy access programs to increase the reach and efficacy of both.

### *2.4.7 Opportunities for Collaboration*

Building on the information and examples described above, several good practices have emerged to support successful integration of energy access and development programs. These good practices, which can be tailored for specific country circumstances, are highlighted below.

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[42] Direct observation by Tim Reber while working on small-farm energy access issues in Karnataka, India, 2013-14.

- **Establish Inter-Ministerial Coordination Processes and Cross-Agency Plans to Support Integrated Efforts:** In a number of cases, governments are supporting design and implementation of inter-ministerial committees and processes to support holistic linked energy access-development programs and system delivery. These processes can support effective coordination, cross-sectoral knowledge sharing, and high-level engagement across the government to engender sustainable outcomes. Working across ministries can also help ensure experience is leveraged, and possible trade-offs and opportunities across sectors are considered.
- **Leverage Development Funding and Explore Innovative Funding Mechanisms:** Ministries of health, education, and environment, and other development ministries can support a broader and more diverse funding pool for energy access efforts. Development banks, donors, and foundations typically focused on social protection areas related to health, education, climate, and disaster relief can be engaged in energy access efforts bringing both resources and knowledge to support successful cross-sectoral efforts. Further, energy access and development funding can be combined under broader and innovative funding pools, such as the climate finance mechanisms to support integrated efforts.
- **Enable Sustainable Outcomes through Dedicated and Ongoing Capacity Building:** Energy access efforts require initial and ongoing capacity building for the operation and maintenance of technologies and to ensure long-term sustainability. Further, communities should be engaged in learning about technologies to build support and create broader energy access markets. Building on long-standing community and NGO relationships established through deeply embedded social protection programs can be a valuable starting point to launch effective capacity building and community engagement efforts.
- **Learn from Experience of Long-Established and Successful Social Protection Programs and Partnerships:** In many cases, development ministries, such as education and health, have vast experience working with rural communities. And, in some cases, they have developed strong partnerships with local institutions and NGOs as well as the communities more broadly. Community groups are important partners and integral to supporting successful system delivery. By integrating energy access and social protection efforts, development program knowledge, experience, and community relationships can be leveraged to support sustainable and successful outcomes (MRFCJ 2013).

# 3 Conclusion

This volume of *Policies to Spur Energy Access* presented an overview of the various policies that impact the energy access market, and it highlighted approaches that can accelerate engagement of private enterprises and attract additional private investment. Governments across the developing world are rethinking traditional energy policy and recognizing that decisions about energy policy, financial policy, development policies, and business policies all play key roles in fostering a vibrant energy access market. While each country has its own priorities and needs, many have recognized the need for policy decisions and public backing of programs that support the technical, labor-related, and financial needs of the entire value chain for energy access services.

This report identifies the range of policy issues that can impact the development of an energy access market, particularly one that engages small and medium-sized enterprises in providing products and services. It has highlights examples from developing countries that are putting these policies into action. Specifically, the report presents four roles a government can play to accelerate energy access:

- **Establishing an Enabling Policy Framework:** National plans for rural electrification and clean energy can underpin overall policy efforts. Specifically including decentralized energy options in these plans reduces uncertainty and provides impetus for enabling policies throughout government. Where energy regulations accommodate the needs of new types of energy technologies and enterprises, innovative business models have taken hold. Where utilities have provided clarity on grid extension plans and regulators have addressed grid extension impacts on off-grid systems, new market opportunities for investors and service providers have emerged.
- **Catalyzing Finance:** Financial policies can be targeted to support the needs of each element of an energy access market. Several countries have created financial intermediaries to channel public funds into financial tools for local finance institutions, energy enterprises, and end users. Banking regulations for green financing increase the experience of finance institutions with the new technologies and markets. Targeted financial support provided through subsidies, concessionary loans, and risk mitigation measures can reduce risk and increase market investment. On the other hand, subsidies (whether for clean energy or fossil fuel) that are not coordinated with the energy access market can distort price signals and hinder the market.
- **Building Human Capacity:** Actors in nascent energy access markets face obstacles posed by the lack of skills and experience needed to build a sustainable market. Some governments, donors, and private investors are supporting small businesses, providing technical assistance, and engaging education networks in workforce development. Experience from several countries indicates that increased awareness of energy access markets and technologies at each level of decision maker—policymakers, utilities, financiers, communities, and end users—can lead to reduced perception of risk and greater understanding of market needs and opportunities.
- **Integrating with Development Programs:** Energy access is interwoven with a wide range of development goals, but governments and donors are just starting to integrate these policies—for example, including energy access in future Millennium Development Goals. Several governments have coordinated programs across ministries and found ways to leverage funds, experience, and networks to meet health, education, agriculture, poverty alleviation, and disaster recovery goals.

*Volume 2: Case Studies of Public-Private Models to Finance Decentralized Electricity Access* includes in-depth case studies of decentralized energy access programs in five countries, with an emphasis on the policy decisions that have directed those programs as well as the impacts of each.

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