Improving Access to Modern Energy Services: Insights from Case Studies

There is increasing global attention on the issue of energy poverty. This is evident in the recent priority accorded to universal energy access by the United Nations and the launch of various related multi-stakeholder partnerships. While the exact role of the international community is still being deliberated and refined, there is a need to ensure that robust analytical information is available to decision-makers.

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I. Introduction

Energy is essential for socio-economic development, and is central to poverty alleviation. Reliable and affordable energy supply is also vital for businesses to strive. Still, a significant portion of the world's population suffers from a lack of access to affordable basic energy services, such as effective lighting and clean cooking (IEA, 2011). Energy deprivation makes it impossible for a society to improve health and education standards, and prevents engagement in vital productive economic activities (GNESD, 2006). In the absence of additional dedicated actions, the number of people lacking access to modern energy services will decline only marginally in the coming decades, and will likely increase in some parts of the world, such as sub-Saharan

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Africa; a clear impetus for change.

The international community has recently increased its attention on this pressing issue. As evidence of this shift, in 2010 a multi-stakeholder Advisory Group on Energy and Climate Change to the United Nations' Secretary-General called for the international community to commit to the goal of reaching universal energy access by 2030 (AGECC, 2010). Subsequently, the UN General Assembly declared 2012 as the *International Year of Sustainable Energy for All*[1] in an effort to catalyze engagement to eliminate energy poverty, and a new High-Level Group on Sustainable Energy for All has been formed to, *inter alia*, present an Action Agenda to tackle the issue.

But while international attention has increased of late, countries suffering from acute energy poverty have been addressing the issue for decades. Thus, there is myriad action at the national and sub-national levels to promote access to modern energy services for the underserved with varying degrees of success. This represents an extensive and rich experience[2] which can, and should, inform the design and implementation of new and more ambitious undertakings. Recent analysis suggests that, despite the progress made, greatly increased efforts (by an order of magnitude) are required to meaningfully address the issue of energy poverty (Bazilian *et al*., 2011; IEA, 2011).

This article considers the wealth of ongoing activities at local, national, and supra-national levels, and draws some lessons learned with ''scalability'' as a guiding objective. In doing so, we present insights from various case studies in a structured manner to inform the development of future strategies. We highlight illustrative cases in different categories of interventions, but recognize that more detailed insights can be drawn from each intervention in future work. Section II reviews the relevant literature. The selected cases are described and assessed in Section III. In Section IV, we extract key characteristics of successful interventions.

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II. Literature Review

This review is not exhaustive. Still, we utilized a broad range of sources, including country case studies, analytical papers, government and regional development strategies related to the promotion of access to modern energy services. We reviewed more than 100 different publications in order to ensure a reasonable data population.

A considerable number of country case studies on energy access interventions[3] have been conducted in recent years. This literature includes several studies distilling best practices. Many publications provide a specific perspective by focusing on particular types of actions and lessons learned, be it with a primary focus on: energy governance and policies,[4] rural electrification,[5] the dissemination of clean cooking methods,[6] financing options,[7] market development and regulation, or business promotion.[8]

Interventions have varying drivers, areas of emphasis, and entry points. A large number of actions are motivated by social aspects (Gaunt, 2005), but other concerns of national governments – such as security or economics – can, in some cases, be even more powerful drivers of change (Bazilian *et al*., 2010a).

Many countries have integrated energy issues into their National Poverty Alleviation and Development Strategies. Also, among the policies formulated in climate change-related Nationally Appropriate Mitigation Actions (NAMAs),[9] a large number concentrate on the energy sector (Ecofys, 2011). In some instances, incentives are exerted via a combination of policies (rather than single approach), a strategy that has proved to be effective (REN21, 2011). As an example, the

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Solar India initiative shows that efforts on rural energy access can be part of a larger undertaking with broad objectives, such as promoting economic growth, energy security, or climate change mitigation (Government of India, 2008). However, Van der Vleuten (2011) claims that the multiplicity of objectives (e.g., climate change, energy security, and business development), and consequently the lack of focus, can represent a deterrent to the efficiency of interventions.

Other drivers include issues of equity based on historical legacy to support particular groups of the population, such as the case of post-apartheid South Africa (Tinto and Banda, 2005). Still others focus on industrial or security concerns as drivers of change. Or, they might focus strictly on poverty reduction at the household level as an entry point before expanding to community-based development and business promotions (e.g., industrial policy). In some countries (e.g., Vietnam), energy poverty has been successfully alleviated by first providing key economic activities with reliable and affordable energy services before targeting underprivileged households. Another common approach is through power sector reforms, although the extent to which those have been successful in providing for the poor is ambiguous (GNESD, 2004).

Although regions vary considerably with regard to energy access, it is useful to note that a large number of developing countries have announced quantified targets and associated strategies related to electricity access, the use of modern fuels, improved cooking stoves and mechanical power (see **Table 1**) (UNDP & WHO, 2009). This illustrates the clear prioritization by governments of this issue. Still, work remains to be done in helping to refine and deliver on these aspirations – especially in terms of capacity building and investment.

In line with the focus of country targets, the vast majority of policies and measures concentrate on electrification (GNESD, 2006; Takada and Charles, 2007; UNDP & WHO, 2009), in comparison to heating and cooking services. Electricity, perhaps because of its versatility and the multitude of services it can provide, is a very appealing energy carrier in developing and industrialized contexts alike.[10] Still, hundreds of small projects on improved cookstoves have been implemented in recent years (Granderson *et al.*, 2009), and there is an increase in effort in this area (Global Alliance for Clean Cookstoves, 2011).

Geographically, there is a focus on rural electrification initiatives. This notwithstanding, urban and peri-urban areas often suffer from acute lack of high-quality supplies (Karekezi *et al.*, 2008). As the non-rural population is expected to increase sharply in the foreseeable future in a number of regions (UNFPA, 2011), a clear focus on urbanization is required in future access plans.

A number of distinct financing models have emerged within the past decade. A ''cash model'' refers to when customers purchase the product paying the full cost. A ''credit model'' refers to when local dealers sell their products to rural clients on credit against collateral or personal guarantees, with payment made in

Table 1: Number of Developing Countries with Energy Access Targets (UNDP & WHO, 2009).

		No. of Countries with Energy Access Targets			
	Total No. of Countries	Electricity	Modern Fuels	Improved Cookstoves	Mechanical Power
Developing countries	140	68	17	11	5
Least-developed countries	50	25	8	4	0
Sub-Saharan Africa	45	35	13	7	5
Arab States	20	3	0	1	0
East Asia & Pacific	31	10	2	0	0
South Asia	9	6	1	1	0
Latin America and the Caribbean	33	14	1	2	0

installments. A ''mixed finance model'' is when governments provide a fixed subsidy and the balance is borne by villagers or private firms. A ''donation model'' is one where the technology is transferred to the community as a gift, usually from a private entity (part of their corporate social responsibility program) or a development donor. A ''fee for service'' model is one where the energy system is owned, operated, and maintained by a supplying company, but the customer pays regular fees for using it. Other models include a ''technology improvement and market development'' model which attempts to improve performance and lower cost by conducting research on new technologies, a ''community mobilization fund'' which funnels revenues into local community development; a ''cooperative model'' where communities own part of the energy system themselves, and hybrid arrangements that combine some of the seven preceding types (Sovacool, 2011).

We now present a classification of the interventions according to the purpose they serve and the mechanism employed to reach the objective. The subjectivity of the selection of the cases is acknowledged, and of course, we recognize that there is overlapping between them, and complexity in defining a rigid classification.

A. Policy. This category primarily deals with national and sub-national policies implemented by a government. Although many countries and regions have included energy within their national development strategies (Iwayemi *et al.*, 2008), often a dedicated energy access strategy is required (ESMAP, 2005).

Innovative strategies are being developed in countries such as Ghana, Rwanda, Morocco, Ethiopia, Kenya, and Brazil. As an example, the recently launched Ethiopian Green Climate Resilience Program includes explicit treatment of the energy sector and access issues within wider economic growth plans (Government of Ethiopia, 2011).

The ''technology improvement and market development'' model attempts to improve performance and lower cost by conducting research on new technologies.

Vietnam's rural national electrification program prioritized the electrification for income-generating sectors that created a basis for stable taxation, thus establishing an important resource for the country's socio-economic development (ADB, 2001). Morocco's Global Rural Electrification Programme developed an innovative access initiative for grid-extension to rural areas by promoting the solar industry with public–private partnerships combined with international aid funding and foreign direct investments (Allali, 2011). China's Renewable Energy Development Project, funded by the World Bank and the Global Environment Facility (GEF), did not just promote energy access via solar home systems (SHS) to regions where energy poverty was widespread, but also helped introduce international standards for suppliers to enter export markets (Sovacool and D'Agostino, 2011).

The Energy Services Delivery Project built the capacity of the micro-hydro sector in Sri Lanka to the extent that they now export systems to South Asia and Africa (Drupady and Sovacool, 2011). The government of Senegal subsidized liquid petroleum gas (LPG) as a cooking fuel for urban and peri-urban areas that helped tackle both deforestation and make access to modern fuels affordable to the poor (Sécou *et al.*, 2008; Brew-Hammond and Kemausuor, 2009).

B. Investment promotion/ financing. Sources for funding energy access interventions usually include: multilateral- or national development banks, bilateral development agencies, national governments, state-owned utilities, rural energy agencies, foundations, microfinance institutions, local banks, and, in some cases, private investors. Multilateral banks apply a range of financing instruments, from

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grants to market rate loans to carbon financing, while developing country governments usually use equity, subsidies, and other fiscal instruments (IEA, 2011).

Achieving universal modern energy access by 2030 will require investments of roughly \$30 to 100[11] billion per year (Bazilian *et al.*, 2010b) with the understanding that traditional financial institutions need to utilize more non-traditional mechanisms, such as small-scale and micro-financing for instance when it comes to alleviating poverty (Morris *et al.*, 2007). Under the umbrella of a government agency, Nepal's Solar Energy Support Programme has successfully linked microfinance institutions to solar enterprises, installing over 100,000 solar home systems (SHS). Tanzania's Promotion of Renewable Energy program (PRET) linked small-scale finance to the promotion of rural energy markets (UNDP, 2009).

Referred to as model for programs in developing countries by the World Bank, Sri Lanka's Energy Service Delivery Project put a strong emphasis on stakeholder participation and capacity building with its well designed financial model and credit facility (ESMAP, 2005; Drupady and Sovacool, 2011). The Strategic Climate Fund under the Climate Investment Funds, jointly managed by Multilateral Development Banks, developed a program for scaling-up renewable energy (SREP) for low-income countries, thereby contributing to lending for increasing renewable energy sources among rural electrification, generation, modern lightning, clean cooking and heating fuels (World Bank, 2008b).

An interesting approach to overcoming the hurdle of a lack of up-front capital for investment is through the ''fee-for-service,'' or energy service company (ESCO). In Zambia, three companies for solar energy services operate with 400 clients paying for the daily or weekly use of 50 W_p solar panels, with four lights and a socket for radio or other appliances. Clients do not own the systems, but pay a fee to have their batteries charged and the panels and components maintained. Fees cover the full operational costs as well as eventual battery replacement (Ellegard *et al.*, 2004, 2004; Gustavsson and Ellegard, 2004). Similar arrangements have been shown to work for SHS in Laos (Bambawale *et al.*, 2011) and solar lanterns in India (Rao *et al.*, 2009).

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Continued innovation in financial products and partnership will be necessary to achieve universal energy access. The partnership between SELCO India (SELCO Solar Light Ltd.) and SEWA (the Self-Employed Women's Association) Bank is one model for linking sustainable energy with development finance. It provides evidence on how the complementary capabilities of a bank and an energy services company collaborate to provide energy solutions for the poor (Hansen, 2007).

The utilization of grants or subsidy interventions has been shown to produce successes, and, at times, market distortions. Unreliable, periodic, and non-sustainable subsidies present a significant risk to projects or enterprises seeking to raise capital in the market (Aron *et al.*, 2009).

Finally, while the availability of capital is essential, that alone will not be sufficient to provide adequate energy access, as factors like capacity building and good governance in order to create a healthy investment climate remain strongly linked to proper policies and regulations (Bazilian *et al.*, 2010b).

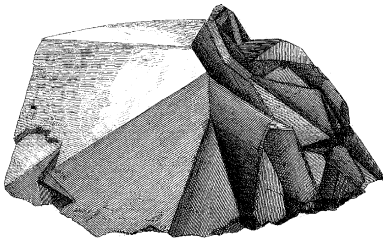
C. Utility/regulations.

There are some institutional models that are capable of absorbing large-scale finance in the area of energy access for the poor. As an example, the World Bank introduced strategies to support the development of rural energy agencies as modern national government institutions able to manage energy funds (EASE, 2011a).

South Africa's rapid and successful electrification program clearly benefited from the institutional structure of the electricity industry composed of the state electricity utility Eskom and other local authorities (Bekker *et al.*, 2008). Various African countries have introduced power sector reforms to address the management and organization of utilities in order to improve their technical and financial performance to increase electricity services (UN-Energy/Africa, 2009).

As an example, Kenya has been successful in implementing, under the Energy Act 2006, an Energy Regulatory Commission that is mandated to deal with the regulation on energy sources, protect consumer and investor interest, monitor the energy sector and develop national energy plans (Government of Kenya, 2009, 2011). Ghana has established an Energy Commission that collaborates with leading energy providers, such as the Ghana Grid Company or independent providers, in order to enable an effective environment for energy delivery services (Government of Ghana, 2011).

After the market-oriented reforms of Brazil's power sector in 1996 to keep up with the growing demand for electricity, a variety of agents (over 1000 companies) have been involved in providing and regulating energy, with one large government-controlled holding – Eletrobras. Additionally, over 60 utilities are active in the distribution of electricity in the country (REEEP, 2011). The Indian government introduced the Electricity Act in 2003 establishing a Central Electricity Regulatory Commission, state regulatory commissions, and rural electrification agencies (Government of India, 2006). Well-governed and well-run utilities will, in many cases, be the primary engine of ensuring energy access.



D. Business development. Small businesses have a large role in driving economic growth and can be efficient instruments to increase modern energy access.

Business development and access to seed capital are necessary to create a robust inventory of investment opportunities for public and private sector capital seeking to invest. For instance, E + Co, a mission-based investment company, has developed an integrated strategy of enterprise development services and capital. The services, defined as a critical risk mitigation strategy, include business development plans, market assessments, operational planning, accounting and financial modeling that has led to enterprises delivering access to modern energy sources for 8 million people in: Cambodia, China, Costa Rica, El Salvador, Gambia, Ghana, Guatemala, Honduras, India, Mali, Morocco, Nepal, Nicaragua, Philippines, Senegal, South Africa, Tanzania, Thailand, Uganda, Vietnam, and Zambia. Integrating and funding local business development and service delivery alongside investment was hard for many funders to comprehend, but critical to success (Eibs-Singer, 2011).

Seed financing is often difficult to secure, yet critical for small energy business development. Most investors are reluctant to engage too early. This means that even high-potential energy access sectors develop quite slowly. The two largest challenges that investors face in providing seed capital financing to early stage projects and companies are the higher transaction costs and increased risks of these small, less mature business ventures (UNEP *et al.*, 2011).

In a related area, there is a vast generation capacity deployed by small-holder farmers, for instance to power irrigation pumps, and the small- and large-scale enterprises that rely on small generators or engines whether directly to power their equipment (e.g., mobile phone operators or grinding mills) or those that need power for shops or for office and

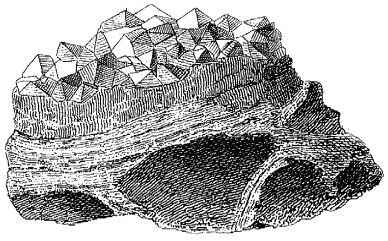
business functions. But the financing for these undertakings is frequently undertaken under very tenuous circumstances such as high loan rates, poor supply chain of parts, poor quality control, and sometimes adulterated fuel.

III. Highlighted Cases

We focus on some successful[12] interventions in order to characterize effective strategies (thus, we do not highlight failures or weaknesses in this area, although these examples are also numerous). Particular effort was made to ensure diversity and balance in terms of the geographical coverage of the cases and types of technologies and mechanisms employed.

The approach to derive key principles of successful interventions is based on a systematic qualitative analysis,[13] evaluating various dimensions, with both endogenous (pertaining to the intervention itself) and exogenous (related to the environment) elements. The dimensions assessed to characterize the interventions are:

- *Integration and coherence:* Interventions do not happen in a vacuum. There might be cross-fertilization effects or tensions, with other programs or policies.
- *Institutional setting and ownership:* The institutional context determines the actors involved, their respective roles and the relationships among them.
- *Monitoring and accountability:* Monitoring frameworks are key to accountability. Monitoring is also instrumental to manage for results and measure progress towards declared objectives.
- *Replicability and scalability:* Given the magnitude of the issue at hand, an important feature of the interventions assessed is their ability to be replicated and scaled up. While both are necessary conditions for our purposes, neither on their own is sufficient.



- *Epistemic quality and determinacy:* Some interventions are driven and informed by evidence-based facts, while others are motivated by other factors. Also, the cases might be deterministic in that they are prescriptive[14] with regard to particular aspects (e.g., technology, energy source) or somewhat indeterminate in nature.
- *Comprehensiveness:* An intervention can be wide in scope or rather narrow and focused.

Table 2, assesses and characterizes illustrative examples based on these dimensions.

IV. Towards Scale: Extracting Principles

A number of different frameworks have been used to evaluate policies, particularly in the fields of renewable energy and energy efficiency and the climate space, both from the perspective of the drivers and the outcomes.[15] Policy evaluation is not only insightful for *ex post* verification of the results (e.g., to assess effectiveness), but it is also useful to further the understanding of the dynamics of the process that the policy aims at influencing.

Drawing from social science, the methodology applied in this article derives from ''analytic induction,'' a method of qualitative data analysis described originally by Florian Znaniecki (1934) and subsequently complemented by a number of other academics.[16] Analytic induction refers to a systematic examination which allows inducing ''laws'' from an analysis of experimentally isolated cases (Znaniecki, 1934). It is used to identify commonalities, or universal[17] propositions, exemplified by the cases (Yin, 1994). This methodology enables us to theorize and describe contexts in which a phenomenon might arise (Pascale, 2010), and thus represents a systematic way

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Table 2: Overview of the Qualitative Assessment of the Selected Interventions.

Interventions	Integration and Coherence	Institutional Setting and Ownership	Monitoring and Accountability	Replicability and Scalability	Epistemic Quality and Determinacy	Comprehensiveness
1. Global Rural Electrification Programme – Morocco	- Continuous political prioritization of universal electrification (dating back from 1994); - Implemented in cooperation with local authorities; - Link with other developmental objectives (e.g., access to drinking water, climate change mitigation)	- Decentralized approach in line with the capabilities of rural areas; - Funded in part by the users; - Delegation of electricity services management to private operators (based on tenders); - Intricate PPP approach (consumers, operator, commercial and development banks, FGEF); - The communes take part early on in the planning	- Monitoring of progress against targets regarding electrification, collection rate of consumers charges; jobs created; - Local agents accountable for results	- Case example whereby moving from pilot program to large-scale operations satisfying real market need Considering replicating the model for services other than those incumbent to households (e.g., water pumping)	- Studied various configurations in an effort to minimize the capital cost for customers; - Decision made on share of gird and off-grid connection - Mini-networks as well as individual systems driven by renewable sources; - Based on a fee-for-service business model	- Utility companies set up in villages; - Transfer of know-how to local population through locally hired staff training
2. Energy Services Delivery – Sri Lanka	- Provision of technical assistance to the government to facilitate the further integration of renewables and DSM in energy policy	Harnessed the potential of the country's dynamic private sector (market-based approach) to complement government efforts; - Conceived when government facing mounting political pressure to address the issue; - Financial model to de-risk private investment; - Local microfinance institutions directly involved; - Community-centered approach for village level projects	- Monitoring of progress by the World Bank and Ceylon Electricity Board	- Initially conceptualized as experiment, and rapidly scaled up based on achievements: - Renewable energy sector thriving with numerous organizations and people directly involved in making or selling renewable energy equipment; - Implementation of a successor project	- Aimed at making use of indigenous renewable energy sources and environmentally sustainable technologies; - Provided incentives to the market, yet without prescribing market, technologies or products to the end user	- Villagers trained in the proper maintenance of their systems; - Provision of training and technical support for renewable energy and energy efficiency initiatives, in particular for energy service entrepreneurs; - Improved end-use energy efficiency targeted are private sector
3. The Integrated National Electricity Programme and predecessors – South Africa	- Electrification considered as infrastructure development; to be integrated with other service-oriented infrastructure development processes; - Integrated approach to household energy problems	- Alliance between the private sector, local governments, and civil society and academia		- Replicability potentially limited (e.g., particular nature of the political transition; presence of a strong national utility, dominant industrial load base)	- GIS-based model which supports electrification planning that aims at addressing development aspects in an integrated way	
4. Upesi Rural Stoves Project – Kenya	- Congruent with poverty alleviation and health improvement policies	- Women's groups involved in the design and filed-testing of improved stoves; - Program spearheaded by the Ministry of Energy, in cooperation with Ministries of Agriculture, and Environment and Natural Resources; - Dedicated center to provide relevant services (design and testing)		- Women's group involved in the project have had contracts to train producers from as far away as Tanzania	- Focused on women, and using women's knowledge and experience; - Strategy used based on insights gained from a stove project in Sri Lanka	- Capacity building for women in stove production, distribution and installation, as well as in marketing; - Marketing incentives developed (e.g., quality award for producers, advertising signs for large distributors, and gifts for successful promoters)
5. Renewable Energy Development Project – China	- Competition with PV projects from other donors; - Shops operate on concession agreements with the local PV companies; - SHS as transition technology before (mini-) grid-fed electricity	- Established project management structures as near-independent bodies; - Proposals submission and competitive process; - Operating on cost-sharing basis	- Certification standards in place for product quality control; - Development of label certifying compliance with defined standards (gradually tightened); - Improving the quality and availability of after-sales services at local level; - Rigorous fines for noncompliance with technical standards or poor performance	- Unprecedented scale (400,000 SHS); - Potential for economies of scale	- Project management tasked to investigate and support mechanisms to encourage consumer credit access; - No explicit poverty alleviation objective	- Established a ''whole-cycle quality improvement'' through manufacturing standards and practices, thereby improving the quality of SHS along the supply chain; - Engaged in promotion activities (e.g., TV, movie) as well as capacity building for PV companies; - Included a technology improvement to accelerate technology innovation; - Market development support facility (product promotion, financial management system improvement and ISO certification) included

6. National Improved Cook Stove Dissemination – Nepal	- Government created favorable environment by formulating new and reforming existing policies; - In line with other developmental and environmental objectives; - Stoves dissemination coupled with other activities, e.g., kitchen improvement, fuel wood management, and household sanitation	- Primarily focused on women; - Flexible structure to allow engagement of various stakeholders; - Government's role as facilitator and coordinator, as opposed to implementer; - Network and collaboration among stakeholder at various levels is paramount	- Continuous monitoring, follow-up and technical supervision on stove performance and use in place	- Stoves built from cheap and readily available local materials; - No end-user subsidies; - Plans to expand the program to other regions	- Technology based experience abroad and customized to local needs, cooking practices, cultural and geographical conditions; - Demand-driven	- Accompanied by capacity building and information campaigns at local level
7. PERMER – Argentina	- Coordination with Secretariat of Environment and Sustainable Development on biomass-related issues	- Multi-donor structure (incl. GEF, WB (IBRD), government (federal and provincial), users; - Project coordination unit created at the Secretary of Energy; - Executed through the Provinces and their respective public or private concessionaires		- The project itself benefited from additional financing to scale up (expand the scale and geographic scope) a successful business model	- Based on assessment of least cost low-carbon technology options at sub-project level; - Project delivery mechanisms adjusted several times during implementation to adapt to the changing conditions; - Conducted a structured consultation with a wide audience of key stakeholders, indigenous community; - Business model based on technology-neutral off-grid concessions	- Includes public promotion, education and information campaigns; - Supports the expansion of private sector participation in the provision of electricity in rural areas and the corresponding strengthening of provincial government capacities to regulate that participation
8. Vietnam Rural Electrification Programme	- Originally, post-war context with a need for infrastructure reconstruction and economy rehabilitation; electrification tied to the objectives of national economic programs; - Initial focus on productive uses, notably electrification for rice production and supporting local industries, in support of economic development at the local level	- Continuous government commitment dedicated rural electrification, translated into dedicated policies and institutions; - Establishment of state utility as lead agency for grid extension and rural electrification; - Business-led strategy; - Multiple sources of financing (e.g., central government, utility, provincial and local authorities, consumers, private, banks, donor agencies); - In some cases, establishment of village management board for rural electrification to form a PPP		- Community organization (high 'willingness to pay') and capacity building were key to widespread electrification	- Centralized planning, with major provincial inputs and initiatives	- Accompanied by energy sector reforms; - Parallel strategy to build up generation capacity, and transmission and distribution systems to match increasing demand
9. Luz para Todos – Brazil	- Promotion of integrated rural development, e.g., through productive uses of electricity; - So-called 'integrated actions' undertaken with partners in the field of health, education, land development, social development, hunger alleviation	- Creation of a Management Committee in each State as participative forums (one representative of: government, coordinator, state government, state regulation agency, concessionaires of electric energy, city halls, cooperatives of rural electrification, organized entities of the civil society); - Coordinated nation-wide by Ministry of Energy, operated by Eletrobrás subsidiaries, and implemented by electric power concessionaires and cooperatives of rural electrification	- Accountability of projects on performing agents (implementers)		- Planning based on survey to assess demand; - Priority in electrification rollout defined by the management committee and the schedule by the executor agent	- Complemented by pilot projects to advise recipients with regard to productive uses, e.g., the production community centers
10. LPG Programme – Senegal	- Triggered by environmental concerns (deforestation and environmental degradation due to due to excessive harvesting of trees for charcoal for domestic uses); - LPG subsidy scheme as part of wider energy sector reform; - Coincident subvention on (e.g., tax break on import, direct subsidy) on hardware (bottles and cookers); - Complemented by policy on wood resource management to further encourage the transition to LPG	- Collaboration with the private sector to extend refining and distribution capacity and infrastructure; - Support for policy organized by consumer organizations, NGOs, and media		- Gas distribution became profitable and therefore could be expanded, even to remote areas; - Hardware customized to local circumstances and cooking practices and manufactured locally to some extent	- Policy adjusted over time to reflect evolving circumstances and increase impact; - Little information on elasticity of demand and impact of subsidy sunset	- Benefits of effective information and awareness-raising campaign

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Table 2 (*Continued*)

Interventions	Integration and Coherence	Institutional Setting and Ownership	Monitoring and Accountability	Replicability and Scalability	Epistemic Quality and Determinacy	Comprehensiveness
11. Clean Energy Business (SELCO) – India	- Link with existing local finance partners that serve the rural poor; - Responding to customer needs with both energy and finance products	- Links end-user (households, orphanages, schools) with technical and financial support; - Social mandate of energy services to the rural poor key characteristic	- Monitoring of progress by investors; - Numerous case studies and evaluation given prominence of business model and lead social entrepreneur	- Designing an incubator and open source process to replicate energy enterprise development and finance	- Priority for PV solutions, determined by customer needs and finance options; - Energy products adjusted based on design of finance solutions; - Rural poor and poverty alleviation a target	- Customer service driven; - Social value and impact
12. Laos electrification program	- Government put rural electrification as a priority in the National Growth and Poverty Eradication Strategy and committed required resources	- Strong commitment by government; - National utility for implementation; - Active participation of private sector; - Electricity utilities as agent to implement off-grid programs; - Set up of a nationally operated cross-subsidy mechanism fund		- Program approaching economic limits of grid rollout; - Current solar home system program challenged by the rising costs of extending delivery chains beyond the close-in rural areas outside the grid's footprint	- Both grid and off-grid solutions used to expand the coverage; - Simple but rigorous prioritization and village-screening process and deployment of many cost-cutting technical innovations; - Focus on the delivery of the services, as opposed to equipment, in the approach to electrification - customers pay an equivalent monthly tariff for an electricity utility service type of arrangement; - Systematic planning and widespread deployment of the lowest cost electrification option	- Comprehensive and sector-wide approach adopted to carry out reform, strengthen institutions and build capacity; - Range of pricing and incentives mechanisms used to support implementation; - Reduction of systems losses
13. Rwanda's sector-wide approach for electrification	- Government ownership and commitment with well-spelled out national plan, integrated with related issues (e.g., water, sanitation)	- Dedicated department of National Electrification Program Management set up within the national utility to oversee the program		- Kenya and Ethiopia using Rwanda's model	- Study conducted to establish the purchasing power and affordability of consumers in case of sustained availability of electricity; - Use of scientific process to identify different demand centers (e.g., using GIS)	- Donor roundtable held to pool up resources; - Technical assistance program put in place to ensure quality control, transparent approach in allocation, efficient procurement processes and optimal resource utilization

Note: An empty cell indicates a lack of detailed information available.

to distil general principles from the set of selected cases.

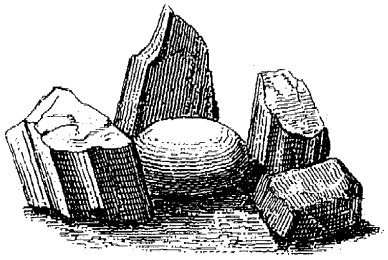
A. General principles

Based on the assessment of the selected cases, and following the methodology described, the general principles are derived. They are:

- **Active participation throughout**: the key stakeholders, including the beneficiaries of the initiative, are engaged as active agents (going beyond consultations), not only in the implementation phase, but also in the formulation and design;
- **After sales service and maintenance**: energy systems are not diffused or distributed and then abandoned, instead after sales service and training in local maintenance ensure that they are cared for by local populations or technicians;
- **Capability**: capacity, if insufficient, is progressively and effectively (lasting) built to suit the needs;
- **Champion**: an individual or group of individuals in a company (e.g., entrepreneur) or institution plays the role of driver and ''owner'' of the intervention;
- **Community ownership:** successful interventions do not ''give away'' technologies for free, nor do they treat the community only as passive consumers; instead, consumers and communities are viewed as active partners;
- **Customized approach and technology appropriateness**: the intervention is well suited and

adapted to the specific context so as to address the particular needs and circumstances; the technology suits the needs and is appropriate to the context in terms of scale, complexity, culture, etc.;

- **Demand-driven**: there is a pervasive demand for the goods and/or services to be delivered by the initiative;
- **Energy-service-focused**: the focus is placed on the affordable delivery of energy services, as opposed to the supply end or the appliances;
- **Integrated methodology**: the ultimate objective goes beyond the provision of energy or electricity and embraces broad developmental benefits, such as education and health, or the generation of income;
- **Market orientation**: the intervention involves market forces, as a complement to public support, thereby ensuring at least partial or complete self-sufficiency;
- **Non-deterministic**: the intervention is not narrowly prescriptive in terms of market, technologies or products to the end user, yet well-framed;
- **Operationalization and implementation**: the role of the implementing agent is fundamental; such agent needs to be solid, committed, and competent;
- **Partnerships**: the intervention involves a diverse range of stakeholders so as to utilize respective comparative advantages, complementary skills and resources;
- **Peer pressure and democratic drive**: there is political pressure exerted by the energy poor, by airing their grievances and aspirations;
- **Policy integration**: the initiative is in line with and complements other policies, thereby allowing cross-fertilizing synergies while simultaneously addressing various high-level objectives (e.g., economic development and job creation, health and education, environmental conservation);



- **Political leadership**: there needs to be a marked and steady political will translated into a strong and lasting commitment;
- **Sound design and planning**: the development of the intervention is based on cutting-edge knowledge and experience in the field, and its implementation is able to adapt to changing circumstances;
- **Timeliness and conducive circumstances**: the state of affairs (e.g., absence of war and disturbing civil unrest, major political change and policy disruption) is such that it allows for a reasonable impact of the intervention;
- **Transformative character**: the intervention is a game changer in that it goes beyond merely tweaking business-as-usual and induces transformative changes;
- **Well-designed business model**: the financial model and credit facility are well established and secured from the onset, with particular attention to mitigating the investment risk.

It is important to note that there is no order, sequence, or hierarchy among the principles identified. There are also many interlinkages, as well as interdependencies, between some of them. In addition, the results obtained by applying this methodology represent a set of attributes which represent conducive, but likely not sufficient, conditions to lead to successful outcomes. Also, not all of these principles need to be present for an intervention to be successful. Conversely, applying these principles literally is also no guarantee against failure.[18]

Finally, conditions central to the success of the intervention might be specific to the context. For instance, Vietnam's extensive hydropower potential is argued to have been instrumental in rapidly increasing the country's generation capacity (ADB, 2001). Still, there are a number of countries with well-developed generating capacity and significantly lower electrification rates.

V. Conclusion

Energy poverty is moving up the agenda of the international community. There exists a plethora of activities aimed at promoting access to modern energy services, and these can serve to help formulate future actions. Still, despite a number of successful interventions, and significant progress in alleviating energy poverty in some instances, providing universal energy access in the coming decades will require a drastic scale-up of action.

The cases selected for our analysis represent a broad range of interventions. Systematically assessing those from the perspective of key dimensions (e.g., integration and coherence, institutional setting and ownership, monitoring and accountability, replicability and scalability, epistemic quality and determinacy, and comprehensiveness) allowed us to draw certain general insights. The resultant ''principles'' represent key conducive attributes, yet unlikely sufficient conditions, of a blueprint of future action. There are also a number of exogenous elements which impact on the success (or failure) of an intervention. There is significant scope for further research in this area. For instance, greater insights could be derived from more detailed analyses of the specific cases.

Brief Case Histories of Selected Interventions

Case 1: Global Rural Electrification Programme – Morocco

The Moroccan government has engaged in various initiatives since the early 1990s for electrification. Due to the country's centralized grid system, extension to rural areas of the country appeared to be very cost-intensive and difficult. The solution was to pursue alternative energy access measures for rural areas, such as the public–private partnership for rural electrification between Morocco's Office National de l'Electricité (ONE)[20] and TEMASOL.[21] The project operates in 24 out of 62 prefectures and provinces of the country. While the main responsibility for installing and maintaining the solar apparatus and the collection of the end-user fees is with the private operator, a utility contract is signed by the customers with the government agency ONE.

The model is a fee-for-service business approach, as solar customers pay a monthly service fee depending on the type of service they signed up for. Through subsidies, offered by ONE, the partnership is able to supply electricity at affordable rates, thereby counterbalancing cost-intensive installation and maintenance expenses. Thus, citizens living in rural areas get the service with almost the same price conditions as urban households that are connected to the central grid. The accessibility, along with after-sales services for solar systems, of private operators to households in rural areas has led to rising levels in demand for solar technologies in the country, despite the ability of rural populations to use alternative ways of electrification.

This solar project activity has so far led to 106,200 customers being granted access to electricity between 2002 and 2008, contributing to the empowerment of women, a higher rate of school attendance, and an increase in local economic activities. The public–private partnership employed a total of 84 people, coming mainly from low-income communities. Environmental benefits included the saving of 32,000 tons of CO_2 over 10 years. The Partnership has registered increasing profits since 2004, up to $419,000 in 2008. This project is a perfect example of how a private–public partnership, together with foreign direct investments and international cooperation, in a developing country can lead not only to outstanding business achievements but also improve the living conditions of thousands of people who were hitherto isolated from socio-economic developments.

Sources: Allali (2011), UNDP Special Unit for South-South Cooperation (2011).

Case 2: Energy Service Delivery – Sri Lanka

The Energy Services Delivery (ESD) project was intended to bridge the widening gap resulting from a serious dearth of investment in Sri Lanka's electricity and energy sector. Although initially conceptualized as a small-scale pilot project, its achievements and potential scalability were so convincing that the World Bank has since declared it a ''model'' for energy development programs around the world. In a span of six years, the ESD project successfully installed 21,000 solar home systems and 350 kW of installed village hydro capacity in rural Sri Lanka, in addition to 31 MW of grid-connected mini-hydro capacity and a 3 MW pilot wind farm. The ESD achieved all of this while exceeding appraisal targets and expending resources below the expected budgetary costs.

Years after its conclusion, the ESD project continues to yield benefits for its stakeholders. Apart from being able to enjoy basic electricity services, rural end users also benefit from improved health by no longer using kerosene, and improved finances from not having to pay monthly electricity bills. Villagers have been trained in proper maintenance of their systems and were able to engage in productive activities

such as the formation of local cottage industries. More impressively, the renewable energy sector continues to thrive in Sri Lanka with hundreds of organizations and thousands of people directly involved in making or selling renewable energy equipment.
Source: Drupady and Sovacool, 2011.

Case 3: South Africa – Integrated National Electrification Programme (INEP)

In South Africa, 6 million households have received access to electricity between 1990 and 2007. In 1990 less than one-third of the population had access to electricity.

South Africa possessed an extremely energy-intensive economy, a world-class electricity supply industry in the form of the state utility Eskom, and a 55 percent reserve margin due to overbuilding in the 1980s. In the 1940s, there was already a government-led initiative to electrify rural white farmhouses. Obstacles to widened access due to institutional and political barriers in the 1980s, were swept away by the transition in the 1990s.

In 1998, the so-called *White Paper on Energy Policy* was released, in order to reaffirm the socio-economic objectives of electrifying the country by the Reconstruction and Development Programme (RDP) enacted by the African National Congress in 1994. The *White Paper* emphasized the importance of increasing access to affordable energy services, by improving energy governance and economic stimulation. The progress of the electrification program is articulated in the two sister directorates, i.e. the Electrification Directorate and the Integrated National Electrification Programme.

The success of the electrification program lay within the efforts of the government to understand and redefine its role in energy planning and with private-sector energy companies, organizations, and the civil society.

Since the inception of the electrification program in 2005, some 5 million households have been connected along with 11,976 schools and clinics. A large number of women have been able to spend less time on activities such as wood collection and have been relieved of the harm caused by indoor pollution. INEP has led to 80 percent electrification for the nation's urban population and 50 percent of the rural population, through grid and non-grid interventions.
Sources: Tinto and Banda (2005), Bekker *et al.* (2008).

Case 4: Upesi Rural Stoves Project – Kenya

The Kenya Ceramic Jiko stove, inspired by the ''Thai bucket,'' was developed through a design process spearheaded by the Ministry of Energy. The Jiko stove easily found acceptance among urban stove producers who were initially offered free training and marketing support by the Kenya Energy and Environment Organization (KENGO), in cooperation with the Ministries of Energy, Agriculture, and Environment and Natural Resources.

The efforts by KENGO developed into a regional program, with the Appropriate Technology Centre at Kenyatta University providing services and becoming the regional center for cookstove design and testing. Although most producers and dealers of the Jiko stove have been men, many women in the smaller urban areas have benefited immensely from the technology.

A recent study reported that women selling and using the Jiko stove in arid and semi-arid areas significantly improved their standards of living through gains in time and income. There have been many other collaborative efforts to develop improved stoves. For instance, UNICEF promoted an all-metal charcoal stove and also worked on Lorena-type domestic mudstoves; the Bellerive Foundation developed institutional wood-burning stoves; and Apro Enterprises has developed a number of innovative waste-burning stoves.
Source: Njenga, 2001.

Case 5: Renewable Energy Development Project – China

From 2002 to 2007, more than 400,000 solar home systems (SHS) were sold in northwestern China under a $316 million World Bank/Global Environment Facility supported by Renewable Energy Development Project (REDP). In line with the ''New and Renewable Energy Development Program, 1996–2010,'' developed by the Ministry of Science and Technology and the erstwhile State Development Planning Commission, the World Bank/GEF designed the REDP to address prevailing concerns over the country's rural energy sector. Of paramount importance at the time were inadequate electricity access among rural households, barriers to private investment in renewable energy manufacturing, and excessive reliance on coal-based power generation. With initial targets of installing 10 MW of SHS (approximately 350,000 units), REDP would address those concerns and provide environmental benefits through avoided emissions of air pollutants.

The State Economic and Trade Commission established a Project Management Office (PMO) to coordinate the REDP, which as a result of government restructuring was transferred to the National Development and Reform Commission (NDRC) in 2003. Consisting of 10 full-time employees assigned to the technology improvement of photovoltaic components, as well as Financial and Contracts Management, the PMO was responsible for making all management decisions at the central government level. This included tasks like selecting participating companies, authorizing grant payments, and designating certification procedures for sub-components. Over the course of the program they engaged in promotion efforts, like the production of television and movie content to expand awareness about renewable energy, and initiated capacity-building courses and conferences for PV companies. While the PMO was an independent body, its decisions still required approval from the NDRC and the World Bank, with whom it had regular contact.

The initial target areas for the SHS component were Inner Mongolia, Gansu, Qinghai, Western Sichuan, Tibet, and Xinjiang, later extended to Shanxi, Ningxia, and Yunnan provinces. As of 1995, more than 9 million people were without electricity across these 10 provinces and autonomous regions. The central priorities under REDP were to improve product quality, reduce production costs, and install a total of

10 MWp of SHS capacity. In reality, the 28 participating companies surpassed the capacity target in 2007 and sold 11.1 MWp. The PMO verified a sales volume of at least 400,000, while companies claimed an even higher unofficial figure of some 500,000 SHS sold during REDP's implementation.
Source: Sovacool and D'Agostino, 2011.

Case 6: National Improved Cook Stove Dissemination in the Mid-Hills of Nepal

The Indian stove models, the Hyderabad and Magan Chula, were the first ''improved cooking stoves'' introduced in Nepal, during the 1950s. In the 1960s, an agro-engineering workshop in the Department of Agriculture developed a mold-based stove model, which was disseminated through the mid-1970s, a number of non-governmental organizations and government organizations (Peace Corps, Women Training Centre, RECAST, and UNICEF) were involved in improved cookstove (ICS) research and dissemination of the Lorena stove model. Unfortunately, lack of funding led to stagnation in stove dissemination. In the 1980s, the National Planning Commission addressed the wood-fuel consumption issues in a five-year plan, together with the introduction of community forestry.

The National Planning Commission initiated dissemination of ceramic pre-fabricated stoves, supported by FAO and UNDP. The ceramic inserts proved inappropriate to most areas of Nepal, since they were often breaking during long and complicated transportation in hill areas. Until I998, 95,000 ICS have been distributed or installed at various districts in the country. Out of this, about 57,000 ICS were distributed by the Community Forest Development Projects (CFDP). Beyond CFDP's role, other organizations involved in the promotion of ICS together promoted about 40,000 stoves in Nepal. New initiatives for ICS dissemination have been underway since the 1990s with new stove designs that can be built completely from cheap, readily available local materials, and a change from top-down, target-oriented, subsidized approaches to bottom-up demand-driven, self-construction approaches.

To complement these efforts, a national ICS program has been initiated with the support of Energy Sector Assistance Programme (ESAP) of DANIDA. Similarly, networking of ICS-promoting organizations has been undertaken with the support of ARECOP. In this initiative, the Centre for Rural Technology in cooperation with various government organizations and NGOs is coordinating network-strengthening activities. The Alternative Energy Promotion Centre, a government agency, is lending further support to the networking activities. The current status is that over 150,000 ICS have already been built and it appears that there is a tremendous and growing demand for them.
Source: Shrestha *et al.* (2008).

Case 7: Renewable Energy for Rural Markets Project (PERMER) – Argentina

In 1999 the country had already achieved an overall electrification rate of 95 percent, yet significant numbers (25 percent) among the rural population remained without access to electricity services. PERMER, a project financed by the World Bank and Global Environment Facility (GEF), targeted the electrification of 35,000 remote households, 1,750 public facilities (hospitals, schools) and 500 businesses through off-grid concessions that would be regulated by a regulating provincial agency.

The type of technology was freely chosen by the concessionaire, while the initial investment costs were divided between them (30–40 percent) and the user (10 percent) including an upfront subsidy (about 50–60 percent) paid in two phases: upon procurement and upon successful installation. The regulatory agency then evaluated installation, customer satisfaction, and service quality. One of the most advanced concessionaires of the project was EJSEDSA, which started by the end of 1996 and managed in five years to deliver to 4,000 rural households sustainable energy through mini-grid systems (micro-hydro, PV-wind-diesel-hybrid systems, diesel) and solar home installations.
Sources: ESMAP (2005), PERMER (2011).

Case 8: Vietnam Rural Electrification Program

Vietnam's rural electrification program has been very successful and provides a set of practical lessons that may serve to mobilize different parts of the society to engage in a clear and systematic way towards national prosperity. The program benefited from numerous factors and was able to produce effective outcomes in a relatively short time.

Natural resources such as an abundance of water for hydropower purposes played a key role for the infrastructure as did multiple funding sources. In addition the government was committed to all necessary areas to expand electrification, leading to effective public–private partnerships. Electrification was prioritized for income-generating activities and sectors, which built a solid foundation for taxation and therefore a resource to finance the nationwide development.

Grid connections were expanded to rural areas, as it became a political priority of the government to provide the population with access to modern energy in order to climb the economic ladder. The perception of the people of Vietnam about electricity and their understanding about its numerous values in creating economic opportunities was a critical factor in pushing the energy service sector and local authorities to increase access to electrification.
Source: ADB, 2001.

Case 9: Luz para Todos – Light for All (LPT) – Brazil

In 2003, the government of Brazil initiated the Luz para Todos program to provide nationwide electricity access, including all citizens, in order to enhance the country's socio-economic development. Until 2009, 11 million people benefited from the electrification program. With

the coordination of the Ministry of Mines and Energy, the program was managed by Eletrobrás and implemented by several distribution companies, privatized and federal power supply enterprises.

The goal is to provide 12 million Brazilians, including 10 million in rural areas, with electricity. By November 2006, 4.6 million people had received access to electricity. Around 70 percent of the funding comes from the Reserva Global de Reversão (RGR), a fund that provides loans that are collected from concession fees and fines paid by energy supply companies, and the Conta de Desenvolvimento Energético (CDE), a fund that delivers subsidies that are collected from tariffs paid by consumers. The federal and state governments and municipalities in cooperation with the power supply companies provide the remaining funds.

In regions with very low initial electrification rates, the government subsidizes the investment of power companies by up to 90 percent, while electricity consumers are spared from paying for any network grid extensions. For small populations within the Amazon region, it was estimated that the most economical efficient option for electrification is the installation of approximately 130,000 PV installations to serve about 175,000 localities.

Additionally 2,300 villages were equipped with so-called mini-grid based systems, fueled by either biomass or solar energy. Further, 680 medium-sized communities were supplied with hybrid systems and 10 larger communities with power generators that are also based on hybrid systems or conventional diesel inputs. In 2006, six applications for schemes using renewable energy were introduced and approved within the program, with all of them applying solar home systems (SHS), resulting in 3,071 installations.

Sources: OECD & IEA (2010), Ministerério de Minas e Energia Brasil (2011).

Case 10: Butanization (Liquefied Petroleum Gas) Program – Senegal

The introduction of liquefied petroleum gas (LPG) for cooking called ''butanization'' in Senegal shows the critical nature of subsidies on the use of cooking gas by the peri-urban and urban poor. This policy has been largely successful and by the time the subsidy was partially withdrawn in 1998 over 85 percent of urban and peri-urban households had switched to LPG.

Alarmed by the high rates of deforestation caused by charcoal production for household use, the government aimed at reducing the charcoal consumption by 50 percent in major urban areas by introducing policies to make LPG accessible and affordable for poor households. The plan was to substitute charcoal and wood by LPG as the main source of energy for cooking.

At first (1974), a cooking stove with an attached gas cylinder containing 2.7 kg of LPG was promoted and later, in 1983, a more solid cooking stove with a 6 kg gas cylinder which was better adapted to the cooking habits and income levels was also subsidized. In addition the Senegalese government exempted all LPG-related equipment from custom duties and eventually subsidized the gas itself in 1976. After the first years (1988), the government still felt that the LPG introduction process in Dakar was too slow and took the decision to increase the subsidies on LPG. This had the effect of dropping the retail price for LPG cylinders by 38 percent and also increased sharply the demand for two new models of LPG-based stoves. The refill price dropped, which was translated into a substantial increase in LPG in urban and peri-urban areas of Dakar. The subsidy on LPG had the double benefit of being a sustainable way to diminish deforestation by decreasing the charcoal consumption and also by giving to the peri-urban and urban poor the possibility to have access to the LPG cylinders at affordable prices.

Sources: Sécou *et al.* (2008), Brew-Hammond and Kemausuor (2009).

Case 11: Clean Energy Business (SELCO India and SEWA Bank) – India

Since the mid-1990s, SELCO has focused on adequate energy access for the population in need. Since then, the energy service company has benefited over 500,000 people in over 80,000 households, along with micro-enterprises and communities, by providing them with access to electricity using PV technologies. The efforts of SELCO in India has made it to one of the biggest solar providers worldwide, by having proved itself to be more efficient than many national government-based electrification programs that have received large funding by multilateral development banks or used subsidies. In 2005, 50,000 PV systems were sold, giving SELCO an annual revenue of US $3 million.

SEWA was established in 1971 in the western Indian state of Gujarat. By today the bank is providing financial services, like credits, savings, and insurance, to over 400,000 female customers, especially in rural areas. Realizing quickly that it already was involved in giving loans to customers who were in need of better energy services, SEWA started to include energy access issues for rural areas in its operations.

This resulted in a partnership between SELCO Solar Light Ltd. (SELCO India) and the Self-Employed Women's Association (SEWA Bank). This partnership serves as a good model for the linkage between development finance and sustainable energy. SELCO entered into a partnership with SEWA in order to assist women entrepreneurs in Gujarat state with better energy solutions. An entrepreneur might buy a solar-powered battery-charging system from SELCO, with a microloan from SEWA Bank. Developing a business of renting solar-charged lamps to other street vendors, she could develop profits of her own, meanwhile enabling other vendors to save money by being freed from reliance upon expensive kerosene to operate traditional lamps. So far, 200 street vendors are served by 50 women who are engaging as battery-charging entrepreneurs.

Source: Hansen, 2007.

Case 12: Laos' Electrification Program

Over two-thirds of Laotian households today enjoy access to grid-quality electricity, a far cry from just one in six families having a connection in 1995. The coverage is envisaged to reach 90 percent by 2020. How did this come about? First, the Laotian government made

rural electrification a priority in its National Growth and Poverty Eradication Strategy (2006–2010) and committed the required resources. Then a comprehensive and sector-wide approach was adopted to carry out reform, strengthen institutions, and build capacity, which resulted in expansion of generation capacity and distribution networks, improved operational efficiency, financial sustainability, and service quality. Both grid and off-grid solutions were used to expand the coverage. The government carried out tariff reform – including cross-subsidization in pricing – and provided subsidy incentives for financial sustainability of the utility and affordability of consumers. Focused capacity building was carried out in Electricite du Lao (EdL), the national utility in planning, design, implementation, and operation.

On the ground, several innovative methods were used to improve the affordability for consumers. A village screening process was put in place – including gender-sensitivity criteria and consultation process – to prioritize villages with clinics, schools, irrigation, and potential economic activities. A Productive Use of Electricity program was launched to ensure income generation and extended social benefits. At the same time, a Power to the Poor (P2P) program was instituted to offer interest-free loans to the poor households to pay for the upfront cost of connection. When P2P was taken to already electrified villages, the coverage went up from 80 percent to 98 percent, including the poor. Where off-grid solar systems were used to expand access, a rent-purchase scheme was implemented facilitating partial payments over a 10-year period, thereby making the systems accessible to the poor. Off-grid systems have covered about 2.5 percent of the households, particularly in remote, inaccessible regions.

The tariff reforms carried out by the government coupled with capital subsidies, has attained an average energy price of $0.065/kWh against the cost of supply of $0.05/kWh. Systems losses went down to 13 percent in 2009 from 20 percent in 2005.

Some of the key lessons from the Laos experience are: Well-governed utilities can achieve fast expansion of access with the private sector playing a complementary role; strong commitment of government is critical; a combination of pricing and incentive mechanisms is necessary for financial sustainability and consumer affordability; strong commitment and capacity are a requisite for program managers; and, innovative, customized solutions are often required to reach the poor.

Source: World Bank, 2011.

Case 13: Rwanda's Sector-Wide Approach for Electrification

In 2004, Rwanda had less than 65,000 electricity connections, just 6 percent access. Another 45,000 connections were added by 2008, mostly in Kigali, the capital. Less than 1 percent of rural households had any access. In early 2009, the Government of Rwanda adopted the Sector-Wide Approach (SWAp) with a five-year target of increasing access to 16 percent and the number of connections to 350,000. SWAp – which was used hitherto in sectors such as water and sanitation – is characterized by a country-led process that focuses on a results-oriented, long-term program that ensures joint accountability of all partners and stakeholders.

The World Bank and other donors came forward to assist in this process. An energy sector working group (SWG) was established by the government, which prepared a results-focused prospectus that set out national priorities, targets, and a framework to achieve them. The prospectus included a plan of electrification, designated roles for the government and other stakeholders that included the private sector and donors. A donor roundtable was held to pool up resources, and the prospectus enabled Rwanda to raise $225 million for a program to extend access to an additional 1 million people.

On the demand side, a study was conducted to establish the purchasing power and affordability of consumers in case of sustained availability of electricity. A technical assistance program was put in place to ensure quality control, a transparent approach in allocation, efficient procurement processes, and optimal resource utilization. A dedicated department of National Electrification Program Management was set up within the national utility to oversee the program.

Beginning with 2010, the program implementation has already improved access from 7 percent to 10 percent and is on track to reach the target of 16 percent by 2013. Several factors have contributed to this initial success: Good governance though strong country ownership and leadership, a consortium approach with clear roles, link to national priorities, pooling of resources ensuring efficient use, a focused implementation plan that used a scientific process to identify different demand centers (e.g., using GIS), and strong monitoring. Based on the initial results, there is every chance that Rwanda can further accelerate the expansion of access to ensure power sector's contribution to its overall socio-economic development.

Following Rwanda's lead, Kenya and Ethiopia are already using SWAp in their access programs. Kenya managed to mobilize $1.5 billion using the consortium approach. A few other sub-Saharan African countries are looking at a similar approach.**Sources:** Sanghvi (2011), Sri Mulyani (2011).

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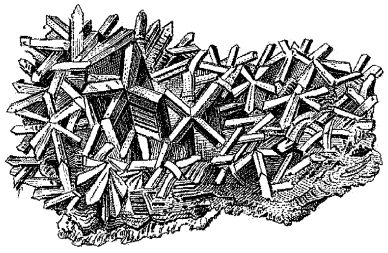

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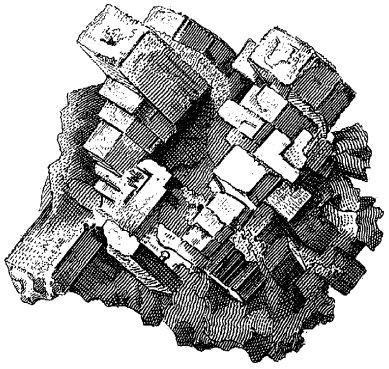

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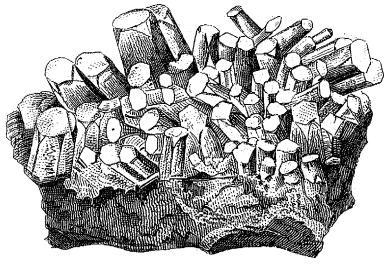

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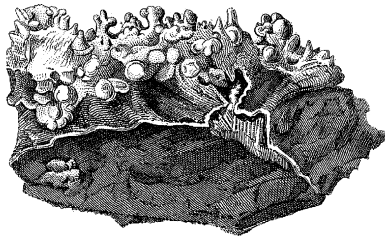

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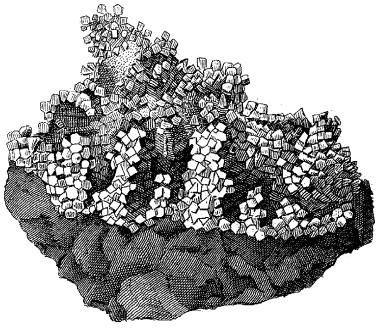

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1. For more information, see www.sustainableenergyforall.org/.

2. We provide extensive references to this end.

3. See e.g., Barnes *et al.* (1994, 2011), Acker and Kammen (1996), Cabraal *et al.* (1996), Bugaje (1999), Abavana (2001), Karekezi and Majoro (2002), Fishbein *et al.* (2003), Heltberg (2003), Davidson and Mwakasonda (2004), Al-Soud and Hrayshat (2004), Pachauri *et al.* (2004), Chaturvedi (2005), ESMAP (2005), Ailawadi and Bhattacharyya (2006), GNESD (2006), Engineering and Consulting (2007), Prasad (2007), Bailis *et al.* (2007), Barnes (2007), Gaunt (2008), Pachauri and Jiang (2008), World Bank Independent Evaluation Group (2008), EAC (2009), Granderson *et al.* (2009), UNDP (2009), Gómez and Silveira (2010), Veen *et al.* (2010), Bambawale Jain *et al.* (2010), Brew-Hammond (2010), Budya and Yasir Arofat (2011), Clemens *et al.* (2011), Drupady and Sovacool (2011), EASE (2011a, 2011b), Sanghvi (2011), Sovacool and Butan (2011), Sovacool and D'Agostino (2011), Sovacool and Drupady (2011).

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5. See e.g., Munasinghe (1987), Pearce and Webb (1987), Foley (1992), ADB, 2001a, Karekezi (2002a, 2002b), Karekezi and Kithyoma (2002), Al-Soud and Hrayshat (2004), Barnes and Foley (2004), Davidson and Mwakasonda (2004), ESMAP (2005), Egels (2005), Sebitosi *et al.* (2006), Ying *et al.* (2006), Charles Moonga (2006), Meisen and Cavino (2007), Engineering and Consulting (2007), Menke (2008), World Bank (2008a), World Bank Independent Evaluation Group (2008), Byrne (2009), Gómez and Silveira (2010), Niez (2010), Asaduzzaman *et al.* (2010), Bambawale Jain *et al.* (2010).

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7. See e.g., UNEP (2003), Hansen (2007), SOFRECO (2008a, 2008b, 2008c, 2008d, 2008e, 2008f, 2008g), World Bank (2008b), Aron *et al.* (2009), UNDP *et al.* (2010), IEA (2011).

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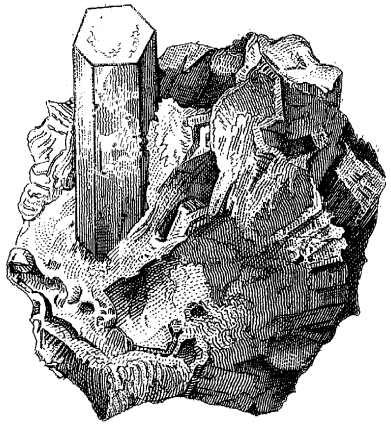
9. Stemming from the UNFCCC vocabulary and reporting structure; NANAs include policies, programs and projects that are undertaken by developing countries to contribute to the global effort of reducing greenhouse gas emissions; It must however be noted that most countries are still in the process of developing or initiating their NAMA; Also, they typically entail no specific focus on household electrification and poverty alleviation.

10. As an aside, electrification top of the list as greatest engineering achievement of the 20th century by the U.S. National Academy of Science; see http://www.greatachievements.org/.



11. Depending on the assumptions and scenarios.

12. It must be underlined that cases not included in this analysis are not deemed as unsuccessful.

13. Qualitative methods refer to ''the development of research practices, and the consolidations of objects of inquiry and analytic strategies employed in relation to data that are either archival or based on direct social observation and interaction, insofar as these methods do not depend on quantitative analysis'' (Hall, 2001).

14. i.e., ''picking winners.''

15. See e.g., Enzensberger *et al.* (2002), Harmelink *et al.* (2006), Neij and Åstrand (2006), Haxeltine (2007), Khan *et al.* (2007), Lund (2007), Brown and Mosey (2008), Carley (2009).

16. The ultimate goal is to make a statement that reflects adequately the dataset scrutinized after an iterative process whereby the hypothesis originally formulated is refined to fit various cases analyzed. Such an approach allows us to distinguish essential characteristics from ''less relevant'' aspects. The emphasis of the process is therefore on the whole (Ratcliff, 1994), rather than on the individual elements. Thus, the sample of selected interventions need not be representative in the statistical sense, but rather the selected interventions should have specific characteristics which when taken together form a pattern. It must be noted that analytic induction is a subjective process, as most qualitative research methodologies are. Also, by definition, analytic induction derives only characteristics that are common and tends to discount infrequent features. To account for this and give credit to possibly innovative elements in interventions, key success factors that are only specific to one or few cases are also discussed in a separate sub-section. Another often cited weakness is the fact that analytic induction specifies only necessary but not sufficient conditions (Katz, 2001).

17. Where ''universal'' means an invariant, complete, positivistic propriety.

18. Some of the hypotheses (principles) explored do not hold scrutiny of the analytic induction; that is, those might not fit the majority of cases but nevertheless represent key elements of one or a few interventions. Some interventions are based on a model focusing on the sale of services (also referred to as fee-for-service), as opposed to the sale of equipment, as warrant of the medium-term sustainability of the intervention. A significant amount of the risk is shifted away from the end-user up the supply chain, where the capacity to withstand shocks is significantly greater.

19. A state-run operator of the country's electricity supply sector that manages rural electrification.

20. Consists of the French oil company TOTAL, the French electricity company EdF, and a joint subsidiary that is responsible to provide design, production, installation, and operation of photovoltaic solar power systems.