

Chapter 2

Holistic and Systemic Approaches to Implement Energy Access Solutions in the Global South

Bertrand Klaiber

Abstract Energy is an essential resource to improve the quality of human life, and to enable both societal development and economic growth. Universal access to energy requires adopting a comprehensive approach to developing and deploying clean, affordable, and reliable solutions in a sustainable and scalable way. These solutions involve a large range of appropriate technologies from energy production, distribution, and storage, to safe and efficient usage. This comprehensive outlook requires considering the whole life cycle of the products, systems, and services as well as the entire value chain, including all the stakeholders, from global and local players in the private sector to public authorities and civil society. The four contributions of Part II (Chaps. 3–6) describe some key learnings and success factors to provide access to energy to remote or resource-poor communities from a global perspective.

2.1 Energy Is Essential for Development

Energy is essential for economic and social development and improved quality of life. Access to affordable and reliable energy is a prerequisite for progress in most sectors, including health care, education, livelihoods, household lighting, cooking or heating services, transportation, and information and communication technologies (ICTs). Although there is a need for a massive increase in energy supply in the Global South, this expansion is inhibited by expensive, underdeveloped, or failing energy infrastructures. In this context, a large range of affordable and appropriate technologies and services are required, from energy production, distribution, and storage to safe and efficient usage.

B. Klaiber (✉)

EssentialTech, Cooperation & Development Center (CODEV), Ecole Polytechnique Fédérale de Lausanne (EPFL), Lausanne, Switzerland
e-mail: bertrand.klaiber@alumni.epfl.ch

2.2 Complexity of Energy Access Projects

In the broader sense, energy refers to *natural resources* (oil, gas, uranium, biomass, solar, or wind), *production* or *conversion* (hydroelectric, geothermal, or coal-fired power plants; wind turbines; photovoltaic installations; cogeneration; or waste combustion), *carriers* (fuel or electricity), *distribution* (transportation, pipelines, or power grids), and *consumption* (energy services and use). It is essential to develop or improve the entire **energy chain** to provide access to energy. Many different technologies are involved at each level, and these are closely related to financial, political, and social factors.

Energy projects must address technical challenges, while also taking into consideration all the actors, interactions, and roadblocks along the entire **value chain**. The concept of the value chain consists of all the activities, processes, and operations needed to achieve the development, implementation, exploitation, and maintenance of appropriate technologies for access to energy. The value chain also involves many different actors, such as technology suppliers, product manufacturers, governmental agencies, nongovernmental organizations (NGOs), international organizations, investors, service companies, and various types of consumers. Indeed, end users may have very different energy needs and consumption profiles depending on whether they are households, public services, or any kind of industries or small and medium-sized enterprises (SMEs).

Technologies and strategies need to be converted into products and solutions that can be successfully deployed in the field. However, these products and solutions generally cannot solve energy issues if adequate social initiatives, business models, and policies do not accompany them. Many deployments of technology have failed due to cultural inappropriateness, the lack of local empowerment and competencies for operation and maintenance, and the absence of adequate financial plans to sustain these solutions. From this perspective, any technology should be considered within a comprehensive framework that includes the resources, capacity, and economic models it requires to function. This creates the challenge of evaluating and influencing several factors that are difficult to measure and quantify, including local skills, competencies, awareness, motivations, traditions, cultural specificities, ability, and willingness to pay for energy services. Finally, energy projects should clearly define the expected social, environmental, and economic impacts that can be monitored by means of key indicators and sustained by appropriate procedures.

2.3 Energy Security, Quality, and Efficiency

While the lack of energy seems to be the more urgent matter, energy access projects should be evaluated not only in terms of the number of kilowatts they may deliver over time, but also by the socioeconomic benefits they may bring, such as productive uses, more numerous livelihood opportunities, and improved community

services. These outcomes rely not only on the quantity of available energy, but also on *energy security*, which the International Energy Agency (IEA) defines as “the uninterrupted availability of energy sources at an affordable price” (IEA, n.d.). In addition, profitable use of energy requires both adequate *power quality* and *energy efficiency*. The first concept refers to the suitability of electric power for consumer devices, which are frequently not working or damaged in developing countries due to perturbations in the electrical grid. The second concept refers to the goal of reducing the amount of energy required for an expected effect or service.

As a consequence of the declining ratio between affordable energy’s availability and energy demand, energy efficiency has become an essential factor for growth in industrialized nations. Likewise, there are great opportunities for policy makers and service companies in developing regions to improve energy productivity, cut energy costs, insulate themselves from future energy shocks, and secure a more sustainable development path. According to research on energy productivity in developing countries conducted by the McKinsey Global Institute (MGI) (Farrell and Remes 2009), measures to improve energy efficiency have the potential to “leave demand some 25 % lower in 2020 than it would otherwise have been. That is a reduction larger than total energy consumption in China today.”

Energy security, quality, and efficiency are essential aspects of any energy project, requiring services from skilled personnel and companies in addition to appropriate technologies. Similar to the last decade in industrialized countries, the paradigm in developing economies needs to shift from technical products and solutions to energy services.

2.4 Holistic and Systemic Approaches

Addressing the complexity, multiplicity, and diversity of problems faced by energy access projects requires holistic and systemic approaches. Several of these approaches are presented in the next four chapters that illustrate the concept elaborated by the *EssentialTech*¹ program of the Ecole Polytechnique Fédérale de Lausanne (EPFL). This program rests on a multidisciplinary methodology addressing three complementary and interlinked aspects of essential technologies for development:

1. Technologies adapted to the local context;
2. Sociopolitical factors in the value chain; and
3. Business models for deployment.

¹<http://essentialtech.epfl.ch>.

2.4.1 Technologies Adapted to the Local Context

Technologies are required along the entire energy chain and for all services that rely on energy. In particular, it is crucial to develop solutions that take into account the local context and current situation instead of trying to apply strategies from industrial countries that increasingly show their limitations.

To provide significant and durable benefits, energy technologies should be efficient, sustainable, affordable, adapted to the local context, administered by local people, and use local and renewable resources as much as possible. The impact of such technologies on society and the environment is an essential consideration on a local and global scale. Clean energies should be favored to avoid damaging the local environment and contributing to global warming.

Appropriate technology developments must address a variety of challenges, such as high levels of ambient temperature, humidity and dust, low-skill personnel, a lack of reliable infrastructures and spare parts, low purchasing power, poor logistics facilities, and different cultural and social behaviors. Both performance evaluation and the total cost of ownership of a particular solution require consideration of the entire value chain, including equipment, infrastructure, processes, and capacities. Therefore, co-creation and collaboration with local stakeholders that are more knowledgeable of the local context is essential. This process can lead to frugal innovation, which in turn could bring certain advantages to industrialized countries.

2.4.2 Sociopolitical Factors in the Value Chain

The impact of a technology is directly dependent on its ability to be deployed, which requires setting up an entire value chain, of which each element must be taken into account in project development. Social and organizational models must be developed to implement the solutions and the incentives or policies fostering sustainable and scalable deployment (e.g., national regulations, tax incentives, tradable carbon credits, or social impact bonds).

The first step involves assessing a situation in terms of material and human resources, competencies, capacities, task-shifting opportunities, regulatory, administrative and institutional frameworks, and societal organization. Cultural specificities should also be taken into consideration, such as the perception of time and priorities or the sense of ownership, moral values, and accountability. Then, the gap between available and required deployment prerequisites should be addressed. This concerns developing teaching and training programs, appropriate policies, awareness campaigns, new processes and organizations, individual and collective empowerment, alliances with private, public, or civil institutions, and so on.

Then, the challenge is to encourage the different actors to participate in the project and initiate the required structural changes. It is therefore crucial to have an interdisciplinary and multicultural approach in energy projects. This approach does

not only concern the project team, but should also be implemented further upstream when designing the technology or elaborating a capacity building program. Implementing this strategy can be challenging in a society that segments and splits everything up, e.g., ministries are often not collaborating, and academic branches and administrative services are frequently very specialized and focused.

2.4.3 *Business Models for Deployment*

New technologies resulting in revenue streams for business ventures and local players are more likely to generate a long-lasting impact than donations, and also have significant potential for scale-up. Products and services associated with a commercial value are often better delivered, operated, and maintained. Energy projects should therefore consider achieving profitability along the entire value chain in order to encourage all the stakeholders to take ownership of the solutions, and to foster both their sustainability and scalability.

From this perspective, appropriate business models must be developed for the entire deployment of energy solutions and services. Business plans should propose ways to fund the initial costs (e.g., acquisition of equipment and creation of dedicated structures), and define models to cover the operational expenditures and generate revenue streams. Initiatives are required to foster the creation of new business ventures and improve their chances of success. This includes, but is not limited to, start-up incubators and “FabLabs,” entrepreneurial mentoring, dissemination of a culture of risk and failure acceptance, and proper supportive plans and policies for SMEs.

Markets may be of very different sizes and types, ranging from high-volume small solutions, such as solar lamps or cook stoves, to single-shot large projects, such as production plants that are generally controlled and financed by governments and international companies. Between those, there is an important yet largely untapped market for community-scale energy solutions, such as rural villages, public buildings, and SMEs. The challenge for these projects is to access important capital investments that are often less structured than micro-credits and national funds.

Both fully subsidized and fully liberal approaches have shown some limits regarding the sustainability of energy access projects. Alternatively, *social entrepreneurship*² (Kayser and Budinich 2015) generates financial returns together with social and environmental impact. It requires *venture philanthropy* or *impact*

²The social enterprise combines commercial and social goals, with emphasis on the latter. It makes use of traditional venture capital model, based on simple risk and reward, while consciously striving to maximize its social impact. The concept of “Scaling Up Business Solutions to Social Problems” is described more thoroughly in Kayser and Budinich (2015), with several examples in the energy sector.

*investments*³ (Rodin and Brandenburg 2014), to achieve sustainable deployment of energy solutions.

Another recognized sustainability factor is the implication or empowerment of local communities (e.g., village populations or local workers) to ensure that they take ownership of the solution and assume functioning of the equipment—while avoiding issues that can occur when the responsibility is left to an individual or a small group. It is therefore essential to involve them, as well as other stakeholders and key opinion leaders (KOL), in the development of the technology and the implementation of the solutions. In addition, involvement of the private sector for marketing, industrialization, and distribution can bring significant advantages for deployment, such as experience and scale effects.

2.5 Universal Access to Energy

Universal access to energy is an extremely complex and ambitious goal due to the multiple technologies, stakeholders, and sectors that are simultaneously involved in energy programs, infrastructures, policies, trade, and services. There is no single universal solution, and thus, energy access projects should take their local context into account. At the same time, these projects rely on more global factors, such as national and international regulations, the prices of resources and equipment, scientific progress, and global warming. Consequently, access to energy can only be achieved through integrated approaches to developing and deploying clean, affordable, and reliable solutions in a sustainable and scalable way. Subsequent dissemination of energy technologies requires identification of generic approaches, global knowledge, and replicable solutions that can be adapted to multiple contexts.

In this respect, the following contributions (Chaps. 3–6) present different strategies and models supported by important lessons from practical experiences. Although each paper is different, they all recognize the importance of a holistic, comprehensive approach to address the multiple problems related to energy access. They describe theoretical frameworks and practical tools for analyzing energy ecosystems and managing energy projects. Each paper has been selected to highlight particular frameworks and key success factors from case studies that could be generalized to provide access to energy in remote or resource-poor communities from a global perspective.

³In *The Power of Impact Investing*, Rockefeller Foundation President Judith Rodin and Margot Brandenburg (2014) explain what impact investing is, how it compares to philanthropy and traditional investments, where opportunities are evolving around the world, and how to get started.

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