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Policies For Energy Access

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Executive Summary

A number of factors contribute to the lack of access to modern forms of energy. They include low income levels, unequal income distribution, inequitable distribution of modern forms of energy, a lack of financial resources to build the necessary infrastructure, weak institutional and legal frameworks, and a lack of political commitment to the scaling up of services. An absence of specific policies oriented to poverty alleviation often explains inequitable economic growth and, consequently, inequality in access to and use of energy. In recent years, several developing countries have defined targets aimed at improving access to electricity, but many developing countries still have no modern forms of energy access targets in place that address meeting basic energy services, including modern fuels for cooking and mechanical power.

As Chapter 2 argues, developing countries require adequate access to modern energy, especially among the poor, in order to meet the Millennium Development Goals (MDGs) as well as their own national development objectives. In line with GEA objectives, Chapter 17 pathways are designed to describe transformative changes toward a more sustainable future. A specific feature of the GEA energy transition pathways is that they *simultaneously* achieve normative goals related to all major energy challenges, including environmental impacts of energy conversion and use, as well as energy security and energy access. 'Energy access' refers to those challenges clearly described in Chapter 19, which will be addressed in this chapter.

Affordable and sustainable universal access to modern forms of energy depends on the evolution of income level and income distribution. Urbanization processes and population growth are the other variables that play a key role, but both cannot be addressed and solved by energy policy alone. Clearly, without a significant growth of per capita income in developing countries, ambitious targets on access to modern forms of energy will face barriers that are both significant and hard to overcome. As such, policies to improve energy access should be part of the strategies on poverty reduction and income distribution. Isolated solutions are not effective. Without an integrated approach to facilitate the inclusion of excluded populations as a means to alleviate poverty, the intended outcomes will not follow.[1] Reaching universal access to modern forms of energy within a period of 20 years needs robust strategies, policies and measures integrated in long-term national programs with clear targets, dedicated and guaranteed funds, and an adequate institutional framework.

If widespread energy access is to be achieved in just a few decades, energy policies would need to work in concert with economic development policies by harnessing the collective efforts and investment potential of markets, international organizations, central governments, regional governments, cooperatives, and local organizations. Large amounts of funding are needed to provide a major clean-energy infrastructure and to leverage private funding through a more sound investment environment. For the poorer regions, grants would in many cases be needed to, in combination with targeted energy subsidies for the lowest-income populations. Policies would need to support local participation in developing and managing energy systems, as this approach has been shown to have the best chance of providing a stable environment for new investment and reinvestment in increased energy access.

A variety of policies and measures applied around the world have provided considerable experience and knowledge. Overall, no single institutional model or strategy can be recommended as the right one, as evidenced by the success or failures of different models for access to modern forms of energy.[2]

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1 For example, decentralized, energy technology itself is a package comprised of "hardware and software." The "hardware" includes the energy technology and physical project components. The "software" includes community mobilization, participatory development of the energy technology itself, capacity-building for the use of production technology and scaling-up through market development.

2 The experiences of the eighties and nineties in energy structural reforms, when the proposals coming from international financing institutions were very similar, ignoring national and local circumstances, led to the demonstration and conviction that "one size coat does not fit all," specially in institutional, regulatory and property right issues. Lessons learned from success stories are very important and they will be address in different sections of the chapter, without being prescriptive.

A major shift appears to be urgently needed in the way countries approach the formulation, planning and implementation of policies designed to facilitate access to energy and, particularly, to meet the energy services of poor people. Current supply-side approaches that simply take as their starting point the provision of modern forms of energy or equipment of a particular type are less successful in reaping the full potential of social and economic improvements that follow from improved energy access. A solid knowledge of the energy services that are a priority of the target population is a crucial prerequisite to identifying the right response with energy source and technology. This often requires innovation, testing and experimentation at both technological and institutional levels. Lack of appreciation of such approaches at the policy level may curtail progress, as many policymakers may follow approaches that do not take into account the contextual differences. The integration of centralized and decentralized options of advancing universal energy access also needs to be explored more carefully.

Fuel subsidies alone will be neither sufficient nor cost-effective in terms of achieving ambitious energy access objectives. Often, financial mechanisms, such as end-user finance, would need to complement subsidies to make critical end-use devices, connection costs for network systems like electricity and natural gas or LPG (liquefied petroleum gas) cylinder costs affordable to poor people. Up-front costs of the equipment and appliances are, in many cases, the most important barrier to access. Policies that address this will make it easier for households to cover the fixed capital costs associated with a switch to cleaner fuels.

The promotion of joint actions involving local communities and authorities, NGOs and energy utilities, both in rural and urban areas, have demonstrated to be a favorable enabling environment to advance access objectives.

Reforming the way energy is financed and sustainably operated has potentially important outcomes in the efforts to reduce inequity. Some principles, such as supporting energy planning, making infrastructure investment, creating incentives for commercial lending, generate soft loans, launching promotional campaigns, and providing technical assistance, have been identified for certain markets. Centralized agencies can also assist by improving this coordination and helping to create needed local institutional and organizational capacity.

Finally, this chapter does not aim to be prescriptive in policymaking, but seeks to introduce the challenges, conditions, and key issues that should be taken into account in the quest for a policy on access to modern forms of energy.

23.1 Chapter Roadmap

Universal access to modern forms of energy is one of the most urgent objectives of energy policies in the coming decades. It is inextricably linked to improved welfare, because energy services have a direct impact on human needs, productivity, health, education, and communication. Lack of access to modern forms of energy and the related lack of access to energy services contribute to and are a consequence of poverty, constrain the delivery of social services, limit opportunities, and often erode local environmental sustainability. Universal access to modern forms of energy has clear implications for the achievement of the MDGs, and beyond. It will help address environmental challenges, guarantee adequate levels of health, increase energy security, and promote economic development.

Several factors contribute to the lack of access to modern forms of energy. They include low incomes, unequal distribution of incomes and of modern forms of energy, lack of financial resources to build the required infrastructure, weak institutional and legal frameworks, and a lack of political commitment to the scaling up of services. An absence of specific policies oriented to poverty alleviation often explains inequitable economic growth and, consequently, inequality in access to and consumption of energy. Many developing countries have no energy access targets in place, particularly for those of its components that do most to reduce poverty. In recent years, several countries have defined targets aimed at improving access to electricity. A few, however, addressed targets on meeting basic energy services, including modern fuels for cooking and mechanical power. These, of course, are crucial if the basic needs of poor people are to be met. Access to energy should also be considered within the broader objective of equity. Access to modern forms of energy contributes to this objective.

The role of the state in the energy system varies by country. What is clear, though, is that public policies are the non-transferable responsibilities of government. Governments would need to put in place feasible and effective policies with defined objectives, targets, and strategies that are appropriate to their needs and conditions, and need to apply appropriate measures and incentives to ensure their proper implementation. At the industry level, some countries consider oil and natural gas as strategic goods to be controlled and managed directly by government through public utilities, while accepting that the private sector has an important role in the power industry. In practice, energy policy requires each country and region to find a policy mix that best meets its goals and particular national and regional circumstances, needs and priorities.

In line with the Global Energy Assessment (GEA) framework and goals, this chapter takes 'universal access to electricity, liquid, and gaseous fuels (modern forms of energy) to satisfy households' energy services' as an objective for energy access policy.[3]

The key challenge for this chapter is therefore to examine the various options of policies and strategies that facilitate universal access to modern forms of energy by 2030. The terminology employed in this chapter, such as 'access,' 'modern forms of energy,' and 'rural or urban energy' is consistent with the use of these terms in GEA, and no further definitions are added here.[4]

Section 23.3 and 23.4 introduces two contextual issues. First, the social dimension of access to energy, including the relationships between energy and poverty, the macroeconomic conditions that relate to inequity and poverty, and their influence in the energy system. Second, it examines the key challenges and barriers to increasing access to modern forms of energy.

The situations, conditions, circumstances, levels of access, sociocultural contexts, history, and other factors vary between regions and countries. Developing proposals that take account of experiential learning demand consideration of regional contexts. Sections 23.6–8 provide a picture of the situation, lessons learned and policies applied in sub-Saharan Africa, Asia, and Latin America. Regional experts offer suggestions and recommendations based on their own experiences.

Sections 23.10 and 23.11 seeks to summarize key findings and lessons learnt and present recommendations to facilitate and improve access to modern forms of energy.

23.2 Introduction

Access to modern forms of energy is a key element in poverty alleviation and an indispensable component of sustainable human development. Roughly, 1.3 billion people still have no access to electricity and some 2.7 billion people rely on traditional biomass (IEA, 2011). More than 99% of people without electricity live in developing regions, of which four out of five live in rural South Asia and sub-Saharan Africa (Baker Institute, 2006).

This widespread lack of energy access makes it reasonable to conclude that the present structures and processes within the energy sector are not functioning for the benefit of poor people. Macro energy policies in developing countries tend to focus on commercial energy carriers: electricity, coal, gas, and petroleum products. Urban users are the primary beneficiaries. Although the urban poor may also benefit to some extent, the rural poor – who are the majority of poor people in most developing countries – generally do not benefit for the most part.

3 This assessment should not be understood as access to basic energy services, but to an adequate level of satisfaction of energy services according to the social-cultural, economic and environmental framework. Of course access to modern forms of energy is a necessary but not a sufficient condition for poverty alleviation and development.

4 The exception is if a concept requires a particular interpretation within the framework of Chapter 23 but for others please see Chapter 1.

Developing countries require adequate access to modern energy, especially among the poor, in order to meet the MDGs as well as their own national development objectives. In line with GEA objectives, future pathways are designed to describe transformative changes toward a more sustainable future. A specific feature of the GEA energy transition pathways is that they *simultaneously* achieve normative goals related to all major energy challenges, including environmental impacts of energy conversion and use, as well as energy security and energy access. 'Energy access' refers to those challenges outlined in Chapter 19 which will be addressed in this chapter.

Grid extension to rural areas is very expensive and off-grid or renewable programs supply relatively small quantities of electricity to rural communities. Oil products, such as kerosene or LPG, depend on road transport, which can be seasonally unreliable, and transport costs may increase the fuel cost considerably. Consequently, rural households and industries rely heavily on locally supplied biomass fuels. Energy planners and policymakers in developing countries, while usually aware of this process, rarely address the roots of the problem coherently.

The situation can be explained partly by a lack of understanding of the processes in rural areas and, in particular, by a failure to appreciate the positive contributions that access to modern forms of energy can make to sustainable livelihoods. To some extent, it is also explained by the fact that some issues related to energy, such as biomass, are not the responsibility of energy ministries, because its sources are normally the responsibility of forestry and agriculture ministries. Lack of cross-ministry cooperation is frequent. Poor understanding of the dynamics of rural energy, along with inadequate institutional cooperation, can result in a weak systemic capacity at the government level.

Energy sector reforms, both globally and in developing countries, have had specific consequences for poor people. Such reforms were not oriented to social objectives having no or negative impact on access to energy.

Next sections consider the main energy access dilemmas. It discusses relationships between poverty, development, and energy access at the macro level, and between energy policies, aggregated policies, and specific objectives, such as access to modern forms of energy. It identifies the key challenges and barriers that an energy policy must negotiate.

23.3 The Development Gap: Socioeconomic, Poverty, and Inequity Context

This chapter builds strongly on the concepts of social issues, MDGs and energy (discussed in Chapter 2). It demonstrates linkages with health and energy (Chapter 4), energy, economy, and investment (Chapter 6), scenario/pathways (Chapter 17), and energy access for development (Chapter 19). Findings from these chapters have fundamental implications for this chapter, which in turn strongly influences the discussions of policies, rationales (Chapter 22), and policies for capacity development (Chapter 25).

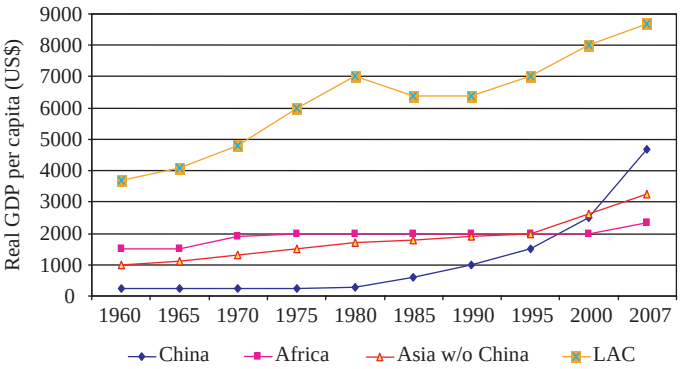


Figure 23.1 | Real per capita income of developing countries by region. Source: Based on data from UNDP Human Development Report, 2009.

At the macroeconomic level, the link between adequate energy services – in quantity and quality – and economic development (as measured by gross domestic product (GDP)) is relatively clear, although the direction of causality may or may not always be so (Ghosh, 2002; Wolde-Rufael, 2006). A more in-depth discussion on this causality is given in Chapter 6. Generally, no socioeconomic system provides an adequate welfare environment without available, affordable, and secure energy carriers. The relationship between per capita energy use and GDP per capita is a clear indicator of the importance of energy in development. Of course, the lack of adequate energy supplies is a barrier to development.

In the 47 years, from 1960 to 2007, GDP per capita in Africa grew at less than 1% per year, in Latin America and the Caribbean (LAC) at less than 2% per year, and in Asia, excluding China, at around 2.5% (Figure 23.1). Between 1981 and 2005, sub-Saharan Africa was the only region that did not see a decline in poverty levels.[5] In absolute terms, the number of poor people in Africa has nearly doubled and, if this trend continues, by 2015 one in two of the world's poorest people will live in sub-Saharan Africa, compared with one in ten in 1980.

The weakness of the economic system[6] is a major challenge to universal access to modern forms of energy, and to achieving the MDGs. Feasible,

5 Global poverty has fallen sharply on the strength of China's growing prosperity over the past two decades. The proportion of the world's population living in poverty fell by half – from 52% in 1980 to 26% in 2005. In the past 20 years, poverty has been declining at 1% annually (Collier, 2007).

6 The weakness of an economic system results from all or many of the following elements: lack of a long-term vision; low competitiveness; lack of scientific and technology development, knowledge, and capacity in general; high concentration of income and welfare; low saving and investment capacity; weak physical infrastructure; unemployment; degree of informal economy; lack or inadequate management of natural resources; inadequate or inefficient institutional framework; weakness of the external sector, among others. There are five dimensions to this: knowledge, natural resources, social, economics, and politics.

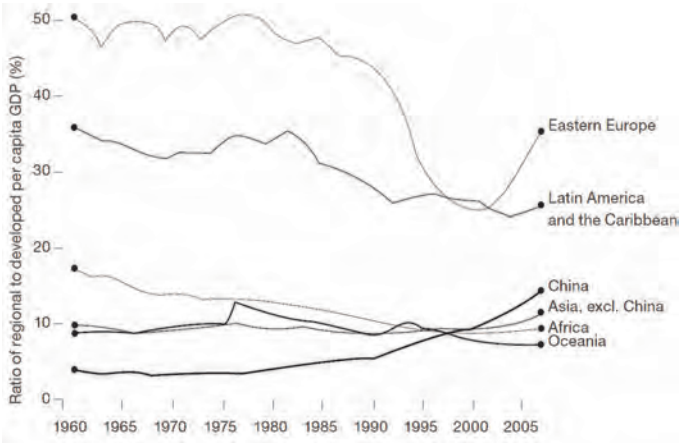


Figure 23.2 | Per capita GDP in relation to Organisation for Economic Cooperation and Development (OECD) countries. Source: UNDP Human Development Report, 2009.

affordable, and sustainable access to modern forms of energy requires an enabling macro- and microeconomic environment to guarantee such an ambitious target as universal access to modern forms of energy by 2030.

There is a clear relationship between low GDP per capita and low access to modern forms of energy. In addition, the disparity in per capita income between the richest and poorest of the world's nations has widened (Figure 23.2). According to UN Habitat (2011), nearly one billion people who live in slums lack both essential physical and social infrastructure. In this respect there has been a lack of convergence between the developed and developing world in the past 50 years, with some exceptions.

Without a significant growth in developing countries' real per capita income, ambitious targets on access to modern forms of energy will become hard to achieve. GEA pathways assume not only an important increase in GDP per capita of developing countries, but also a convergence among the developing and developed world (Chapter 17).

Improved income distribution, at both the global and domestic level, should go hand-in-hand with the creation of feasible, affordable, and universal access to modern forms of energy and cleaner cooking by 2030.

23.4 Key Challenges and Barriers to be Addressed by a Policy for Access to Modern Forms of Energy

The complex and multidimensional character of the development concept is broadly known, but qualifying it as sustainable makes the concept still more intricate. This is not just because it is hard to agree a universally acceptable and applicable definition, but because the dynamics of a largely complex system must be qualified. These multiple dimensions are strongly related to the reality of a specific socioeconomic system, in which they interact dynamically with each other.[7]

It is evident that the current situation may not be considered as socially sustainable, particularly given extremely low incomes and the challenges in accessing the most basic services, such as health, education, housing, and energy. In respect of energy, greater sustainability demands an understanding of the access to, and coverage of, basic energy services – in terms of both quantity and quality. This should include not just household needs, but the needs of essential services, such as health, education, and drinking water.

Energy policies should be consistent with policies on employment, income, foreign affairs, institutional structure, social objectives, environment, science and technologies, regional development, financing, to name a few. General policies influence the feasibility and effectiveness of sector policies, such as energy. There must be complementarity between energy strategies and other cross-cutting policies, other sector policies, and general development policy. They cannot be developed in isolation. And to be effective, they should include specific definitions of interventions and of the system as a whole.

In consequence, it is not sufficient to address energy access as a list of strategies and measures, but also as the need to establish the analytical framework by identification, through a diagnosis, of the barriers that should be overcome for universal access to modern forms of energy.

An evaluation of the extent of the challenge should note some of the key conclusions and recommendations of a UNDP/WHO (2009) report on the energy access situation in developing countries summarized below:

- The global development community must take specific and far reaching measures to massively scale up initiatives to expand access to energy services for poor and un-served people.
- The quantity and quality of statistical information related to energy access need major improvements and further efforts to address this need
- In order to expand access to energy services, especially cooking and heating services, as well as access to mechanical power in rural and remote areas, more dedicated and broad-based efforts are needed.
- The use of targets is a key to providing a framework for tracking progress and accountability. These targets, in turn, need to be part

7 Complexity and, in many cases, the unique conditions of the socioeconomic systems are a key reason to avoid the proposal of prescriptions that should run overall without taking into account national circumstances and specific factors of the energy system. Prescriptions in the energy policy of the type "one size fits all" promoted during the 1980s and 1990s and still today, are the best example of the consequences of ignoring the characteristics and conditions of the target systems.

of viable energy access strategies, backed by appropriate priorities, policies and programs, and financial resources, if they are to be realized.

- If massive efforts are not made to expand the range, quality, and quantity of energy services available to poor people, many countries – particularly those with large pockets of population with low rates of access to modern forms of energy, are unlikely to achieve their development aspirations.

Although electricity use has expanded and programs are in place to spread distributed generation technologies and modern fuels, often these efforts have been plagued by numerous problems, and the scale at which the growth is occurring is barely sufficient to keep up with a universal access to electricity and modern cooking fuels target by 2030. In many cases, the barrier exists in the policies themselves, along with the institutional arrangements that impact energy services. The importance of institutional factors for implementation and sustainability, especially in rural interventions, is widely cited (e.g., World Bank, 2008a; Green Nine, 2004).

The following section examines the importance of various challenges, and how they should be considered in defining policy objectives and strategies.

23.4.1 Political Failure

In general, a policy's failure to obtain the expected results is due to one or more of the following: failure of diagnosis through lack of information, failure to identify the barriers to be overcome or the main problems that the policy should address, or inadequate strategies, instruments, and measures to address the problems and barriers. Of course, lack of political will and government commitment to prioritize investment in energy should also be considered as a failure, or a short-term view of the energy system.

Planning and policy implementation are often based on inadequate diagnosis, which means no clear identification of the problems and barriers. Consequently, strategies, instruments, and measures fail to address the objectives. A proper analysis of why the situation is as it is and how it will evolve is vital. This is the most important phase of designing and implementing an energy policy. Even with decades of experience of the analysis of human needs, the approach to addressing energy use remains based on supply and technology. In general, the wrong question is asked: how can electricity or photovoltaic (PV) panels or other technology or energy sources help to facilitate access to energy? There are other questions that would need to be asked first. Which human needs are the ones that need to be prioritized? What role can energy play in meeting these needs? What is the best combination of technology and energy to meet these priorities? What is the capacity of target users to incorporate the sources and the technology? What other conditions would need to be put in place to ensure the proposed solutions' affordability and sustainability? How will demand change when access to modern forms of energy becomes a reality? Are the sources and technologies sufficiently flexible to address future needs? If not, what will be done? Attention would need to be given to the needs of the target populations and on the energy services to be provided.

Inadequate diagnoses are commonly related to a lack of clear understanding of the energy access situation in countries, including regional and national trends, rural/urban disparities, and the range of energy sources typically used in poor households, and are a barrier to a comprehensive situation analysis.

Biomass represents a major share of energy use by poor people in rural areas. It is collected at zero monetary cost, mainly by women and children, and therefore falls outside national energy accounts. In the formal statistical data bases, several times it becomes invisible. This invisible collection of energy source means that decision makers are rarely aware of its significance. Policies and strategies therefore fail to address the issue adequately.

Do policymakers have sufficient understanding of where to begin improving access? What improvements will be valued by poor households and communities? To answer these questions requires some understanding of how energy is obtained and used today and of future trends, both for final use and for productive activities. Also essential is knowledge of poor households' requirements for better energy services, and their willingness to pay for them.

Improving access to modern forms of energy for poor people will require greater attention on two fronts. First, policymakers and their advisers need to use as many energy data as are available to design strategies that, at least, do not close off energy options valued by poor people or distort incentives to supply and use better services. Second, they need to design policies and strategies that elicit access and energy use information effectively, to give enabling conditions for any proposed solution.

23.4.1.1 Availability and Use of Adequate Energy Access Data

Data collection on these issues was – and remains – weak. Of late, policy advisers and donor agencies have worked to improve their understanding of poor people's needs and to tailor actions to their preferences. But the data gap remains wide. Niez (2009) cites, "sound statistical data … and a clear description of the [energy services] situation" as the first precondition for successful rural energy access policies.[8]

8 This does not mean that the main barrier for energy access is lack of data, but in the absence of the real dimension and quantification of energy needs, the design and implementation of policies and strategies could have poor results in the actions proposed, the assessment of impacts and the effectiveness in addressing the priorities from the target population point of view.

Table 23.1 | Basic energy use in different bioclimatic zone.

Bioclimatic zone	Urban or rural	With or without access to electricity	Final energy use by household (kgoe)*	Useful energy use by household (kgoe)	Annual Electricity consumption by household (kWh)
Hot	Urban	With	243	124	1596
		Without	596	100	0
	Rural	With	658	131	1521
		Without	1069	130	0
Moderate	Urban	With	380	162	1492
		Without	706	151	0
	Rural	With	1034	170	1388
		Without	1451	174	0
Cold	Urban	With	606	262	1416
		Without	961	255	0
	Rural	With	2062	287	1353
		Without	2504	293	0

* kilograms of oil equivalent

Source: Bravo, 2004.

Available information shows that poor households rely on highly varied energy sources. They often incur real costs that are far higher than those for equivalent energy from, for example, electricity networks. Evidence suggests that poor people are, indeed, often willing to pay for more modern forms of better energy. Identification of this situation, and meeting that demand, therefore becomes a major challenge. Information as to the economic capacity to afford access to modern forms of energy is generally lacking.

A valid example is the estimation made for LAC on the quantification of basic energy services and the right to energy (Bravo, 2004):

> "Any quantification of basic energy services is space specific, time related, and influenced or determined by environmental and sociocultural conditions. It is not possible to fix global, regional, or national values for basic energy services. There are three elements around any energy service: human need, appliance or equipment, and energy source.[9] In basic energy services for household consumption, only indoor energy services are included.
>
> Basic energy services are lighting, cooking, water supply, water heating, space heating, and food conservation. The requirement for each energy service is determined by sociocultural conditions, urban, rural, or peri-urban localization, biogeographic and climatic conditions, access to energy sources, types of appliances available, building characteristics and family size, and other factors. In addition, the capacity, efficiency, and annual use of appliances determine the useful and net energy consumption.
>
> The total basic energy use estimated for different situations are summarized in Table 23.1. This demonstrates the importance of environmental conditions and access to an energy source, such as electricity. Of course, the structure of energy services differs by zone, urban, or rural location, and access to electricity.
>
> Similar studies could be useful to determine the amount of basic energy services needed to assume reasonable conditions of human dignity, and should offer a figure for the right to energy. A comparison with current levels of use in useful energy could be useful to measure the extent to which the needs are met and could feed into policy and strategy development."

There is substantial variation in energy use patterns, depending on climate, local fuel resources, the country's economic history, location (urban, rural, or peri-urban), and other factors (Box 23.1). Excessive focus on supply, along with incomplete understanding of the real and priority needs of poor households, can limit proposals for positive change.

Poverty often leads households to use a mix of energy sources that are suboptimal from the economic, financial, health, and environmental perspectives. They also tend to use less modern forms of energy than they would be willing and able to if supplies were commercially available at prices that are fair such that the suppliers are able to recover their costs. Such situations are often explained by an inability to afford the up-front costs of the appliances needed to satisfy the energy services, or the costs of connecting to grids, in the case of electricity.

Households in most developing countries are getting smaller and may have fewer wage earners, which reflects factors such as higher per capita incomes, smaller family sizes, greater access to education, and increasing urbanization. People living in these smaller households are less likely to be poor and therefore more likely to have disposable income to spend on modern forms of energy. But smaller households also mean that each new electricity connection may benefit fewer people than in

9 The energy services beyond the basic may be different combinations of appliances and sources.

Box 23.1 | Factors Relevant to Energy Access

Understanding what type of energy carriers and end use technology are available, who uses them, how much they cost, and the benefits they provide to users, are factors to consider when assessing energy access. For instance, energy access can include measures related to:

- The quality and quantity of energy provided. Data regularly collected by statistical agencies generally do not provide detailed information on the quantity (e.g., hours of use and availability) and quality (e.g., rated voltage and frequency) of the energy services provided, although these may be available from utilities and other sources.
- Energy end-use appliances and equipment and the services they provide. Data on the availability of certain household and agricultural equipment – lighting using different energy sources, water pumps, refrigerators, and different types of stoves – are available from some international surveys, and would be useful to collect, but are beyond the scope of this report.
- Socioeconomic profiles of energy users and energy affordability. Data on income levels and geographic location of energy users are often available from statistical agencies, but other socioeconomic data on users – prices of energy services, gender-disaggregated data, and disaggregation for key sectors such as businesses, schools, and health centers – may not be.

Source: UNDP/WHO, 2009.

the past. This has implications for the design of programs to increase access. Understanding how this will evolve in the medium and longer terms is crucial to generating reliable market estimates.

These findings come from partial analyses in various regions, and should be examined further and verified in region and country specific contexts before policies on access to modern forms of energy are developed and implemented. The absence of a good and reliable diagnosis could be a key barrier to the success of a policy or strategy.

23.4.1.2 Coherence and Convergence between Objectives and Strategies

To ensure coherence and convergence between objectives and strategies is a necessary, but not evident, issue in policy design and implementation.

The most recent policy failures, at least in addressing the social dimension of a sustainable energy policy, are the structural reforms implemented in the past 20 years in the electricity and in other sectors of the energy system. The emblematic role given to market forces, the private sector, and the transfer of decision making to decentralized stakeholders should be assessed in relation to the results and in how they helped or did not help to increase access to modern forms of energy. Reducing the governmental role in controlling and managing a strategic good such as energy is, indeed, a key issue for important consideration in this decision.[10]

Divestiture of public utilities and energy resources, changes in the regulatory framework, openness to foreign investment, and abandonment of long-term planning were just some of the strategies proposed and implemented as a panacea to promote sustainable development.

One rationale for the reforms was that they would enable increased access to modern forms of energy and even facilitate rural electrification (Bouille and Wamukonya, 2003). Injection of new capital and the increased efficiency that would come with the need for private sector returns was viewed as essential to create the infrastructure necessary to bring electricity to rural areas and shore-up existing distribution systems.

An in-depth GNESD (2006) [11] study explains that:

> "… the reasoning behind such initiatives was simple: streamlined and restructured energy sectors, being more efficient and less costly, would widen access to energy services and produce benefits for health, education, nutrition and entrepreneurship for all. In this context, the role of government is reduced to creating an enabling environment within which private sector mechanisms develop and provide services."

The failure was largely the result of a policy vacuum as far as the needs of poor people were concerned (GNESD, 2006). The key negative impacts on poor people include reduction in electrification rates and increased

10 A careful reading of the fundamentals and considerations in the laws that made reform possible demonstrates very similar arguments, and proposed an *urbi et orbi* approach.

11 The main values of the GNESD report are the broad representation of countries involved, deeper analysis made by centers of excellence of the countries or regions, the use of a common methodology, and a collection of common findings. The countries included in the analysis were Kenya, Uganda, Senegal, Mali, South Africa, Zimbabwe, India, Philippines, Thailand, Bangladesh, Vietnam, China, Argentina, Peru, El Salvador, and Brazil.

Table 23.2 | Comparison of results of analysis of selected indicators for the Argentina, El Salvador, and Peru case studies.

Selected indicators	Argentina		Peru		El Salvador	
	Pre-reform	Post-reform	Pre-reform	Post-reform	Pre-reform	Post-reform
Electrification levels (%)	91	95	38	62	62	76
Annual electrification rates (%)	2.04	1.03	7.8	5.8	6.6	4.1
Average household consumption (kWh/month)	155	205	136	106	104	112
Poor household lifeline tariff (USc/kWh)	4.35	11.77	6.8	17.2	4.8	8.6/16.8[12]

Source: GNESD, 2004.

tariff levels. See, for examples, some Latin American cases (Table 23.2). This was largely due to a "one size fits all" approach, whereby wholesale policy transfer was applied with little consideration for context, national circumstances, technical issues, or degree of development and maturity of the energy system.

The International Monetary Fund (2008) concluded:

> "As of 2006, more than 80% of sub-Saharan African countries had enacted a power sector reform law, 75% had experienced private participation in power, about 66% had corporatized their state-owned utilities, more than half had established a regulator, and more than one-third had independent power producers reform programs typically followed an orthodoxy that aimed at creating competition among private electricity suppliers, but few energy markets in Africa are large enough to support the multiple suppliers needed for a competitive environment. As a result, despite reform measures, utility performance continues to be disappointing and associated hidden costs can absorb as much as 2% of GDP."

If the proposal for future strategies follows the 1990s paradigm, some lessons learned could help to avoid the same mistakes, at least in the power sector:

1. Ring fencing, or protecting, the funds for providing electrification for poor people. In several countries funds have not been protected, Kenya being the best example. Brazil and South Africa emerge as model examples of how to ring fence. In Brazil, two important measures were implemented. First, the Electricity Act has made it mandatory for all electricity distribution concessionaires to contribute to the Global Reversions Reserve (RGR – Brazil) – the national electrification fund. Second, the allocation of funds for electrification by the Reserve was predetermined by region and matches the electrification needs of specific regions.

2. Sequencing of reform. Is it better to embark on wide-scale electrification of poor populations prior to privatization, or vice versa – privatizing and thereafter launching an electrification program? In countries where wide-scale electrification was undertaken prior to market-oriented reform such as privatization, notably South Africa, Zimbabwe, Mauritius, Thailand, and Philippines, a significant proportion of poor people gained access to electricity.

3. Explicit focus on poor people. With some exceptions, reforms in most countries examined in the Energy Access study (GNESD, 2006) did not focus explicitly on poor people. There are several ways in which reforms could ensure that poor people become a critical consideration of the reform process. Examples include Brazil, South Africa, and Bangladesh. One way to ensure that reforms explicitly focus on poor people is by enacting laws that ensure they gain access to electricity. This was the approach adopted in Brazil, which has three key laws that focus on poor people.[13]

4. Establishing dedicated institutions for poor people to have electrification is another way that reforms could ensure an explicit focus on poor people. This approach appears to have been successful in Bangladesh and South Africa. In Bangladesh, the Rural Electrification Board was established, with one of its key mandates being to widen access to electricity and to ensure poverty alleviation in rural areas (Shrestha et al., 2004a). In South Africa, the National Electrification Program was designed formally to target underprivileged groups under the apartheid regime, who constituted the majority of poor people.

5. Participation of poor people in the electrification process. Apart from ensuring an explicit focus on poor people, their involvement in the electrification process appears to be equally important. With the exception of South and Southeast Asian countries, there appears to be limited involvement of poor people in other regions covered by the Energy Access study (GNESD, 2006).

The key challenge is not to tie policies to paradigms that do not include a clear diagnosis of the national circumstances and the technical, socioeconomic, and cultural situation,[14] and to avoid

12 Depending on level of consumption and localization (rural or urban) the tariff range is between both figures.

13 Policy oriented to the poor during the Lula presidential period reduced the number of people living below the poverty line in Brazil by 30 million (Coutinho, 2007).

14 Proposals to introduce competition and unbundling in power systems that have less than 1000 MW of installed capacity are an example of the lack of logic in such a paradigmatic approach.

Table 23.3 | Urban and peri-urban key issues.

Category	Urban	Peri-urban
Institutional	Government representation, good infrastructure, single municipality, information systems	Absence of the state, poor infrastructure, unregulated land use, across different municipalities, poor information on land use and population growth
Land use	Regular settlements, vertical buildings, few better-off shantytowns	Many irregular settlements, many shantytowns, housing projects
Demographic	Low or negative population growth, job offers, older population	High population growth, unemployment, pressure over public infrastructure, younger population
Environment	Presence of parks, better sanitation and environmental conditions	Sanitation problems, deforestation, pollution of water sources, invasion of protected areas, landslides

Source: based on da Gama Torres, 2007.

prescriptions that appear as magic solutions without evidence of success in similar circumstances.

23.4.2 Population Dynamic: Urban and Peri-urban Access to Modern Forms of Energy

Urban energy, peri-urban energy, and rural energy make up part of the analyses of access to modern forms of energy, or the provision of adequate energy services. But is there a clear definition of each category? Is there common agreement on the meaning of each category? Which is the most challenging from the perspective of access to energy?

An urban area is characterized by a higher population density and many human features not found in areas that surround it. Urban areas may be cities, towns, or conurbations, but the term is not commonly extended to rural settlements, such as villages and hamlets. Internationally, the standard determinant of a rural area is population density. Therefore, rural areas are defined as those with low numbers of people who live on any given area of land.

However, the most challenging issue is the definition of peri-urban populations. In short, they could be considered as the transition zones, or interaction zones, where urban and rural activities are juxtaposed, and landscape features are subject to rapid modifications, induced by human activities.

For many African countries, peri-urban literally means the area around an urban settlement. It is distinctive in its diversity, with a mix of land uses and residents. It is rural in appearance, but many residents will have jobs in the nearby urban area to which they commute. Houston (2003), also cited by Buxton et al. (2008), defines the peri-urban areas on the basis of population density, employment in non-agricultural industries, and population mobility. Barr (2005) defines a similar region in terms of "rural amenity landscapes," by analyzing the relationship between rural land value and agricultural production value. Differentiation between urban and peri-urban conditions can be considered in various ways (Table 23.3).

Why are peri-urban areas important for access to energy? The challenge is twofold. First, agreement is needed on what peri-urban means. And second, population growth in developing countries is largely concentrated in peri-urban areas, which accentuates the key challenge of infrastructure development, including the energy infrastructure.

Population dynamics in developing countries show that an increasing share of the total population is found in peri-urban areas. In addition, a deficit exists in peri-urban information. The information deficit results from invisibility or the trend to ignore poverty. This refers to a situation in which policymakers are located elsewhere, where there is a lack of media coverage and focus, plus inadequate registration by urban information systems. This can lead to poorly located schools and healthcare facilities, crowded public facilities, the state's inability to regulate land use, and a lack of infrastructure such as water and energy.

Recognizing that urban, peri-urban, and rural situations imply different challenges, the peri-urban situation is the most complex. It challenges the planning of sustainable and affordable access to modern forms of energy. The multidimensional characteristics of peri-urban areas demand an integrated policy approach, including to energy access.

In relation to LPG, recent studies show different situations, all of them with the common issue of the need of intervention through public policies. There is a generalized situation of irregularity in the energy provision: LPG is not available in some places, it is expensive and the subsidized cylinder is found to be adulterated (Bariloche Foundation, 2008). LPG was found prominent in economically well-off households, however LPG had issues like affordability and delays in refill attached to it. Due to lack of awareness, LPG was perceived as a dangerous fuel. Access to biomass and kerosene was relatively easier than LPG or electricity as the latter required a valid residence proof and had higher upfront costs. Lack of awareness of the harmful effects of using conventional biomass stoves and lack of willingness to give up biomass usage due to its ease of access and the non-continuous supply of other fuels, were key factors driving continual usage of biomass even in households having other cooking fuel options. Kerosene was found to be the baseline fuel used in all households however due to factors like not-well-targeted subsidies, market distortions and need for ration cards to acquire it, and the fuel had accessibility issues (TERI, 2008). In spite of LPG not being a very common source of fuel among the urban poor population, trends indicate that its use and dissemination is steadily growing. LPG has a very high upfront cost which is normally beyond the reach of the majority of the urban poor. The overall cost of a simple cylinder with its related accessories is

approximately 10 to 15 times the national per capita income. This has greatly affected the dissemination of LPG mainly among the urban poor. In addition, although the cost of refilling the LPG cylinders is normally affordable and within reach of the urban poor population, the prices are dictated by the world oil prices which fluctuate from time to time. This causes uncertainty about its use within the target group. The safety aspect and reliability (volume found in each cylinder may vary substantially pertaining to the use of LPG is also of great concern among the urban poor (Karekezi et al., 2008)). In spite of LPG not being a very common source of fuel among the urban poor population, trends indicate that its use and dissemination is steadily growing.

The key access issues for the urban poor in the slums studied in Delhi were high upfront costs, insecurity of tenure of land and the lack of recognition and permanence of many slums in Delhi. Mistargeted subsidies, market distortions, lack of accountability on part of service providers and no monitoring mechanisms were identified as the other pressing issues hindering access. Broader issues included lack of database on urban poor and their energy use patterns, unclear institutional responsibilities and lack of policies targeting clean energy access to the urban poor (TERI, 2008).

Almost 85% of the world's urban population has access to electricity. Indeed, in some parts of the developing world, namely North Africa, East Asia (including China), the Middle East, and Latin America, the level of urban-energy access is nearly universal. About 95% of population growth over the next 30 years will occur in urban areas. Thus, fast population growth and urbanization and rising demand for electricity will exert tremendous pressure on infrastructures and create strong demand for new investment. Unless appropriate steps are taken to meet that growing demand, the urban poor are certain to lose ground in access to electricity.

In urban areas, extending electricity access to poor people is a matter first and foremost of getting the policies right. The infrastructure is generally already in place in most of the world's large urban centers, except in Africa. Therefore, energy companies need to make fewer new capital investments. But even with lower capital costs and higher incomes in urban areas, poor people still often cannot afford the connection fees or monthly rates – even if conditions in these areas are more favorable in terms of distance to the network and density of population. However, in addition to low incomes, other issues are crucial for a sustainable supply, notably at the management level and also the dubious legal status of many peri-urban settlements.

Consequently, supportive policies are needed that make service expansion to the urban poor sustainable. The problem of reaching poor people in urban areas generally requires a change in the mindset of urban utilities, as serving poor populations often calls for special policies, investments, and innovative technical and financial solutions.

Urbanization growth rates are surpassing national growth rates in many countries (Box 23.2). Many urbanites are settling in peri-urban areas, which are generally illegal. Planning for service provision, including modern forms of energy, tends to exclude such areas. Initiatives for service provision in such areas can be *ad hoc*, and have minimal impact. This is escalating poverty and crime in these areas, and retards development. At the very minimum, governments would need to provide regulatory guidance to enable access to energy services in peri-urban areas.

In recent years, several international forums have addressed the issue of peri-urban electricity problems (Rojas and Lallement, 2007). Poor people pay extremely high prices for electricity, often to illegal entrepreneurs. Often safety issues are ignored by such entrepreneurs and service levels are usually very poor. The solutions to these problems are not insurmountable. However, implementation has been lagging in many countries, and there is a need to address these issues more directly.

In addition, the lack of income may sometimes be more of a deprivation in urban than in rural areas. In the latter, poverty is usually accompanied by traditional or pre-modern ways of life. Access to energy through the use of firewood may be partially guaranteed, but in ways that are highly undesirable because of the effect on health and on the work of women and children, and also because of the correlation with other deficiencies, i.e. access to education, health services, and water.

23.4.3 Rural Energy and Electrification

Rural energy is a complex issue that encompasses a broad and diverse spectrum of resources – from petroleum fuels and coal to biomass and renewable energy – that spans multiple sectors, including forestry, electricity, and health. Many new projects are developing the technical capacity to tackle rural energy issues in all their complexity.

International agencies have sometimes taken short cuts to address this problem, and have advocated projects with a narrow technology focus. However, to focus on single technologies does nothing to develop markets, companies, or non-governmental organizations (NGOs) to support rural energy development. Such an arrangement is not conducive to solving the problem of universal access. Whatever experience is gained by a specific project cannot be applied to subsequent projects because of lack of continuity. Moreover, single efforts generally seek exceptions to regulatory policies, but are unable to change them. As a result, it is not possible to see the long-term effects of such projects in the form of greater access to quality energy services.

The development of rural energy policy institutions could provide advice and support for how to better focus the use of funds. Their role would be to promote sound policies for rural areas and innovative pilot projects. It must be understood that, for the most part, rural energy is an unprofitable business, because in many cases there are costs involved in market development that cannot be borne by private sector companies. However, by using a combination of loans and subsidies, both large- and small-scale businesses can become viable to better promote

Box 23.2 | Urban Poverty Today and Tomorrow

"Over the past half century, the world's urban population increased from around 730 million in 1950 to over 3.15 billion in 2005. Around 1 billion, or nearly one-third of the world's urban population, are now believed to be living in slum conditions. With virtually all population growth until 2030 taking place in urban areas, that number is likely to double.

In India, an alarming accompaniment to increasing population and urbanization has been the deepening of urban poverty, growth of urban slums, and the deterioration in basic service delivery. Slums in Delhi include informal settlements that are either squatter or illegal colonies where people live on undeveloped and unserved land without secure tenure or access to basic services.

In Argentina, over 13% of the population of Greater Buenos Aires lives in slums. Here, as in other cities, there is a parallel growth of rich, well-serviced neighborhoods and gated residential communities close to dense inner city or peri-urban slums that lack even the most basic of services. There is parallel growth of slums, country clubs, and closed wealthy neighborhoods (often with private security services). As slums grow even within the city, high-income housing seems to bridge these neighborhoods.

Kenya is experiencing very rapid urbanization. Over 40% of the population is urban, a figure that looks set to rise to around 50% by 2050. Around 34% of the urban population lives below the poverty line and income distribution shows a large disparity between poor people and non-poor.

In South Africa, urbanization is already ahead of the global trend. The 2001 census showed an urbanization level of over 56%, leading to major problems in terms of infrastructure, unemployment, and poverty.

In Thailand, people migrate from the countryside to urban areas in search of better employment opportunities and higher income: 81% of the dwellings in the Bangkok region house people who have migrated from other regions or slums. Most slums are in the city's core areas, but there are indications that this is changing with slums in core areas decreasing and new ones arising in urban fringe areas."

Source: GNESD, 2008.

a wide range of rural energy services, from LPG and grid electricity to improved stoves and tree growing. Moving forward requires a combination of research, production and delivery, support, and monitoring and evaluation, all of which must be done through a variety of businesses – including rural electric cooperatives, NGOs, private sector companies, and local municipalities – interested in serving rural energy customers.

In the case of electrification, the choice is between a large-scale infrastructure and the local delivery of energy. The current dominant development model focuses on achieving macroeconomic growth. This results in a predominance of attention to, and investment in, large-scale energy infrastructures to provide energy for growth. There is a need to redress the balance, with much more attention and investment directed toward the supply of local energy services for poverty reduction in local communities. A policy that takes account of both the infrastructure for energy development and energy access priorities is needed.

The rate of electrification in rural areas is very low, particularly in sub-Saharan Africa. This inhibits social and economic development in these areas. A combination of three drivers helps to explain this – the density and dispersion of population, the distance to the network, and the income of the population, all of which are particularly unfavorable in these rural areas. These drivers influence the decision between grid or off-grid rural electrification. The decision-making process would need to consider what inherent limits they place on the extension of the grid, as a way to motivate the use of off-grid approaches.

In rural electrification, the key financial barriers and challenges to attract both local and foreign private companies incorporate additional barriers to the issues mentioned (ACP-EU, 2009):[15]

- Rural electrification is often not a profitable business, and there will be limited interest in such activities from a purely financial point of view, in particular since many countries require that a nationwide uniform tariff be applied.
- As it can be politically unacceptable to raise tariffs, these are often not adequate for the financial sustainability of the economic models, for both national utilities and independent producers.

15 Although these statements are related to Africa, they are still valid for other developing regions.

- The investment capacity of national utilities is often limited, which restricts their ability to maintain the existing network and, in the best case, to create commercially viable grid extensions. The financial situation of these utilities is often weak through a combination of factors: inadequate tariffs, low levels of revenue collection (commercial losses), technical losses, inefficiency and obsolescence of the power systems through inadequate maintenance, low level of consumption, and low rate of interconnection, among others.

- Lack of financing schemes, or poor implementation of existing schemes, dedicated to increased investments in rural access, such as cross-subsidies between urban and rural areas, special levies to benefit rural electrification, and public guarantees for loans.

- Inadequate project size. Programs are often too small to be attractive to financing institutions and, even more so, to international private investors.

- Lack of interest from local banks for rural electrification because of a lack of knowledge and of confidence in this sector. This can be explained by the fact that local financing institutions are used to working in sectors they already know and whose risks they can measure and charge for, on a short-term period, and to working with established clients. Local loans are expensive and a short-term approach to financing is not suitable for financing long-term assets.

- Lack of credit-enhancement schemes, such as various bank guarantees and co-financing instruments for private investment in rural electrification.

- Risk of unmanageable escalation of exploitation costs, because of the higher price of fossil fuel, for example. Even when these can be included in the tariff, escalation may cause a loss of customers and a reduction of receipts, and therefore inhibit planned expansion.

- The exchange risk for imported goods, which are paid for with foreign currency but with receipts in local currency.

In summary, the two main challenges for financing rural electrification are:

- How to ensure the service's long-term financial viability.

- How to divide risks among stakeholders in a sustainable manner.

The choice of short, medium, and long term outlooks is another significant consideration. In the short and medium term, the only way to reach isolated households that do not have electricity is through single-household systems and small electricity providers, using both renewable and conventional energy sources.

Off-grid household programs in Bangladesh and Sri Lanka demonstrate that it is possible to implement large-scale, off-grid projects that complement strong grid-electrification programs (Govindarajalu et al., 2008). The challenges of off-grid projects in both countries have taken advantage of private sector institutions, NGOs, and microfinance institutions that operate in rural areas. Also, they have required centralized institutional support. In Sri Lanka, financing is provided though microfinance institutions, banks, and leasing companies for renewable energy systems that are provided by the private sector and NGOs. Today, off-grid solar home systems (SHS) and village microhydropower (MH) grids provide electricity to 3% of all Sri Lankan households (World Bank, 2008b). This solution would need to be considered as short term, because SHS consist of PV modules with capacities that range from 30–60 W_p watts and therefore offer limited access.

Small grid systems vary widely, from MH to locally generated private distribution. To grow and thrive, such systems often require external technical and financial support. The challenge is, therefore, to assure the program's affordability and sustainability. Off-grid electricity has the drawback of high cost compared to that of grid electricity in urban areas, along with low financial capacity or willingness to pay for modern forms of energy in many remote or rural areas where access is lacking.

Although their institutional forms vary, successful grid-extension programs generally require financially and technically strong utilities.[16] To ensure sustainability, distribution companies must address the issue of increased technical losses and low revenues creatively, or with the introduction of cross-subsidies. In Jujuy, Argentina, for example, the utility reduced fixed costs by creating two companies, with a common management, for the grid and off-grid electricity public service. This minimized the need for government subsidies. The extension of cooperative electricity has been successful in Argentina, Bangladesh, and the Philippines.

23.4.4 Scale of Investment for Universal Access: Scenario Target

The GEA pathways carried out in Chapter 17 sought to assess options on how to achieve 'almost universal access to electricity and modern cooking fuels by 2030'.[17] This includes the diffusion of clean and efficient cooking appliances, extension of both high-voltage electricity grids and decentralized microgrids, and increased financial assistance from industrialized countries to support clean-energy infrastructures. The costs of almost universal access estimated by GEA are substantial, some US$36–41 billion/yr until 2030.

Several estimates have been made for the cost of universal access to energy services at the global, regional, and project levels (Table 23.4). In general, estimates focus on electricity – fewer data are available for fuels

16 See Barnes (2007), for more examples.

17 The target is "almost universal access" because reaching the remotest rural populations is exceedingly expensive and urban electrification costs are not included.

Table 23.4 | Cumulative investments to facilitate access to modern forms of energy.

Geographical focus	Goal	Cost estimates (billion US$)		Source
		Electricity	Cooking	
Global	Universal energy access	700 [i]	56	OECD/IEA (2010)
	Improved access to reach MDG 1	223	21 [ii]	OECD/IEA (2010)
	Universal energy access	35–40/year [iii]	39–64 [iv]	AGECC (2010)
	Universal electricity access	~55/year	1.8/year	Saghir (2010)
	Universal electricity access	35/year		IEA (2009)
	Improved access to clean cooking [v]	858		Birol (2007)
	Universal electricity access [vi]	200		World Bank Group (2006)
	Improved electricity access to reach the MDGs	665		IEA (2004)
	Universal electricity access			IEA (2003)
Regional/local				
Africa	Improved electricity access [vii]	17/year [viii]		African Development Bank (2008)
Sub-Saharan Africa	Improved energy access	6–15/year		BREW-Hammond (2010)
	Increase household electricity access to 35%	4/year		UN-Energy/Africa (2007)
East African Community (EAC)	Improved energy access [ix]	1.5	0.262	East African Community (2006) [x]
Economic Community of Central Africa States	50% electrification	1.45		CEMAC (2006)
Economic Community of West African States (ECOWAS)	60% electrification, 100% improved cooking fuels, access to mechanical power in 100% of villages	2.1	2.8	ECOWAS (2005)
South Africa	Electrificacion	US$1000 per connection [xi]		Eskom (2009), Niez (2009)
Kenya	Electrification	US$1900 per household [xii]		Parshall et al. (2009)
Botswana	Electrification	US$1100 per household [xiii]		Krishnaswamy and Stuggins (2007)
Mali	Rural electrification	US$776 per connection [xiv]		AMADEER, quoted in Foster et al. (2010), p. 199
Senegal	Increased electrification rate from 47 to 66%	0.86		ASER (2007)
Bangladesh, Cambodia, Ghana, Tanzania, and Uganda	Improved energy access in line with the MDG targets	US$13–18 per capita/year [xv]		Sachs et al. (2004)
South Asia	Universal access to LPG		449	IIASA [xvi]
Brazil	Promoting LPG access to underprivileged households		0.5 [xvii]	Jannuzzi et al. (2004)
(Unspecified)	Electrification	Above US$1200 per connection [xviii]		Practical Action (2007)

[i] Including both rural and urban grid connection, generation, transmission, and distribution; minigrid generation and distribution; off-grid generation.
[ii] Including advanced biomass stoves, LPG stoves, and biogas systems.
[iii] Based on IEA (2009b).
[iv] Improved cookstoves, 11–31; biogas, 30–40; LPG, 7–17. Includes capacity-development costs.
[v] LPG cylinders and stoves to all the people who currently still use traditional biomass.
[vi] Includes breakdown by major regions.
[vii] Reliable electric power to 90% of sub-Saharan rural population, 100% of the sub-Saharan urban population, and 100% of the both the rural and urban populations in the Northern African middle-income countries.
[viii] Considering only new generating capacity, including generation as well as transmission and distribution.
[ix] Reliable electricity for all urban and peri-urban poor; modern cooking practices for 50% of population currently using traditional cooking fuels; energy services for all schools, clinics, hospitals, and community centers; mechanical power for heating and productive uses for all communities.
[x] Including capital expenditure, programs, and loan guarantees.
[xi] The average is expected to increase as the electrification process moves to communities in more remote rural areas.
[xii] Average cost per household in a so-called realistic penetration scenario, with US$1500 and US$2615 for infilling and grid extension, respectively; based on modeling of grid extension.
[xiii] Based on project experience.
[xiv] Based on project experience from AMADER (Agence malienne pour le développement de l'énergie domestique et l'électrification rurale).
[xv] Including costs of end-use devices, fuel consumption, electrical connections, and power plants.
[xvi] Updated analysis based on the methodology described in Ekholm et al. (2010).
[xvii] Subsidies for LPG access to underprivileged households in 2003.
[xviii] New connection to electricity, based on case studies, varies from country to country, and can be as much as US$6000 in some cases.

Source: Bazilian et al. (2010) and references therein.

for caloric uses. A recent report summarized a wide range of estimates (Bazilian et al., 2010). Electrification costs range from US$5–40/capita/yr, "reflecting the large uncertainties associated with such evaluation and the sensitivity to certain assumptions." The report suggested a general underestimation of the financial effort to satisfy universal access to modern forms of energy. Most estimates consider only capital costs and do not include fuel and operation and maintenance (O&M) costs.

Several issues influence the results. The most important include the combination of grid, off-grid, and minigrid in the structure of the system, population density, urban and rural population mix, annual level of consumption per capita, and mix of generation technology and generation fuel.

For mechanical power, the available information is very poor.

The annual costs for universal electrification vary between US$12–134 billion/yr, accordingly to per capita annual consumption estimates.[18] Total estimates, including those for cooking, run from US$14–135 billion/yr. Many of the countries that require the most effort to achieve universal access are those with GDP per capita less than US$1000, a range in which lie many of the LDCs with low access to modern forms of energy.

The question is not only how much the global investment would need to be or how high the other global costs are, but where the investment has to be made, and recovered, taking into recognition the economic capacity of the target population and of the country as a whole.

Table 23.5 is a preliminary indicator of the required effort, only in terms of investment, by some developing countries if they are to satisfy universal access by 2030. Considering figures of Table 23.4 and depending on the family size, the cost of connection to electricity could be up to two times the annual income of the household.

The magnitude of the resources involved and the need to recover them during the lifetime of the investment is, perhaps, the major challenge for some developing countries.

23.4.5 Funding Gap and Financial Constraints

The great majority of people without adequate access to energy live on less than US$2/day, which makes it difficult for them to access good services, including energy services. Energy access is not without cost and the initial expenditure on electricity connections or better technologies can be high. A large funding gap in providing energy access for poor people has not been addressed seriously by existing financial mechanisms and financing institutions.

Table 23.5 | Population without access to electricity and Per Capita GDP – some Sub-Saharan African Countries.

Country	Share of population without electricity access (%)	GDP per capita 2008
Burundi	97	138
Liberia	97	216
Chad	97	863
Rwanda	95	465
Central Africa Republic	95	459
Sierra Leone	95	332
Gambia	92	497
Malawi	91	313
Uganda	91	455
Niger	91	391
Burkina Faso	90	578
DR Congo	89	185
Guinea-Biassau	89	264
Tanzania	89	520
Mozambique	88	477
Kenya	85	660
Ethiopia	85	657
Lesotho	84	1248
Mali	83	468
Zambia	81	436
Madagascar	81	439
Togo	80	828
Guinea	80	1224
Benin	75	216
Cameroon	71	863

Source: UNDP Human Development Report, 2010.

Lack of access to (affordable) capital in many countries is a problem that exists at every scale, from national governments and large utilities through to households. Until the 1990s, most developing countries relied on the international financial institutions, the World Bank, and regional development banks for investment in the energy sector. However, during the 1980s the World Bank promoted private investment. Countries responded by reforming the sector and initially private investors moved in, especially into the larger economies. However, not only did private funds start drying up in 2000, but most investors generally avoided additional generation capacity, which contributed to power and economic crises, as evident in Brazil (Bouille and Wamukonya, 2003; Millán, 2006; Woodhouse, 2005).

The level of success in private sector financing has been rather limited. In Africa, for example, private sector financing accounted for an average

18 Low, urban 100 kWh/cap and rural 50 kWh/cap; medium, urban 456 kWh/cap and rural 152 kWh/cap; high, urban 456 kWh/cap and rural 360 kWh (Bravo, 2004). See also the reference for the estimation of basic energy services for LAC.

Box 23.3 | Private Activity in Energy Reaches a Record High

In 2009, there were 139 energy projects with private participation that reached financial or contractual closure in 21 low- and middle-income countries, involving investment commitments of US$58.5 billion. In addition, energy projects implemented in 1990–2008 attracted new investment of US$10 billion, bringing a total investment commitment to the energy sector of US$68.5 billion in 2009.

Private activity, however, was concentrated in just a few countries and electricity generation projects. Brazil and India accounted for 67% of investment and 43% of new projects, and for all of the growth in private activity in 2009. Electricity generation accounted for 79% of investment and 80% of new projects. 100% of the non-electricity projects were in China, while Chinese electricity projects focused on the grid and mainly BOT or BOO systems.[19]

In East Asia and the Pacific, two countries (China and the Philippines) implemented 22 new projects that represented US$7.6 billion in investments. China had seven natural gas distribution projects and five power plant projects with a total investment of US$3.1 billion. The Philippines implemented nine power plants (mainly divestitures[20]) and a concession for the national electricity transmission company, with a total investment of US$4.5 billion.

In LAC, four countries (Brazil, Chile, Costa Rica, and Peru) implemented 43 new projects that represented US$20.5 billion in investment commitments. Of these projects, 31 were for electricity generation and 12 for electricity distribution. Most projects and investments were located in Brazil: 26 power plant projects and 11 electricity transmission projects, representing US$19.4 billion investment. In addition, investment commitments to projects implemented previously in the region came to a total of US$4.6 billion.

In South Asia,[21] four countries (Bangladesh, Bhutan, India, and Pakistan) implemented 38 new projects with a total investment commitment of US$22.4 billion. Thirty-five of these projects were power plants along with three electricity transmission lines. Most activity took place in India with 23 projects and US$21.0 billion in investment. In Pakistan, 11 power plant projects reached financial closure, eight of which were emergency rental power plants. Additional investment in previously implemented projects in the region totaled US$2.2 billion.

In sub-Saharan Africa, four countries (Ethiopia, Kenya, Liberia, and Uganda) implemented five electricity generation projects that represented US$212 million in investment. Three were emergency rental power plants in Ethiopia and Kenya, while the other two were the Kakata power plant (a waste-to-energy project) in Liberia and the Buseruka hydropower plant in Uganda.

In addition to the 139 projects that reached financial or contractual closure in 2009, at least 124 projects were awarded throughout the year, but did not reach closure by December 2009. Those projects were distributed across the regions, with 41 in East Asia and the Pacific, 19 in Europe and Central Asia, 44 in LAC, 16 in South Asia, and four in sub-Saharan Africa.

Source: World Bank Group (2010).

of just US$300 million/yr over the decade 2000–2010, against a total requirement of US$4 billion/yr. The sustainability of private sector players has been minimal, with many exiting within a few years of their entry.

Overall, private sector investment in the energy sector has accounted for 15.6% of the total private sector participation in sub-Saharan Africa from 1990 to 2006 (World Bank Group, 2010). Nearly all this investment has been concentrated on national – and hence urban – needs. Attracting the private sector into rural areas has proved to be extremely difficult (see Box 23.3 for a summary of private investment in developing countries).

The conclusion from the Private Participation in Infrastructure Database of the World Bank (World Bank Group, 2010) is that there is no evidence to date on the role that the private sector could play in improving access to modern forms of energy, particularly in rural areas. Consequently, the

19 BOT = build, operate, and transfer; BOO = build, own, and operate. This system, in general, means that price and quantity is guaranteed by the government, and there is no risk.

20 Divestiture means that they were not new investment, only the transfer of property from the public to the private sector.

21 South Asia is one of the regions with the lowest level of access to electricity and is, at same time (according to the data of the World Bank), the region with the lowest investment from the private sector in electricity.

task of bringing in private capital and moving from rhetoric to reality remains a major public policy challenge.

A further factor that hinders access to modern forms of energy is the high up-front cost. Subsidies have been used, but it is evident that they are not always sufficient to enable poor rural and peri-urban populations to access modern forms of energy just because subsidies address energy costs, but not capital costs related to the equipment necessary to satisfy energy services.

Electrification access is also hindered by the initial connection and operational costs. Local energy entrepreneurs face a capital access problem in trying to establish businesses to meet rural energy needs. In particular, banks have a difficult time assessing the risks of these loans.

23.4.6 Capacity, Management, and Institutional Gap

Managing the process of delivering energy services for poor people requires ample public institutional capacity, specifically at the subnational and local/community levels. These include:

- analytical ability to create district-level rural energy policies and plans that are appropriate to specific locations and are, at the same time, aligned to national energy access visions, targets, and budgetary allocations;
- ability to manage financial resources transparently and accountably;
- technical capability to guide, regulate, and train non-state implementing actors (e.g. local NGOs) to initiate, deliver, and manage energy systems, energy services, energy users, entrepreneurs, and small-scale energy financing institutions; and
- ability to collect and manage data to establish a baseline and to monitor ongoing performance.

The current reality is that the majority of public institutions in developing countries have only limited capacities to handle these tasks. Moreover, a prevailing vacuum in institutional platforms for the delivery of energy services at the local level is often transferred to the national level, which makes capacity development efforts uncoordinated and often ineffective, thereby exacerbating efforts to scale up the programs.

Furthermore, without these capacities, transaction costs and operational risks increase considerably for potential actors, particularly private actors, to invest in energy activities in rural areas. This restricts their business opportunities and, at the same time, deprives rural people of access to modern forms of energy to meet basic human needs.

Institutional, systemic, and individual capacity developments – along with reinforcement of many different stakeholders' existing capacities – are needed if the energy system is to be instrumental in bringing about sustainability. In a broad sense, capacity refers to the ability of individuals and institutions to make and implement decisions and perform functions in an effective, efficient, and sustainable manner (UNDP, 1994). This definition has three important aspects. First, it indicates that capacity is not a passive state, but is part of a continuing process. Second, it ensures that human resources, and the way in which they are utilized, are central to capacity development. Third, it requires that the overall existing context and functions of organizations be a key consideration in designing strategies for capacity development (UNCED, 1993).

A UNDP study, related to energy access in rural areas (UNDP, 2010), report on experiences from Nepal that showed that the focus needs to be on: "(1) planning, oversight, and monitoring; (2) policies and regulations; (3) situational analysis; (4) stakeholder dialogues, communication, and community mobilization; (5) setting up and enhancing institutions; (6) training program implementers and community members; and (7) implementation and management" and remarks that "developing capacities in all these areas is essential for making the scale-up of rural energy access a reality." In addition, a key conclusion is that "Upfront public investments are needed to develop national and local capacities for scaling up rural energy services delivery, and can catalyze private financing."

The challenges require innovative answers to old and new problems. They also require a search for more flexible and pragmatic strategies, approaches, tools, instruments, and action to obtain results in a new framework. The new operating environment in which energy solutions must be found suggests a new and essential role for government in terms of its responsibilities to make markets and the energy system work to satisfy, among others, the objective of universal access to modern forms of energy.

23.4.7 Gender and Energy

Inequity along gender lines is one of the main factors that drive the establishment of gender focused programs (see Chapter 2). The issue is predominantly a phenomenon of developing countries, and the gender and energy approach is justified on the basis that women's end uses of energy is different to that of men, and that providing energy to women will improve their livelihoods.

This approach has resulted in interventions that focus more on energy than on the service, and more on the woman than on her context. As such, the technological approach (UNDP, 2004), namely improved biomass stoves, ethanol stoves, or solar homes systems, taken in isolation of the development context, may achieve only marginal results.

The challenge, and the reason that this chapter does not give a particular focus to the gender perspective, is to recognize that access to

modern forms of energy (and the energy problem in general) is not a household or gender-specific problem, but a development issue related to poverty and inequity. This shift acknowledges and calls for a paradigm change toward a full understanding of the macro- rather than the micro-development framework. Such a program, rather than the project-funding approach advocated and implemented by donors, could offer a good start if planned in a down–up approach in which local sector staff are involved in structuring from the outset.

Is the problem of gender in developing countries related to low income? The gender and energy approach is justified on the basis that women use energy differently from men, and that providing energy to women will improve their livelihoods. Some have also argued that energy is a basic good, implying that women are entitled to it as much as to health and education. There are arguments against energy as a basic good, but as an important input for satisfying basic needs.

The gender and energy approach focuses on the impacts suffered by women in gathering firewood. The doubt is, though, that by contextualizing and defining the energy problems from such perspectives, the approach may have masked the real issues and misdirected resources. Energy is an input to development, but an insufficient condition for development. Wamukonya remarks, "that women suffer energy problems maybe the case. That they are experiencing these problems merely because they are women is subject to debate. While there may be traditional cultural factors tying women to certain tasks, and hence curtailing employment mobility and flexibility, improvements in income levels are particularly important in determining the relationship between energy and women. In households with higher income, women can employ men or women to procure energy and where alternative modern forms of energy carriers are available, they switch to these fuels."

The challenge and remaining doubt is if the gender and energy issue and gender equity is an energy problem or a much broader socio-cultural and economic challenge. Apparently, the approach has to have a broader view than to look only for ways to substitute biomass for cooking.

The challenge, and the reason that this chapter does not go deeper on the "energy gender perspective," is to recognize that access to modern forms of energy (and the energy problem, generally) is not a household or gender-specific problem, but a development issue that is related to poverty and inequity.

This shift acknowledges and calls for a paradigm change towards a full understanding of the macro rather than the micro development framework. The program rather than the project funding approach, being advocated and implemented by donors, could offer a good start if planned in a down-up approach where local sector staff are involved in structuring from the outset.

23.4.8 Climate Change, Green Economy, and Poverty

For billions of people struggling with poverty, access to affordable energy services is of higher priority than climate change. Evidence suggests that increasing energy access to poor people would entail a small increase in the level of emissions[22].

It is expected that additional electricity will be, partially, centralized generation, partially mini-grid solutions and the remaining by isolated off-grid solutions. In the case of mini-grid and isolated off-grid, the majority should be provided by renewable.

Given that the priority objective is poverty alleviation through access to modern forms of energy, it would be more useful to look for synergies and convergence with global objectives of climate change and clean energy. Looking for a convergence and win-win actions in energy access, climate change, and poverty alleviation, GNESD has summarized some key findings in policy papers. These include:

- diversifying energy generation sources, with a wider mix of energy sources;
- promoting proven renewable energy technologies for electricity generation; and
- setting renewable energy targets in the energy mix.

Such measures could be a major contribution to reducing vulnerability to climate change and at the same time improve access to energy.

23.4.9 Decision Making under Uncertainty

Despite decades of rural energy programs, interventions, and research on rural energy, a number of gaps remain in our understanding of the dynamics of energy choice of poor households and the welfare impacts of access to modern forms of energy. This has made it more difficult to create sound public policy and to mobilize efforts that sufficiently and appropriately address the problem.

The report by UNDP/WHO (2009) remarks that "understanding what type of energy carriers and end use are available, who uses them, how much they cost, and the benefits they provide to users, are factors to consider when assessing energy access." As mentioned before, to solve such uncertainties a clear diagnosis is needed.

22 World Energy Outlook 2011 devoted a special chapter named "Energy for All: financing access for the poor." According to such report "achieving the Energy for All Case requires an increase in global electricity generation of 2.5% (around 840 Twh)…" "in 2030, CO_2 emissions in the Energy for All Case …are 0.7% higher than in the Baseline Scenario." The figures include LPG to replace Biomass in cookstoves.

There is a lack of information, especially based on field studies, on the quality and quantity of energy used and provided, energy end-use appliances and equipment, and the services they provide, as well as the socio-economic profile of energy users and energy affordability. Examples of this problem include:

- Costs and benefits of modern cooking fuels. Many programs and projects are justified on the basis that the benefits outweigh the costs. For clean cooking fuels, the costs include all the capital and programmatic costs, while benefits range from improved health outcomes that impact household finances to the impact on the health-care system itself. A recent set of reports and guidelines from UNDP/WHO (2009) has helped clarify how to estimate these costs and benefits, and has provided a global set of estimates. But much work remains in refining the methods and determining these values in particular circumstances.

- Ability versus willingness to pay for energy services. It is common to find projects and programs based on consumers' willingness to pay. However, the outcomes tend to demonstrate that this is a misinformed approach, as ability and willingness differ in reality. For example, the ability of poor people to pay for SHS is often based on theoretical calculations of the savings they would make by not buying kerosene. Yet reality shows that outlays on purchasing kerosene are made in small amounts and income restrictions act as a barrier to making periodically structured payments toward SHS (Green Nine, 2004).

- Opportunity costs of biomass collection. The time spent by households in collecting biomass is assumed to have an opportunity cost, because that time could be used on other activities, such as income generation or education. However, to determine the value of that opportunity cost and how it plays into households' decisions is still an active area of inquiry (Campbell et al., 1997; Arnold et al., 2003, 2006).

Therefore, estimates of benefit and potential penetration are based on theoretical or on controlled experiments and not on reality, or from taking a social[23] instead of an economic approach as the framework for estimating benefits. In many cases, inadequate knowledge and diagnosis results in poor estimations.

23.4.10 Oil Price Volatility

Crude oil prices behave much as any other commodity. They experience wide price swings in times of shortage or oversupply, through political instability, and for many other reasons (see Chapter 5). The crude-oil price cycle may extend over several years in response to changes in demand, as well as Organization of the Petroleum Exporting Countries (OPEC) and non-OPEC supply.

Since 1973, crude oil prices have swung wildly. They reached levels that few predicted and then dropped precipitously, before rising again and falling in response to global economic crises. This has a direct impact on low-income energy services.

Most rural and peri-urban populations rely heavily on kerosene or LPG. Indirectly, the prices of other goods they depend on are influenced by oil prices. Developing countries are notably more dependent on imported oil and oil products. Many countries subsidize oil to keep the products affordable.

Also, escalating and unpredictable petroleum prices have placed many countries in a dilemma on how to protect the poor communities. The costs of direct subsidies are, in many cases, unsustainable. The recent instability in the price of petroleum fuels has, in some cases, actually caused households to switch back to traditional fuels.

Oil-exporting countries like Venezuela, where the market is controlled by the public utility Petróleos de Venezuela, S.A, do not fix domestic prices and consider the opportunity cost based on international prices. A similar situation is given in Ecuador, where Petroecuador controls the domestic market.

In Nigeria, the structural reforms implemented during the 1990s, including privatization of the state oil company, increased deregulation of petroleum prices, and domestic crude-oil allocation to the Nigerian National Petroleum Corporation would be paid for at export parity with immediate effect. The objective was to attract investment from international oil companies and improve profitability. Also, using the case of Nigeria and analyzing the impact of oil-price volatility, Moser et al. (1997) arrived at the following conclusion:

> "Inflation rate depend on shocks to output and the real exchange rates. However, the findings demonstrated that fluctuations in oil prices do substantially affect the real exchange rates in Nigeria. Also, it was found out that it is not the oil price itself but rather its manifestation in real exchange rates and money supply that affects the fluctuations of aggregate economic activity proxy, the GDP. Thus, we conclude that oil price shock is an important determinant of real exchange rates and in the long run money supply, while money supply rather than oil price shocks that affects output growth in Nigeria."

This is another example of the impact of the policies of liberalization, privatization, and deregulation implemented during the 1990s (Moser et al., 1997; Onayemi, 2003; Olomola and Adejumo, 2006).

Some countries, such as Chile, China, and Indonesia, have used direct cash transfers to cushion poor households against petroleum price hikes. However, most developing countries can ill afford such measures.

23 Considering the benefit for the economic system as a whole, but also the direct benefit that the target population involved in the project will receive (economic benefits).

23.4.11 Final Remarks on Challenges

It is neither our intention nor possible to cover all the challenges and barriers to access to modern forms of energy.[24] National circumstances, specific conditions, drivers related to the target population, energy chains addressed (electricity or oil products and natural gas), the organization of the energy system (public, private, mix), institutional structure (policy authorities, regulatory bodies), constitutional aspects (property rights on natural resources), and availability of energy sources are just some of the challenges.

The initial challenge is to avoid defining a policy approach based on ideological preconceptions[25] or preconditions, because they leave aside or ignore potential solutions. Strategies, instruments, measures, and actions need to be the consequence and result of adequate analysis, and offer a pragmatic path toward affordable access to modern forms of energy.

It is important to be as accurate as possible in estimating costs. An underestimate gives a false notion of what is possible within a given period. Estimates and, consequently, the achievement of targets will depend on proper understanding of the relationships between the investment needed, the economic capacity of the country, the financial instruments, and the capacity of the target population to afford the costs.

A third set of challenges is found in the capacity to design and implement public policies, along with a lack of information about the energy services to be addressed in terms of quantity, quality, location, time, logic, and means.

Rapid urbanization, both historical and current, poses a further challenge in agreeing where, how, and what type of infrastructure should be developed. There are sociocultural issues related to the behavior of rural populations moving to peri-urban areas and maintaining their rural customs to satisfy energy services. The increasing and different needs of urban and rural environments, along with the prerogative to keep rural populations in rural areas, are among the challenges that would need to be part of any public policy process, along with the objective of meeting human needs.

Robust decision making in public policies is another key challenge in the quest for feasible measures and actions. The volatility of oil prices,[26] however, brings uncertainty to the equation. Oil products are immediate, feasible, and natural substitutes for biomass and other caloric energy services. In many countries, oil is the main source of energy for power generation. Ethanol and biogas may be considered as options, but massive development in the production of such energy sources and associated appliances must be put in place immediately if they are to represent a solution for the 2.7 billion people using solid biomass as their main source of energy for cooking.

23.5 Introduction Regional Analysis

Although the aim of GEA, and of this chapter in particular, is to approach the global problem of access to modern sources of energy, the specific situations and realities of each region and country cannot be ignored. The magnitude and characteristics of the problem, the underlying reasons, the national and regional contexts, the current and historical circumstances that have influenced the situation, the policies and strategies that have contributed to solving problems (or, in some cases, to aggravating them), the socioeconomic structures, and the characteristics of energy systems, to cite only some of the many dimensions, necessarily imply that suggestions or recommendations would need to take account of the different realities and potentials. It is important to avoid the mistakes of the recent past, such as promoting particular institutional models without appropriate consideration of the peculiarities of the individual environmental, socioeconomic, and energy systems.

Section 23.4 identifies some of the principal challenges and barriers to meeting the objective of universal access to energy by 2030. It is important to prioritize a full understanding of the unique characteristics of different regions and countries.

The lack of access to modern sources of energy is dramatic in most sub-Saharan African countries and in much of South Asia and other Pacific Asia (Table 23.6). In these regions, the national and regional response capacities are different from those in LAC, where more

Table 23.6 | Electricity and human development (2008).

Concept*	Africa	Asia	LAC
Average kWh/capita	540	847	1806
Average electrification rate (%)	29	61	84
HDI high (% of population)	4	7	38
HDI medium (% of population)	48	93	62
HDI low (% of population)	48	–	–
Average GDP/capita (PPP-US$)	3101	4161	7859
GDP/capita ratio†	19	11	8

* HDI, Human Development Index; PPP, purchasing power parity.
† Relation between the GDP per capita of the richest and poorest countries in the region.

Source: Based on information from UNDP, 2011 and World Bank Group, 2011.

24 The energy systems have multiple dimensions as part of their own nature. Environmental, national constitution, and legal frameworks, sociocultural, economic, strategic, institutional, political, human health, security, technological, temporal, and energy reserves are the key dimensions addressed in different ways in different countries.

25 Such as "a free market is the best way for an efficient allocation of resources" or "private sector contribution is the only way to address access to modern forms of energy."

26 In many cases oil prices act as reference prices for the other energy sources (renewable and non-renewable).

Box 23.4 | Access to Modern Forms of Energy

"Access to energy services is still low in developing countries and this lack of access disproportionately affects the least-developed countries (LDCs) and sub-Saharan Africa.

- Three billion people – almost half of humanity – still relies on solid fuels: traditional biomass and coal. In LDCs and sub-Saharan Africa, more than 80% of people primarily rely on solid fuels for cooking, compared to 56% of people in developing countries as a whole.
- Two million deaths annually are associated with the indoor burning of solid fuels in unventilated kitchens. Some 44% of these deaths are children; and among adult deaths 60% are women. In LDCs and sub-Saharan Africa more than 50% of all deaths from pneumonia in children under five years and chronic lung disease and lung cancer in adults over 30 years can be attributed to solid fuel use.
- Access to improved cooking stoves is also very limited. In LDCs and sub-Saharan Africa, only 7% of people who rely on solid fuels use improved cooking stoves to help reduce indoor smoke, compared to 27% of people in developing countries as a whole.
- One-and-a-half billion people are still living in darkness – over 80% of them in South Asia and sub-Saharan Africa. More than 70% of people in LDCs and sub-Saharan Africa lack access to electricity, compared to 28% in developing countries as a whole."

Source: UNDP/WHO, 2009.

favorable macroeconomic conditions, development levels, maturity of energy systems, and contexts of regional cooperation offer a better framework in which to implement and succeed with oriented policies.

Access to electricity also varies dramatically among countries in the same region. For example, in LAC, 62% do not have access in Haiti, but only 2% lack access in Brazil. In sub-Saharan Africa, in countries such as Chad, Liberia, and Burundi, more than 95% of people lack electricity access, while only 25% are without access in South Africa, and less than 1% in Mauritius (Box 23.4).

Access to modern fuels for cooking, meanwhile, also varies dramatically among developing countries in the same region. In Asia, for instance, less than 10% of people in Bangladesh have access to modern fuels, but access is almost universal in Malaysia. In sub-Saharan Africa, less than 1% of people in Burundi, Liberia, Mali, Rwanda, Somalia, and Uganda have access to modern fuels, but 83% of people in South Africa have access.

There are significant differences in the availability, control, and management of energy sources among regions. The roles of the public and private sectors differ substantially within the same regions. Systemic, institutional, and individual capacities to implement policies and strategies are not the same. A long history of intervention by public utilities and governments in many LAC countries, for example, implies a different culture and approach to energy issues than in countries without such experience.

23.6 Africa Review: Successes, Failures, and Proposals

23.6.1 Introduction

In Africa, access to energy services varies greatly between regions, between rich and poor, and between rural and urban populations (see Chapter 19). North African countries have achieved universal access to both modern cooking fuels and electricity, with the exception of Mauritania. In sub-Saharan Africa, the situation is very different and only 17% of the population has access to modern fuels. This ranges from 0.3% in Burundi to 96% in Mauritius. At 26%, sub-Saharan Africa is the region with the lowest levels of electricity access (UNDP/WHO, 2009).

23.6.2 Access

Of the sub-Saharan African population, 26% have access to electricity, but only 6% use electricity for cooking because they cannot afford the relatively high electricity tariffs. In fact, the average power tariff of US$0.13/kWh is around twice that found in other parts of the developing world, and almost on par with that in the countries of the OECD.

To alleviate power shortages many sub-Saharan countries rely on short-term leases of diesel generators for emergency power, which leads to high average electricity costs of more than US$0.20/kWh (Eberhard and Shkaratan, 2010).

Access to electricity reflects the wide rural–urban and income divide. In sub-Saharan Africa, 71% of urban and 13% of rural residents have access, and only 4% of the lowest income quintile, as compared to 74% of the highest, have access (Banerjee et al., 2009).

From 1997 to 2007, sub-Saharan African countries invested in their infrastructures and the economy grew at about 5% per year while the power sector was growing at only 3% (Foster and Briceno-Garmendia, 2010). In 2010 sub-Saharan Africa spent US$45 billion on the power sector (just half the amount required to catch up with other developing areas) and US$30 billion of annual spending is domestically financed from the pockets of African taxpayers and consumers (Foster and Briceno-Garmendia, 2010).

The electricity generation capacity of the region with a population of 800 million is only 68 Gigawatts (GW), comparable to that of Spain with a population of 45 million, and when South Africa is not counted the total amounts to only 28 GW (Eberhard and Shkaratan, 2010). Access varies across regions and countries. North African countries, except Mauritania, have achieved universal electricity access, but in sub-Saharan Africa 561 million people, equal to 74% of the population, have no access to electricity, a figure that rises to 89% in rural areas (UNDP/WHO, 2009). The per capita consumption levels are only 457 kWh annually, on average, which reduces to 124 kWh without South Africa, compared to 1155 kWh in the developing world and 10,198 kWh in high-income countries (Eberhard and Shkaratan, 2010). When present electrification rates and population growth rates are projected to 2030, more people (654 million) will be without electricity in 2030 than in 2009 (587 million) (OECD/IEA, 2010).

Sub-Saharan Africa has adequate modern forms of energy resources (hydropower, oil and gas) for its population, but they are largely unused and 83% of the population still cook with solid biomass on open fires (UNDP/WHO, 2009). Most of the electricity generated in Africa (76%) is from thermal and/or fossil fuels (particularly from coal and oil), 22% is from hydropower, and the rest is from other sources – nuclear (South Africa) and geothermal (East Africa). All oil and gas producing countries in sub-Saharan Africa export fossil fuels. For example, in Mozambique 84% of the population still cook with solid biomass and only 12% have access to electricity, yet at the same time the country is exporting gas and electricity. Low population densities and dispersed settlement patterns in rural areas make affordable access very difficult. In Nigeria, a major oil-exporting country, 75% of the population still cook with solid biomass and have no access to modern cooking fuels.

Africa's energy situation is paradoxical in that the continent desperately needs energy for economic growth and poverty reduction, yet it is a net exporter of energy.

In addition to access to energy, both energy security and regional cooperation are among the key energy priorities in all reviewed national policy papers. Also, there is a growing interest in biofuels production and trade as an alternative option to fossil sources of energy. Efforts toward access to electricity and cooking fuels might be impacted by an additional burden of more expensive imported petrol and its derived products.

Table 23.7 | Number of people who rely on fuelwood and charcoal for cooking in assessed Sub-Saharan African countries.

Country	Population in 2006 (millions)	People who rely on fuelwood and charcoal for cooking	
		(millions)	%
Angola	16.6	15.7	95
Cameroon	18.2	14.2	78
Chad	10.5	10.2	97
Congo	3.7	2.9	80
Côte d'Ivoire	18.9	14.7	78
Equatorial Guinea	0.5	0.3	59
Gabon	1.3	0.4	33
Mozambique	21.0	16.9	80
Nigeria	144.7	93.8	65
Sudan	37.7	35.2	93
Total	273.1	204.0	75

Source: IEA, 2008.

To increase access to energy services, governments have to improve the performance of the sector in areas of governance, infrastructure, access to finance, and increasing regional trade. Also, income levels of both the rural and urban poor have to rise to make the transition from solid biomass to modern fuels and their appliances affordable.

23.6.2.1 West Africa

West African[27] countries are endowed with very significant energy potentials (oil, natural gas, uranium, hydropower, coal, renewable energy). There are major oil and gas reserves in Nigeria, Cote d'Ivoire, and Ghana. The most important reserves of oil and gas are concentrated in Nigeria. Hydropower potentials are important in Nigeria, Guinea, Ghana, Liberia, Cote d'Ivoire, and Mali. The main sources are the Niger, Senegal, and the Volta Rivers. In addition, solar resources are available and significant throughout the region and all year long.

In West Africa, electricity consumption is among the lowest in the world (on average 139 kWh/yr/capita compared with an average of 1020 kWh/yr/capita in North Africa) while the world's average is around

27 Africa is generally divided into five subregions: North Africa, West Africa, Central Africa, East Africa, and Southern Africa. The regions have formed economic communities and some countries are members of more than one regional community.

2400 kWh/yr/capita.[28] This low consumption is mainly a result of the low access to electricity services, especially in rural areas.

Annually, per capita electricity consumption in West Africa is slightly higher than the sub-Saharan African average. Cape Verde, Ghana, and Cote d'Ivoire have the highest electricity-access levels. They have implemented energy policies to improve access at affordable prices. The highest levels of access resulted from public policies to improve access to electricity while ensuring affordable pricing: the lifeline tariff in Ghana and subsidies in Cote d'Ivoire.

Lessons learned show that social tariff, social electrification, moderate residential tariffs, and subsidized connection were key instruments for their success. Government subsidies to LPG have been a key incentive for a large diffusion of the use of this product for cooking. Different mechanisms were used, such as cross-subsidies, specific funds, funds from the general treasury, and others.

23.6.2.2 Central Africa

In Central Africa, energy potentials are large and diverse. After Nigeria, the region has the most important oil producers in Africa – Angola, Equatorial Guinea, Gabon, Congo, and Chad. The oil reserves in Central Africa are estimated to amount to some 11.4 billion barrels representing 11% of Africa's reserves. The gas reserves are estimated to be more than 430 billion m^3 (3% of Africa's reserves), and are located in Cameroon (37% of Central Africa's reserves), Congo (23%), Rwanda (12.7%), Angola (10.6%), Equatorial Guinea (8.5%), and Gabon (7.8%). However, this resource remains underexploited (CEMAC, 2006).

The region also has very important hydropower resources (1000 TWh), which is around 60% of Africa's potential. This potential is located mainly in the Equatorial zone: DR Congo ranks first with 100 GW, Cameroon is second, followed by Congo, Gabon, and Equatorial Guinea. Elsewhere in Central Africa, Rwanda has geothermal resources and there are significant methane deposits in Lake Kivu on the border between Rwanda and DR Congo.

Although the region is richly endowed with large modern forms of energy resources, wood, charcoal, and forest residues make up 70–90% of primary energy supply, and up to 95% of household energy use in some countries. A large majority of the Economic Community of Central African States (CEMAC/ECCAS/CEEAC) population uses wood energy harvested without regard for its sustainability, which is burned in unhealthy conditions.

With the exception of Gabon, where 68% of the population uses it for cooking, the use of LPG is still limited to urban areas of most of sub-Saharan Africa. In fact, this product (bottled in small to medium canisters for households and small enterprises use) is a better and cleaner fuel than wood and charcoal used for the same purposes.

Several electricity companies that have been unable to invest and keep up with growth in the demand within the localities they serve, or that have suffered conflict-related damages, now find themselves with inadequate or obsolete production and transport facilities. In the best-case scenarios, private sector companies that provide a good level of service are not able to be the driving force behind hydropower investments, because of the high investment per unit of capacity, the long-term return on the investment, and the lower rate of return of the investment.

Peri-urban electrification is, in most cases, below standard and, with the exception of Cameroon and Gabon, rural electrification has not been pursued on a significant scale. No power company has developed a pro-poor commercial culture. The overall rate of household electrification in CEMAC is less than 15%, according to Africa Development Indicators (World Bank Group, 2011).

23.6.3 The Energy Dimension in the Poverty-reduction Strategies

In general terms, a sectoral approach has been used to include the energy dimension in poverty-reduction strategy papers (PRSPs).[29] Energy has been treated as a stand-alone sector and from a supply-side perspective (power-generation systems, biomass energy production and management, electricity-grid extension, petroleum exploration), mainly under the aspect related to the macroeconomic framework enhancement or infrastructure development.

The articulation of the energy dimension with the other main axes dedicated to poverty alleviation (social and income-generating activities, human development, access to basic social services for poor and vulnerable groups, rural development, and gender equity) was not seen as very significant.

However, an awareness of this gap in considering energy for poverty alleviation as arisen and the second generation of the PRSPs engaged an interactive multistakeholders dialogue to integrate the energy dimension into the poverty-alleviation options.

Table 23.8 summarizes the energy options as considered in the PRSPs documents elaborated by selected countries in Africa (Benin, Burkina Faso, Guinea RD, Mali, Niger, Rwanda, and Senegal).

28 Own estimation based on information from UNDP/WHO (2009), UNDP Human Development Report (2010) and Niez (2009).

29 PRSPs: country-driven approaches to tackling poverty, which have been developed through nationwide consultations with stakeholders.

Table 23.8 | Main axes in the PRSPs.

	Main axes in the PRSPs	Associated energy options	Benin	Burkina Faso	RD Guinea	Mali	Niger	Rwanda	Senegal
1	Macroeconomic framework and wealth creation		X	X	X		X	X	X
		Power capacities and generation	√		√			√	√
		Grid extension	√					√	
		Oil/gas/peat exploration	√					√	
		Energy infrastructure development							√
		Private sector involvement		√	√			√	√
		Investment and financial mechanisms						√	√
		Energy sources diversification							√
		Access to domestic fuels							√
		Rural electrification						√	√
		Energy sector restructuration and private sector involvement							
		Power sector management		√	√				
2	Human and environmental capital		X		X			X	X
		Rural electrification (including renewable energy options)	√						
3	Good governance and institutional capacities			X	X	X	X	X	
4	Job creation and development of revenue-generating activities			X		X	X		X
		Rural electrification (including renewable energy options)		√					
		Forest management and introduction of alternative energies		√					
5	Participative implementation		X						X
6	Rural development						X	X	
7	Infrastructure development					X	X	X	
		Improvement of access to energy					√		
		Energy infrastructure development and rehabilitation				√			
		Sub-regional cooperation				√			
		Awareness raising on alternative energy forms				√			
		Tax exempts for renewable energy				√			
		Forests management				√			
		Privatization				√			
8	Private sector promotion						X	X	
9	Urban development						X		
10	Access to basic social services for poor and vulnerable groups and gender equity			X	X	X	X		X
		Encouragement of renewable energy uses				√			
		Rural electrification			√				

23.6.4 Assessment of National Energy Policies/strategies in Selected African Countries

23.6.4.1 West and Central Africa

The assessed policies[30] relate to those of selected countries such as Burkina Faso, Cote d'Ivoire, Central Africa Republic, Ghana, Liberia, Mali, Niger, Senegal, Sierra Leone, and Togo. Nearly all of these identify access to energy as an objective or a priority in their energy policies. Table 23.9 summarizes the objectives and priorities and provides common threads of the energy policies in some of the selected countries. But rarely were objectives and expected results accompanied by a set of strategies, measures, and actions to achieve the targets.

Access to energy, energy security, and regional cooperation are the key energy priorities in all the reviewed national policy papers. In some countries, efforts have been made to speed up access to clean energy forms through dedicated programs and projects. A successful initiative from Senegal in West Africa is given in Box 23.5.

23.6.4.2 East and Southern Africa

In East and Southern Africa access to energy services varies more widely than that in West and Central Africa (see Chapter 19). Countries in East and Southern Africa can be divided into three groups. The first are those that have achieved or have definite policies and targets for universal access (e.g., Mauritius, South Africa). The second group consists of countries well on their way to having and implementing policies, and actively pursuing targets for greater access (e.g., Botswana, Kenya, and Zimbabwe). The third group includes countries with very low access rates and policies that do not seem to promise greater access rates in the near future (e.g., Burundi, Malawi).

Access to finance is a major barrier to extending energy services. In East Africa, Kenya addressed the problem and successfully raised finance to improve electricity generation. In 2006 the Kenya Electricity Company raised substantial investments through a public offer (PO) on the Nairobi Stock Exchange. The PO was an unexpected success and the electricity company exceeded the targeted amount (over US$112 million) and the share offer was oversubscribed by nearly double this amount (Bhagavan, 1999).

South Africa had the political will, the financial resources, and the capacity to implement the National Electrification Programme and increase electricity access from 36% in 1995 to 75% in 2007 (Niez, 2009). The connections to poor households are very highly subsidized, which makes access affordable for poor people. Every household in an area is provided with electricity supply, not only those customers who apply and pay, which significantly reduces cost. Other measures, such as prepayment meters, further reduced cost. Many people could not benefit from the huge investments in electricity supply because they could not afford to use it. The government then introduced a lifeline tariff of 50 kWh free of charge for poor customers. The Free Basic Alternative Energy Tariff subsidizes energy sources such as kerosene, LPG, and renewable energy, particularly in areas not connected to the grid, but this tariff is not or is poorly implemented (Box 23.6).

In Botswana, the Rural Electrification Collective Scheme (RCS) started in 1988 is an example of adjusting conditions of supply when the initial policy does not achieve its objective. The government extends the grid to the village and customers pay for the extension to their houses. Initially uptake was very slow and it took over ten years to adapt the scheme by gradually easing payment conditions, but not the total amount, until potential customers were able to afford the smaller installments over a longer period and then electricity access substantially increased at full cost recovery.

In Zimbabwe, low take-up rates threatened the minimal returns on investment in rural electrification. The Rural Electrification Agency (REA) established in 2002 supports income-generating activities for small and medium enterprises (SMEs) in order to increase electricity demand in rural areas and stimulate small-scale commercial and industrial development. REA provides loans and delivers electrical machinery ordered by SMEs. The Rural Electrification Programme is funded by a levy on all electricity bills of 6% (in 2007) as well as government fiscal allocations. Once small enterprises had access to electricity demand went up, and the variety and use of electric machinery increased and, at the same time, the use of stand-alone generators declined.

The third group is made up of low-income countries that cannot afford the necessary additional investments to accelerate greatly their energy access rates and will have to raise more finance from external sources, move their access targets from 10 to 20 or 30 years, or use alternative low-cost technologies serving more people in the short to medium term.

In the GEA solid biomass, and in particular woodfuels, are not considered as a modern energy form. However, 80% of the population still depends on woodfuels for their energy needs in Africa. To bridge the energy gap until modern energy forms are available and affordable, there is a need to relook at the traditional woodfuels sector with a view to modernize access, use, and supply. The wood and charcoal sector must be re-evaluated because it is an economic resource from which millions of people derive jobs and income. In Malawi and Burundi – two landlocked countries – the woodfuel market contributes about 2% to GDP. Community-based woodfuel production (CBWP) has been introduced in some African countries (Madagascar, Mali, Senegal) and has proved to be a successful strategy to decentralize forest management from exclusive government control to the local level, empowering communities to

30 The national energy policies/strategies are reviewed based on the existing/available policy papers or other available documents that mention the principles of national energy policies.

Table 23.9 | Main focuses of national energy policies.

	Burkina Faso	Central African Republic	Ghana	Mali	Niger	Senegal	Sierra Leone	Togo
Main focuses of national energy policies								
Increasing investment and infrastructure in energy			√			√		√
Enhancing security of supply and diversification of energy sources	√	√	√	√	√	√	√	√
Promoting renewable energy and energy efficiency	√	√	√	√	√	√	√	√
Managing the environment			√	√		√		√
Improving access to energy	√	√	√	√	√	√	√	√
Promoting the institutional framework	√		√	√		√	√	√
Enhancing energy to alleviate poverty and promote rural development	√		√			√	√	
Gender and energy								
Other energy policy focuses								
Enhancing research and development			√	√				
Promoting employment			√			√		
Exploring oil/petroleum					√			
Developing subregional, regional, and international cooperation			√	√	√	√		√
Capacities development		√		√				√

Source: Compiled by the author, based on following documents:

Burkina Faso: Energy Policy (Source: Energy Sector Development policy paper).

Central African Republic: Energy Policy (Source: Energy Policy National Framework for Poverty Alleviation, 2003).

Ghana: Strategic National Energy Plan and Policy 2005–2020 (Source: Energy Commission of Ghana, 2005).

Mali: Energy Policy (Source: Ministry of Mines, Energy and Water, 2006).

Niger: Energy Priorities and Objectives (Source: UEMOA-BERP, 2007).

Senegal: Energy Policy (Source: Ministry of Energy, 2008).

Sierra Leone: Energy Policy (Source: Ministry of Energy and Power, 2004).

Togo: Energy Policy (Source: Ministry of Energy and Water, 2006).

Box 23.5 | Senegal LPG National Program

A national program to promote LPG use in Senegalese households was implemented in 1974. This program was developed to attenuate the effects of drought and deforestation. The program's goal was to increase LPG consumption and decrease the reliance on biomass by the most vulnerable populations. Initially, a cooking stove with an attached 2.7 kg LPG cylinder was promoted. Then, in 1983, a more solid cooking stove with a 6 kg LPG cylinder better adapted to the cooking habits and income levels was also subsidized. In addition, the Senegalese government exempted all LPG-related equipment from customs duty, and eventually subsidized the LPG itself in 1976. This program, which focused on the distribution of 2.7 and 6 kg LPG bottles (called popular gas), resulted in an annual increase in LPG consumption from 3000 tons in 1974 to nearly 140,000 tons in 2005. This represents an average annual growth rate of 10–12%. The transition from biomass to LPG was achieved gradually, particularly in urban areas. It resulted in a new domestic fuel consumption profile in urban areas characterized by the use of LPG and charcoal. The key lesson learned from the Senegalese LPG program is that the political will and adequately targeted measures are necessary to achieve large-scale access to modern forms of energy.

Source: ENDA, 2006.

Box 23.6 | Electricity Access for Poor People: a Study of South Africa and Zimbabwe, Key Findings

In both countries examined, primary data on the electrification of poor people are almost non-existent – and this forms a key limitation of this study. Although, for instance, the National Electricity Regulator in South Africa keeps track of rural electrification levels, the data are not categorized by poor and non-poor users. Because of these data limitations, the findings and conclusions of this study should not be regarded as fully conclusive.

The comparisons between South Africa and Zimbabwe indicate that the policy environment to encourage and enable the provision of energy services for poor people needs to be designed for the specific needs of the country. The reforms undertaken to enhance access to electricity realized positive outcomes, particularly under the grid-based electrification programs. In South Africa, national electrification levels more than doubled from 34% to 70% between 1994 and 2001, as they also did in Zimbabwe, growing from 20% to 42% between 1980 and 2001. The Government-funded electrification program in South Africa took a shorter time and reached a much larger proportion of the population than the program in Zimbabwe.

In an attempt to reach poor people in remote locations, both countries focused on the establishment of off-grid programs which were mostly centered on SHS powered by solar PV technology. Even if all the operational and financial problems are resolved, off-grid programs based on solar PV home systems require an urgent review as they are focused on lighting, which is not the highest priority for poor people (Davidson and Sokona, 2002). Designing energy programs for poor people must address household-cooking and water-heating needs as a priority over lighting, which would, for example, reduce dependence on fuelwood. Similar priority would need to be attached to the provision of electricity for motive power, which would support small-scale rural industries for income-generating activities, and other services such as water pumping.

In both countries, the reforms have attempted to make electricity affordable to poor people. South Africa has introduced special subsidies on electricity consumption, including some free electricity. Zimbabwe has established a rural electrification fund to subsidize rural electrification schemes.

The electricity basic services support tariff (EBSST) subsidy in South Africa, which supplies 20–50 kWh of free electricity to poor people in selected areas, seems to have realized direct benefits for poor people. It had some positive impact on poverty alleviation as it reduced electricity expenditure. The reforms in both countries have ensured the protection of funds for financing the electrification of poor people by requiring transparency and accountability, albeit in different ways. In South Africa, the National Electricity Regulator (NER) aggressively monitors and makes public the progress of the National Electrification Programme through the NER's annual reports. In

Zimbabwe, the Performance Improvement Programme includes explicit rural and urban electrification targets that the utility is obliged to meet.

In order to meet the electrification challenge in rural areas, a diverse set of technical and institutional approaches will be needed – covering large-scale grid-connected extensions and new developments, together with smaller-scale distributed energy systems using both conventional and renewable energy sources.

Strong institutions are the backbone of an efficient and effective energy sector. National policies that create the right enabling environment for investment and business-led market growth are going to be essential.

The paper recommends the following for further investigations:

- Income-differentiated electrification, both current and trend data.
- More detailed understanding, through participatory approaches, of the associated social and economic characteristics of energy-consumption patterns of poor people.
- Innovative technological approaches to reduce connection fees and distribution costs, and so reduce the overall cost of increasing access to electricity to poor people.
- Further assessment and review of the use of renewable energy, especially SHS, as a poverty-alleviation tool in off-grid electricity supply.
- Exploration of public–private management schemes that could benefit poor people. This should include an assessment of the role of independent power producers and energy service providers.

Source: Davidson and Mwakasonda, 2004.

manage their forest resources sustainably (de Miranda et al., 2010). The CBWP approach has also been successful in promoting forest rehabilitation and reducing deforestation rates, creating long-term ecological benefits. In countries where the dependence on woodfuels is very high CBWP could be part of national energy policy.

At least as a transition phase, there is an urgent need to disseminate modern woodfuel technologies more widely as part of the access to energy services agenda. Traditionally, people use woodfuels in open fires with major negative impacts on health. Modern woodfuel technologies, including gasification, save woodfuels, minimize harmful emissions, and can make sustainable use of Africa's forest resources. In addition, efficient modern charcoal kilns should be strongly supported and disseminated to improve productivity and reduce waste of forest resources.

23.6.5 Energy Strategies of Africa and Sub-regional Bodies

The New Partnership for Africa's Development (NEPAD), adopted at the Organization of African Union in Lusaka, Zambia, in July 2001, recognizes the important role that energy plays in the development process of African countries, not only as a domestic necessity, but also as a factor of production whose cost directly affects prices of goods and services, and the competitiveness of enterprises (Zhou, 2003). In this regard, NEPAD has identified actions that need to be taken to address the critical barriers to universal access to modern energy in Africa.

NEPAD set a target for providing access to electricity for 35% of the population of Africa by 2015 and modern forms of energy for cooking, such as improved stoves or fuels like LPG, to half the population. Since then, all regional organizations have developed strategies or action plans.[31]

31 In 2002, NEPAD proposed that regional organizations, such as ECOWAS, CEMAC, or the EAC, play a key role in increasing the access to modern forms of services. NEPAD set a target for providing access to electricity for 35% of the population of Africa by 2015 and modern forms of for cooking, such as improved stoves or fuels like LPG to half the population. Since then, most of these regional organizations have developed strategies or action plans, such as the ECOWAS/UEMOA White Paper on Energy Access, the EAC Energy Access Strategy, and the CEMAC Action Plan for Promotion of Energy Access (all adopted in 2006) (Holland and Mayer-Tasch, 2007).

23.6.5.1 West and Central Africa

In West Africa, ECOWAS and the West African Power Pool (ECOWAS/UEMOA, 2006) formulated policies to enable at least half of the rural and peri-urban population to gain access to energy services by 2015. This would give access to 36 million additional households and over 49,000 additional localities. The specific objectives are to provide access to:

- 100% of urban and peri-urban areas; in rough terms, this means doubling the current access rate.
- 36% of rural populations – where the rate in the least densely populated countries is just 1%, and for the more advanced countries is 10%.
- Moreover, 60% of the rural population will live in a locality equipped with modern basic social services – healthcare, education, drinking water, communication, and lighting. This will be achieved through either decentralized electrical facilities or grid extensions. The objective entails increasing current levels threefold.

In Central Africa the CEMAC Action Plan (CEMAC, 2006) is geared primarily to rural and peri-urban zones, and energy access development will be balanced through:

- Strong LPG dissemination in peri-urban areas (70%), increased usage in secondary towns (50%), with use rates decreasing from 35–10% depending on the size of the inhabited area.[32]
- Usage by other households of improved stoves with chimneys (proportion of households increases from urban to rural areas).
- Supplying 50% of the peri-urban population with electricity through the power grid.
- Providing 35% of rural households with grid electricity or solar kits.
- Installing a corresponding infrastructure in non-electrified villages, giving 56% of rural inhabitants access to power supplies.

A set of 11 strategic activities are included and consist of:

- coordinated development of hydropower;
- rational use of surplus biomass;
- waste from agroindustrial units and peri-urban areas;
- rural energy service projects in promotion zones;
- intensive peri-urban electrification project;
- promotion of PVs;
- optimizing the domestic fuel market;
- support for the coordinated development of the hydrocarbon market;
- elaboration of an energy charter;
- establishment of an energy access observatory; and
- technology transfer and strengthening of national value added.

23.6.5.2 East and Southern Africa

As in West Africa, in 1995 the Southern African Power Pool was created to develop electricity trade, reduce energy costs, and promote greater supply stability for the region's 12 national utilities.

The Southern African Development Community (SADC) countries signed an energy protocol which came into force in April 1998 (SADC, 1998). Key objectives of the protocol are:

- to harmonize national and regional energy policies, strategies, and programs;
- to cooperate in the development and utilization of energy and energy pooling to enhance security and reliability;
- to develop jointly the human and institutional capacity of the energy sector; and
- to promote standardization where appropriate in the energy sector.

23.6.5.3 Summary of Regional MDG-related Energy Target

Regional organizations for sub-Saharan Africa have also proposed targets for countries in their regions to adopt, as follows for 2015 as specified in the MDGs objectives.[33]

The Forum of Energy Ministers of Africa Position Paper (FEMA, 2006):

32 We assume a combination of measures, including substitution between sources. This means that in some areas the LPG share will increase, but in others another energy source will replace it.

33 The majority of summary is drawn from a publication by UNDP/WHO in 2009, "*The Energy Access Situation in Developing Countries: A Review Focusing on the Least Developed Countries and Sub-Saharan Africa*".

- 50% of Africans who live in rural areas and use traditional biomass for cooking would need to have access to energy services, such as improved cooking stoves, which reduce indoor air pollution, as well as efficient kerosene and gas stoves.
- 50% of urban and peri-urban poor should have access to reliable and affordable energy services for their basic energy needs, such as cooking and lighting, and productive uses such as agrocultural processing and general value addition.
- 50% of schools, clinics, and community centers should have access to modern electricity services for the provision of lighting, refrigeration, information, and communication technology.

The ECOWAS White Paper (ECOWAS/UEMOA, 2006):

- 100% of the total populations (325 million people) will have access to a modern cooking fuel.
- At least 60% of people who live in rural areas will have access to productive energy services in villages, in particular motive power to boost the productivity of economic activities.
- 66% of the population (214 million people) will have access to an individual electricity supply, or 100% of urban and peri-urban areas, 36% of rural populations, and, moreover, 60% of the rural population will live in localities with:
  - modernized basic social services – healthcare, drinking water, communication, etc.
  - access to lighting, audiovisual, and telecommunication service, etc.
  - coverage of isolated populations with decentralized approaches.

The CEMAC Action Plan for the Promotion of Energy Access (CEMAC, 2006):

- 50% of the population to have electricity access, with at least 35% of the rural population having access.
- 80% of the peri-urban and rural population to have improved access to modern fuels for cooking and heating.

The EAC Energy Access Strategy (East African Community, 2006):

- 55% of the total population in the region will have access to LPG or improved stoves and to sustained biomass supply. This is the equivalent of an additional 50% of the population that currently does not have access to modern cooking practices.
- 100% of urban and peri-urban households will be provided with an electricity service.
- 100% of the rural population will live in a locality where social service centers are equipped with energy services.
- 100% of administrative headquarters and localities with more than 3500 inhabitants will be equipped with mechanical power and heating technology.

The SADC Regional Indicative Strategic Development Plan (undated):

- 70% of rural communities will have access to electricity (by 2018), or
- 70% of rural communities will have access to modern forms of energy supplies (by 2018).

23.6.6 Key Conclusions on Policies at a Regional Level

It is evident that Africa has sufficient energy resources to fuel its own development, but so far most of the resources are undeveloped or exported. This is particularly so with oil that is sold in crude form and imported back as refined products, and yet the continent could build additional refinery capacity that can supply the bulk of Africa's needs. The energy industry is oriented to export (in oil-producing countries) and there is a lack of investment to mobilize the hydropower resources, large and small, and natural gas resources are unexploited. The hydropower resources in the DR Congo are barely exploited and are far from demand centers. There are few economies of scale in Africa, which makes the development of large energy resources unaffordable for individual countries and requires joint investments. Increasing the trade of energy, especially of oil, gas, and electricity, among African countries can significantly improve the uneven distribution of energy resources in the continent. To achieve this, capacity development and reinforcement in areas of governance, financing, and energy are necessary. Such capacity should be created at individual, institutional (individual capacity integrated with the institutions to afford its objectives), and systemic level (adequate coordination among the institutions).

Recently, regional bodies have developed a growing interest in promoting policies to improve energy access for poverty alleviation in addition to their natural regional priorities geared toward regional cooperation, infrastructure development for electricity and gas interconnections, and capacity development.

As cited above, ECOWAS, CEMAC, and SADC have developed time-bound objectives for access to modern forms of energy in their subregions in line with the MDGs horizon. This regional political will needs to be pursued and completed by action plans for the implementation and mobilization of funds.

The African Development Bank et al. (2003) has developed a strategic plan that takes poverty alleviation as one of its priorities. The Bank is

updating its energy sector policy (enacted since 1994). An appropriate updated policy has to comply with national priorities and support energy security at both the macroeconomic and local levels.

South Africa, Botswana, Ghana, and Zimbabwe have implemented policies and strategies to give poor households greater access to electricity and to make the use of electricity more affordable. Emphasis on access was, in three cases, the primary focus and in their different ways the policies and strategies have achieved their objectives. When it was found that the programs started in these countries did not fully achieve their objectives, adjustments were made over time. In South Africa the Free Basic Electricity tariff was introduced, in Botswana up-front cost and the repayment rates were reduced, and in Zimbabwe the cross-subsidy was raised from 1% to 6% to pay for the program.

23.6.7 Lessons Learned

- Sub-Saharan Africa has adequate energy resources (hydropower, oil, gas, coal) to fuel its development, but they are largely unexploited. Greater regional cooperation and trade offer the least-cost option for energy development.
- The experiences of West African countries show that social tariff, social electrification, moderate residential tariffs, and subsidized connections were key instruments for their success.
- National and subregional energy policies and strategies would need to be harmonized with other relevant policies for efficient implementation and development.
- Energy policies should aim at creating conditions to support subregional and regional energy industry and market development for renewable and non-renewable energy resources.
- There are many successful African examples of addressing barriers to energy development. Learning from and upscaling these best practices will avoid costly mistakes and increase access to energy services.
- Sub-Saharan African's utilities have implemented some reforms, but more needs to be done to increase the efficiency of the power sector. Tariffs are often not cost reflective, and subsidize the affluent sector of society who could afford a connection anyway. Charging full cost to this group would save the government subsidies which might be better used to extend the grid to a poorer part of the population and advance development.
- Energy issues should be well integrated into PRSPs and other national and regional development issues. In particular, energization of rural areas achieves greater results when integrated into multisectoral rural development strategies, and programs.
- All options of energy supply, grid, minigrid, and off-grid, are valuable in their appropriate context.

23.7 Asia Review: Successes, Failures, and Proposals

23.7.1 Introduction

One-fifth of the population (some 800 million people) of the Asia-Pacific region still lack reliable access to electricity, and more than half (near two billion people) still lack access to clean cooking facilities. According to a recent report by the International Energy Agency (Niez, 2009), around 1.3 billion people globally lack access to electricity, and more than half of these are in the Asia-Pacific region. This has severe socio-economic costs, particularly for the 641 million people in this region who live on less than US$1/day as they tend to spend a higher proportion of their income on energy.[34]

Although in some Asian and Pacific subregions the proportion of the population with access to electricity improved overall between 1990 and 2005, this growth was much less than the GDP growth rate over the same period. Growth in access to electricity and in GDP has also been much greater than the global averages (see Chapter 19). In southeast and northeast Asia, this growth was also much greater between 1990 and 2000 than that in more recent years.

By 2005, more than two million households in the region were generating electricity from stand-alone SHS.[35] However, assuming an average household size of five persons across these countries, this only equates to roughly 10 million people or only 1% of the population without access to electricity.

23.7.2 Energy Access Programs and Success Stories in Some Selected Countries

This section highlights the roles of factors that enhance access to electricity supply through successful rural electrification programs in Asia. In grid-based rural electrification programs, these factors include:

- dedicated public institutions and community organizations for rural electrification;
- self-sustainable revenue generation;

34 See UNESCAP, 2007 from which this section draws heavily.

35 However, they receive very limited access to electricity, as the SHS have a supply very low capacity, and supply very few energy services.

- strong non-residential customer base to cross-subsidize electricity to residential customers;
- sufficient public investment in rural electrification prior to reforms that allow private participation in electricity supply;
- economic growth;
- sound financial performance of rural electrification institutions and an ability to expand generation capacity adequately;
- involvement of stakeholders in planning and implementing rural electrification schemes;
- in some cases, the removal of regulatory barriers, e.g., house registration identity documents in Thailand.

In rural electrification programs not based on grids, the key factors to increase electricity access include innovative financing schemes to overcome the barrier of high up-front costs of isolated or decentralized electricity-generation systems (e.g., *Grameen Shakti*, see Box 23.7), SHS, and technology support.

While the figures in the next paragraphs serve as a common denominator to the problem, there exists wide disparity in rural electrification in South Asia. Sri Lanka has a rural electrification rate higher than the global average, while only 12% of the rural population in Afghanistan is connected to the grid. India, Pakistan, and Bangladesh alone constitute more than 90% of the region's population without access to electricity, with the remaining 10% in other South Asian countries.

India, Nepal, Sri Lanka, and Bangladesh have taken the lead in using off-grid technologies to create access to electrification in rural areas through a range of schemes and models. Of the region's 614 million rural people without electricity, many live in isolated communities, far from the national electricity network. These off-grid communities are generally small and dispersed, consisting of low-income households with characteristics that are economically unattractive to potential private sector energy providers, or even to government electrification programs that usually prioritize the allocation of scarce resources.

In 2008, the national electrification rate in Nepal was 64.5% with a very uneven urban–rural distribution. In urban areas, where less than 20% of the population lives, the household electrification rate is 93.1%, while the rate in rural areas is only 52.5%. It is highest in the accessible lowland regions and lowest in the mountain regions. The per capita electricity consumption is only 81 kWh/yr, one of the lowest in the world (Palit and Chaurey, 2010). In 2001, only 27% of the total population had access to grid electricity. In 1996, the Government of Nepal started a pilot electrification project under the Rural Energy Development Program (REDP) to promote modern forms of energy. Its objective was to alleviate poverty, improve livelihoods, and preserve the environment in remote and rural parts of the country, where grid-based electrification was not expected to materialize in the near future. After the successful implementation of the pilot projects in five districts, it was extended to a further 25 districts.[36]

The REDP concept is heavily based on the decentralized and participatory decision-making process and a holistic development approach. A salient feature is its strong community mobilization process, focusing on (i) organizational development, (ii) skills enhancement, (iii) capital formation, (iv) technology promotion, (v) environmental management, and (vi) vulnerable community empowerment. Participation, transparency, consensus decision making, and inclusion of all households in the community, irrespective of class, color, creed, or gender, are the four pillars of good governance for ensuring equal ownership and equitable sharing of benefits accrued from MH systems.

By 2007, the REDP had installed 185 MH plants, with a total capacity of 2.47 MW. Together, these plants provide electricity access to more than 120,000 people for lighting and mechanical power for agroprocessing and other productive applications (Rijal et al. 2007). The main reason for REDP's success is its effective resource investment in capacity development of local stakeholders, effective community mobilization, and affordable tariff structure (GNESD, 2004).

The Energy Sector Assistance Programme (ESAP) has also been instrumental in supporting the Alternative Energy Promotion Centre to promote MH schemes of up to 100 kW. Besides loan financing available through commercial banks, there was also the provision of financial subsidies for these projects. Also, a total of 69,411 SHS were installed in the country, bettering the program target of 40,000 systems under the ESAP's first phase. The program was also successful in establishing guidelines for administering solar energy subsidies and putting in place quality assurance and monitoring systems for the solar energy projects.

Sri Lanka stands out in South Asia for its high rate of household electrification. Between 1986 and 2005, the national electrification rate improved substantially from 10.9% to 76.7%. Almost 75% of Sri Lanka's rural households are connected to the electricity grid, while another 2% are provided with basic off-grid electricity connections. In the off-grid sector, small hydropower has been the preferred option, with the first off-grid village hydropower scheme commissioned in 1992. The program resulted in a dramatic increase in the development of grid-connected and off-grid renewable energy projects, prepared and implemented by the private sector and village communities. Studies have concluded that the large-scale penetration of SHS in Sri Lanka has helped rural communities to improve their socioeconomic conditions and reduce adverse environmental impacts.

36 In Nepal, almost 30% of electricity supplied in the rural areas is through the off-grid route. The use of alternative energy sources for rural electrification took place because of the early realization by the Government of Nepal that the central electricity grid may not reach most rural populations (Palit and Chaurey, 2010).

With a view to enhancing rural electrification, the Energy Service Delivery Project (ESDP) was jointly initiated by the World Bank and the Government of Sri Lanka in July 1997 for a five-year period. The project aimed to create nationally coordinated programs to introduce, popularize, and consolidate alternative energy sources including village MH system. The project provides financing, including a grant portion from Global Environmental Facility, for both grid-connected schemes and off-grid connected schemes for rural electrification.

The project facilitated an accelerated development of village MH schemes in Sri Lanka, with technical backstopping from the Intermediate Technology Development Group (ITDG), a NGO. As ITDG had been promoting grid-connected small hydropower plants, off-grid MH systems, biogas systems, and small wind systems for 15 years in Sri Lanka, its expertise was helpful during the dissemination program.

The successful lessons from the ESDP are now being replicated on a larger scale under a successor program, Renewable Energy for Rural Economic Development Project, funded by the World Bank (World Bank, 2003).

In Thailand, the Provincial Electricity Authority (PEA) formulated a 25-year National Plan for accelerated rural electrification in 1977. This served as the master plan for the country's rural electrification. The PEA was able to increase electricity access to rural populations from 7% in the 1970s to 99% by 2007. The key factors behind the rapid growth in Thailand's rural electrification include the creation of a dedicated entity, the Office of Rural Electrification, by the PEA, with specific responsibilities to implement the rural electrification program, self-sustainable revenue generation, involvement of end users in planning, financing of development of distribution network, and subsidies to residential customers (Shrestha et al., 2004b). High levels of electrification were achieved in Thailand by the early 1990s. As a result, subsequent reforms in the power sector, such as private participation in power generation and tariff reform, do not seem to have affected the rural electrification in Thailand.

Bangladesh's rural electrification program was launched in 1977 at around the same time as that of Thailand. The program in Bangladesh was implemented through two-tiered institutional arrangements involving the Rural Electricity Board and rural electricity cooperatives known as *Palli Biddut Samities* (PBSs). Each consumer is a member of the PBS that serves them. The Rural Electrification Board is responsible for planning and developing the distribution network. The PBS is responsible for preparing a master plan on electrification of its members and for forecasting load growth. The PBS also manages financial and operational activities. The 70 PBSs established provide electricity to more than 40 million people living in 38,000 villages (GNESD, 2007).

Rural electrification has helped generate local employment and promoted local non-farming economic activities in Bangladesh (Barkat, 2005). This has helped to make electricity more affordable for people. PBS has been successful in reducing system losses by 50% and improving billing collection, which stands at more than 95%, compared to national utilities (Rijal et al., 2007). According to GNESD (2007), PBS is a model to be followed by highly centralized national electricity utilities. Its success lies in effective decentralized actions, facilitation of cooperatives with subsidized finance, a revolving fund for loss-making cooperatives, subsidized power from the Bangladesh Power Development Board, performance target agreement of cooperatives with the Rural Electrification Board, and intersectoral cross subsidy provision for customers (Rijal et al., 2007; GNESD, 2007).

The rural electrification programs in Bangladesh and Thailand have a number of things in common. These include (Shrestha et al., 2004b):

- the creation of an entity with specific responsibilities to implement the rural electrification program;
- involvement of end users in the distribution network planning process;
- financing of distribution network development, the creation of the distribution networks, is funded through grants and low-interest loans from the government, as well as bilateral/multilateral agencies; and
- provision of subsidies to residential consumers of electricity.

Despite the similarities in approach, the achievements were more significant in Thailand. Only 19% of Bangladeshi households were electrified by 2000. Although the Rural Electrification Board and PBSs covered 90% of the area in Bangladesh with a basic distribution infrastructure, household connectivity is still very low. According to the IEA, the overall electrification rate in Bangladesh was 41% in 2008, with 76% of the urban population and only 28% of the rural population having access to electricity. Although the rural household electrification rate is poor, Bangladesh has recorded an impressive rural electrification performance with the help of solar PV technology, particularly SHS (Box 23.7). The solar PV program was developed by the Infrastructure Development Company Limited, Bangladesh, with the help of the World Bank.

Three factors that appear to have influenced the divergence in achievements of the rural electrification programs in Bangladesh and Thailand are financial resources, electricity generation capacity, and level of economic growth:

- Financial resources: The PEA in Thailand was able to cover its operational cost through revenue generation from the sale of electricity. This enabled the PEA to use new resources allocated for rural electrification to expand the distribution network. However, unlike the PEA, the PBSs in Bangladesh were not able to meet their operational costs. Both, however, received power from a national electricity-generating

Box 23.7 | *Grameen Shakti* Microfinance Scheme in Bangladesh

Grameen Shakti was incorporated in 1996 as part of the *Grameen* family of companies. It specialized in renewable energy, such as SHS, wind, and biogas. The main objective was to produce electricity to provide the minimum needs of electricity for lighting after dusk to enable income- generation activities to continue at night. *Grameen Shakti's* board of directors and top management had extensive experience of microcredit financing and many were founding members of the Grameen Bank. Their experience in microcredit was essential in the design of *Grameen Shakti* programs.

Grameen Shakti has various financing models (Barua, 2005).

- Mode 1: The customer has to pay 15% of the total price as a down payment during installation and the remaining 85% of the cost is paid by monthly installation within 36 months, including a 12% service charge.
- Mode 2: The customer has to pay 25% of the total price as a down payment during installation and the remaining 75% of the cost is paid by monthly installation within 24 months, with an 8% service charge.
- Mode 3: The customer has to pay 15% of the total price as a down payment during installation and the remaining 85% of the cost, including a 10% service charge, is made by 36 post-dated checks.
- Mode 4: 4% discount is given for cash purchase.
- Mode 5 (microutility): The customer has to pay 10% of the total price as a down payment during installation and the remaining cost is paid by installments within 42 months, with no service charge. Here the customer sets the system up on his/her premises, and other shop owners receive the facility of SHS in exchange for payment.

Grameen Shakti developed one of the most successful market-based programs with a social objective of popularizing SHS, as well as other renewable-energy technologies, to millions of rural villagers. *Grameen Shakti* used its Grameen Bank concept of microcredit to evolve a financial package suitable for rural people, which helped, in particular, to bring down costs. The customized pricing system based on installments helped *Grameen Shakti* to reach economies of scale with the increase in sales. Their business is centered on customer-service excellence. *Grameen Shakti* engineers pay monthly visits to households and offer their services for a small fee upon the signing of an annual maintenance agreement by clients. *Grameen Shakti* also undertakes several other activities, such as educational loans and gift schemes, which go well beyond the energy service itself and help develop trust between it and the local communities. By the end of December 2009, the total number of installations had reached 113,736 SHS.

authority at subsidized rates. But the ultimate financer of these subsidies in Bangladesh was the government, as the Bangladesh Power Development Board had been losing money and was unable to generate its own resources to pay for its operations. This was caused by combination of factors, including that the average Bangladesh Power Development Board tariff was set below the long-run marginal cost, there were high system losses (38%), and a low rate of bill recovery. The losses in Bangladesh also adversely affected the availability of financial resources from multilateral institutions, as between 1990 and 1995 they withdrew from financing the power sector in Bangladesh.

- Generation capacity: Lack of adequate supply, because the power-generation capacity expanded more slowly than the projected increase in demand. Unlike Bangladesh, generation capacity was not a barrier to expanding rural electrification in Thailand.
- Economic growth: High economic growth also implies expansion of commercial and industrial activities and therefore increased demands for electricity. The rise in the number of non-residential customers and the level of their electricity consumption provide a greater resource base for subsidizing residential consumers. The smaller, non-residential resource base was a factor that seems to have inhibited the electrification rate in Bangladesh. The per capita income growth during the rural electrification program was much faster in Thailand than in Bangladesh. At less than 2%, the poverty levels[37] in Thailand were very low, compared to 36% in Bangladesh in 2000. Bangladesh's high poverty levels imply that the consumer base with very low paying capacity is much larger in Bangladesh than in Thailand.

37 Population earning less than US1$ a day (UNDP Human Development Report, 2003).

In 1997, Indonesia promoted a household electrification program based on off-grid, stand-alone SHSs. This electrified rural areas where there were no plans to extend the government-owned utility's grid network. The Indonesian government has established a revolving fund, or grant, to implement these systems.

Users made down payments to cooperatives, and then paid monthly fees until the cost was covered. The program emphasized the formation of representative community groups (involving men and women in all stages of the electrification process), which helped to manage the electrification projects successfully.

The program promotes the use of locally made system components, which makes it cheaper and technically sustainable. This has been a success story for the off-grid electrification process, particularly for countries that lack the financial resources for grid extension in remote areas (UNEP/GNESD, 2002). The credit for this success goes to the effective management of cooperatives and the development of local manufacturing capability, which have reduced the system costs. However, as this scheme is based on a bottom-up approach, with users bearing all costs, it is limited to high-income groups only.

23.7.3 The Experience of India in Rural Electricity Access

With the largest rural population in the world, India is facing a huge electrification challenge. About 60% of rural households have access to electricity. Electricity consumption per capita is low at 543 kWh/yr/capita (Niez, 2009). There is also wide disparity in access to electricity between urban and rural populations, and also between states.

In the power generation sector, although India has considerably improved its generating capacity over the years, with installed capacity growing from 1362 MW in 1947 to 159,648 MW[38] by 2008 (Palit and Chaurey, 2010), the supply of electricity across the country currently lacks both quality and quantity. There is an extensive shortfall in supply, a poor record for outages, and high levels of technical and non-technical losses.

A number of specifically targeted schemes were launched in India to facilitate electricity access for poor people (Box 23.8). Most of these schemes were implemented by the state electricity utilities with central financial assistance disbursed through the Rural Electrification Corporation (REC).

The grid connection is the most favored approach to rural electrification for most rural households. But renewable off-grid technologies, such as solar PV, mini-/microhydropower, biomass gasifiers, biofuel-powered generators, and small wind aerogenerators in hybrid mode are also disseminated to areas that are inaccessible to the grid, such as remote, hilly, and forested villages, islands, or hamlets that are not recognized as villages by national census records.

Off-grid technologies have been used either through the creation of local minigrids, or by disseminating household-level technology, such as solar PV, for lighting and other low-consumption activities. It is reported that off-grid capacity in India is around 13 GW, of which 10 GW is diesel and 3 GW is renewable energy (Banerjee, 2006). Off-grid power plants based on renewable energy are typically in the range 1–500 kW, and are located in independent distribution network (minigrids). Most off-grid systems have been promoted by Government of India schemes.

23.7.3.1 Rural Electrification Policy

Rural electrification is a key factor in accelerating rural development. The provision of electricity is essential for the requirements of agriculture and other important activities, including small and medium industries, *khadi* (indigenous) and village industries, cold chains, healthcare, education, and information technology. Where a grid extension is not feasible in rural areas, the policy recommends distributed generation, through either conventional or non-conventional means, as the preferred option. District committees would coordinate and review the extension of electrification in the district, review the quality of power supply and consumer satisfaction, and promote energy efficiency and conservation. The policy stresses that the state governments should actively raise awareness of electricity issues, including generation, distribution, energy conservation, and the energy efficiency and energy-water nexus.

The policy says that it is essential for energy efficiency to be promoted in rural areas through mass campaigns. It also notes that the use of inefficient and energy intensive equipment by the agricultural sector distorts the consumption pattern and results in non-optimal utilization of tariff subsidies. It recommends the use of economically viable, energy efficient farm equipment, especially irrigation-pump sets.

The main vehicle chosen to implement the policy's universal access objectives is the *Rajiv Gandhi Grameen Vidhyutikaran Yojana* (RGGVY). This was launched in April 2005 with the goal of electrifying all villages and hamlets that were without electricity, and providing access to electricity to all households within five years. The RGGVY's basic objective is to create a rural electricity infrastructure in the country in order to provide all rural households with access to electricity within a given timeframe. The RGGVY emphasizes not just village electrification, but the facilitation of rural development, employment generation, and poverty alleviation through access to electricity. This includes below-the-poverty line (BPL) households, and also caters to the needs of agriculture, small and microenterprises, cold chains, healthcare, information technology, and education.

38 Thermal power (coal, gas, and diesel) accounted for about 64% of total installed capacity with 102,704 MW, large hydropower for 23% with 36,863 MW, grid-connected renewables for about 10% with 15,521 MW, and the rest from nuclear power.

Box 23.8 | Policy Regimes for Rural Electrification in India

In 2002, the Gokak Committee recommended that a choice between grid connection and decentralized generation should be made on the basis of technical, managerial, and economic issues. These included distance from existing grid, load density, system losses, and load management.

The Electricity Act 2003 was enacted in June 2003. Its overall objective was to develop the electricity industry and provide electricity access to all areas. Sections 4 and 5 of the Act specifically require the Government of India to formulate appropriate and adequate policies for the supply of electricity in rural areas.

The aims of the National Electricity Policy, introduced in 2005, include:

- Access to electricity: available to all households in five years.
- Availability of power: demand to be fully met by 2012; energy and peaking shortages to be overcome and adequate spinning reserve to be made available.
- Supply of reliable and quality power to specified standards, efficiently, and at reasonable rates.
- Per capita availability of electricity to be increased to over 1000 kWh by 2012.
- Minimum lifeline consumption of 1 kWh/household per day by 2012.
- Financial turnaround and commercial viability of electricity sector.
- Protection of consumers' interests.

The National Electricity Policy also states that wherever grid-based electrification is not feasible, decentralized distributed generation facilities (either conventional or non-conventional methods of electricity generation, whichever is more suitable and economical) together with local distribution networks will be provided, so that every household can access electricity.

The scheme's scope includes the provision of a rural electricity distribution backbone (i.e., 33/11 kV substations with adequate capacity and lines in blocks), creation of a village electrification infrastructure (i.e., electrification of unelectrified villages and settlements), provision of distribution transformers of appropriate capacity in electrified villages/settlements, decentralized distributed generation and supply, and electrification of rural households below the poverty line.

The RGGVY provides a capital subsidy of up to 90%. This is disbursed through REC Limited, a nodal agency for the scheme's implementation. The other 10% is to be arranged by the project developer. It is planned to involve private developers in the program, with the subsidy to be released on an annuities basis depending on the system's performance over five years. However, electrification of BPL households is financed with a 100% capital subsidy. The guidelines say that priority shall be given to villages where grid connectivity is not foreseen in the next five years.

The remote village electrification (RVE) program of the Ministry of New and Renewable Energy (MNRE) started in 2001. It aims to provide basic lighting facilities in unelectrified census villages, regardless of whether these villages were likely to receive grid connectivity. But the scheme was subsequently modified to cover only those unelectrified census villages that are not likely to receive grid connectivity. In addition to domestic use, the scheme has the option to provide energy services for community facilities, for pumping for drinking water or irrigation, and for economic and income generating activities in the village. Like the RGGVY, central financial assistance of up to 90% of the projects' costs is provided as a grant with specific benchmarks. The balance of 10% is financed through other decentralized governmental institutions.

The Village Energy Security Programme (VESP) was conceptualized as a step toward the RVE program. It also addresses a village's total energy requirements for cooking, electricity, and motive power, and it aims to transform the largely unsustainable use of locally available biomass to

Box 23.9 | A Good Example to Follow: Village Energy Security Programme in India

Launched in 2004, the Village Energy Security Programme (VESP) is a community-based initiative that aims to provide clean, affordable energy in rural areas – home to around 70% of India's population. The focus has been on finding ways for villages – particularly those located in remote rural areas that are unlikely to be provided grid electricity in the near future – to achieve energy security based on locally available renewable energy sources (preferably biomass). The program goes beyond rural electrification to village energization. It therefore places additional emphasis on cleaner options of cooking through improved cook stoves and biogas, productive use of energy for livelihood generation, and sustaining the energy systems through captive plantation. As of December 2009, 79 test projects have been sanctioned, of which 55 were commissioned in eight different states. These test projects were undertaken in non-electrified remote villages and hamlets that are not likely to be electrified through conventional means in the immediate future. Based on a community centric approach, a one-time grant (up to 90% of the project cost) was provided to the village community for installation of energy systems capable of meeting the village community's energy demands. The community, in some cases, also provided an equity contribution (either in cash or kind) to bring in the much needed ownership required for the success of any community centric projects. Based on an assessment conducted to review the performance, impacts, and lessons of the VESP test phase, it was found that the VESP projects emerged as a vehicle to motivate the community, especially the youth, to attempt develop their skills. Local youths enhanced their skill to operate the installed power-generation systems in almost all the VESP subprojects. Innovations adopted by select Project Implementation Agencies for capacity development of the technology operators helped to improve project performance. There are mixed results for social mobilization and leadership of the Village Energy Council (VEC), with mobilization and leadership relatively better in the test projects implemented by NGOs as compared to those implemented by state departments. Revenue management is comparatively better in projects where villagers have cash income because of either existing income-generation activities or newly introduced activities after being electrified under VESP. Active involvement of Gram Panchayats in some projects helped to develop the required synergy in getting village-development funds for VESP, both toward project cost and operational expenses.

However, along with the above-mentioned best practices some shortcomings were also reported. The uptime of the projects, considering their remoteness and various other inherent technical and institutional problems, is satisfactory in some of the projects, but it is poor in most of the projects. Some of the challenges for sustainability were found to arise from less-concentrated electricity demand in the villages, low economic activity (implying a lower electricity demand), less ability to pay by the consumers, difficulty in O&M, limited technical knowledge within the VECs, and weak fuel-supply chain linkages. One or a combination of these factors leads to a low load factor and fewer hours of operation, and thereby a low capacity-utilization factor. The potential of income generation activities and productive load was also not fully exploited because of the absence of proper guidance to the VECs to initiate and execute such possibilities.

Source: Palit and Chaurey, 2010.

innovative, sustainable modern biomass energy. The objectives of the VESP are:

- To meet village energy requirements through biomass material and biomass-based conversion technology, or other renewable technologies where necessary.
- To go beyond electrification by addressing the total energy requirements, such as those required for household cooking.
- These projects would involve the installation of energy production systems: biomass gasifiers, biogas plants, plantation activities, and improved cooking stoves (*chulhas*).

23.7.3.2 Institutional and Financial Viability of Electrification

Electricity is in the concurrent list of the Indian constitution, and therefore both state and central governments have jurisdiction over it. The state governments' jurisdiction includes generation, intrastate transmission, distribution, and intrastate trading of electricity. The central government's purview includes policy formulation, generation plants catering to more than one state, interstate transmission, and interstate trading of electricity. In the rural electrification sector, the principal actors have traditionally been the state electricity utilities, because they were responsible for the distribution of electricity in the states.

Table 23.10 | Subsidies for rural electrification schemes in India.

Scheme	Target under the scheme	Subsidy vehicle	Amount of central financial assistance
RGGVY	100% household electricity access throughout India by 2012	Capital subsidy	90% grant is provided by the Government of India 10% as loan by REC to the state governments Total subsidy disbursed by September 01, 2009: INR256,790,000,000
VESP	1000 villages to be electrified within the current five-year plan	Capital subsidy Operational subsidy for first two years	90% of the total project cost Maximum CFA per household is INR20,000 10% of the total project cost
RVE	Electrification of villages and hamlets that are not likely to receive grid connectivity	Capital subsidy subject to upper limits	90% of total costs of electricity generation systems

Source: TERI, 2007.

The total costs of RGGVY schemes were estimated recently as US$13.64 billion. The Ministry of Power funds 90% of RGGVY project costs, with state governments funding the remaining 10% through either long-term loans from the REC or other financial institutions, or from their own budgets. Household-connection charges are borne by individual households. However, for unelectrified households below the poverty line, the household connections are financed wholly by capital subsidies.

The total implementation costs for the RVE program and the VESP are estimated to be US$377 million. As with the RGGVY, subsidies from MNRE cover up to 90% of the project implementation costs (Table 23.10).

23.7.3.3 India Programs: Key Lessons

- Government support is essential to the development of a successful rural electrification plan. Laws and reforms have shaped the institutional and legal framework, but without firm implementation of policies and goals, enforced through legislation, the electrification process is difficult to achieve.
- The creation of franchises for the management of local power distribution in rural settings is reported to have brought efficient billing and revenue collection, and thereby ensure stable delivery of electricity. Studies by The Energy and Resources Institute (TERI) indicate that franchises are particularly effective in managing electricity provision and cost recovery, because they are in close contact with the targeted communities. This has led to a stronger sense of ownership of the electrification process.
- The three-tier quality-monitoring mechanism established the RGGVY is reported to be ensuring proper implementation of projects, thus contributing to their efficiency and long-term sustainability. Similarly, the five-year performance warranty and annual maintenance contracts for all systems installed by the RVE program is securing proper and sustained energy supply services.
- Involving rural communities in the decision-making process has contributed substantially to the effectiveness of the off-grid electrification program, adding value to the planning process and giving communities a sense of ownership of the process.
- A study by TERI in 2008–2009 to review the off-grid and grid-connected distributed generation projects produced a number of interesting observations. Lessons learned from the study include:
  - Grid-connected projects have advantages in terms of reliability and quality of supply, as the grid acts as a balancing sink or source, and also supplements power in the local area during periods of plant shutdown. The productive load, irrigation pumps, and agroprocessing can be served on demand, which is particularly significant for small, off-grid projects that are otherwise not being served at all. There also seems to be a greater community demand for grid-connected power, because of the limited hours of supply that off-grid projects provide.
  - Off-grid projects encounter many sustainability challenges, because most of these projects are located in remote villages. These challenges lead to the system's lower plant load factor and low uptime. This leads to a higher generation cost, which users may not be able to afford. Users also become reluctant to pay when the plant doesn't function. Lack of payment then makes it hard for the operators to continue to run the service, creating a vicious cycle in the system that can be difficult to break out of.

23.7.4 China

China is the largest developing country and makes poverty reduction a top priority policy. Since the late 1970s, when China started opening up to the world, it has made immense progress, both economically and socially. This has been the case particularly since the early 1990s, when the country moved from a planning-based to a market-based society. Over the past 10 years, the major energy programs have been rural power-grid development, a national biogas program, a rural hydropower-based electrification program, and electrification in remote areas.

23.7.4.1 Energy Access for the Urban Poor

In general, there are no significant barriers for urban residents to access energy for any purpose. Cities of all sizes have the infrastructure to provide basic services, for example electricity, safe water, and

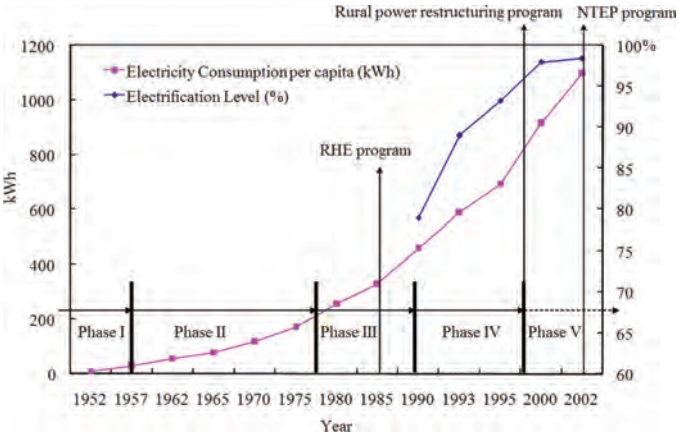


Figure 23.3 | Results of NTEP Program.

telecommunications. The household electrification level[39] in China exceeded 98.4% in 2002, and all townships[40] in China have had access to electricity since the National Township Electrification Program (NTEP) in 2005. The power-grid extension is not determined by affordability, but by the requirements of families. The Chinese government allocates a special subsidy that allows the poorest urban households to afford their basic needs, including energy.

23.7.4.2 Energy Access for Rural Populations

Energy system construction is a key part of China's development of its rural infrastructure. Rural energy should be understood in two ways. One focuses on the general idea of rural areas, while the other concentrates on hard to reach, remote, or mountainous regions. As a large country, the difference in approaches to 'general rural' and 'special rural' is highly significant.

'General rural' requires a universal energy service system. This involves the government promoting development of the energy system in line with the urban standards. This helps to improve livelihoods and the quality of life in rural areas. For 'special rural', remote areas or mountainous regions where infrastructure is difficult to access or construct, China uses local resources, such as small hydropower, wind, or solar energy, to provide clean and relatively cheap energy (in comparison to other approaches, such as grid extension). These are included in the NTEP, which uses wind turbine, solar PV panels, and other advanced technologies.

Electricity is the most difficult infrastructure to develop in rural areas. China has moved rural electrification forward through five main stages (Figure 23.3):

1. The first stage was the initial development period for rural power, from 1949 to 1957. Rural electricity generation depended largely on local resources, but local communities also developed small-scale power stations.

2. The second stage was a stable period of rural power development that lasted from 1958 to 1977. This aimed to meet the demands of agricultural production and irrigation.

3. The third stage, from 1978 to 1989, saw the rural power infrastructure develop rapidly, driven by small hydropower-based primary electrification.

4. The fourth stage, from 1989 to 1998, began as a planned development period from 1989 to 1998. From 1989 the government introduced standardized management to rural electrification construction to ensure effective development.

5. The fifth stage, which has been underway since 1998, highlights management reform of rural power and restructuring of rural grids.

23.7.5 Lessons Learned

- Energy access needs to be closely linked with the creation of social equity, rather than taken in isolation. Energy programs for poverty reduction need to be always integrated into a wider social program, along with access to clean water, roads, and education.

- In general, the experiences were related to social goals, meaning access to modern forms of energy for final use to improve welfare. Energy as a production input in poor and isolated rural areas in combination with other factors and opportunities could create income opportunities. For this, more and deeper analysis is needed.

- Governments need to play an important role in achieving equity. They should, therefore, take responsibility for planning, organization, and social mobilization aimed at fulfilling social targets.

- Developing countries seem to have no unified approaches to addressing poverty reduction and energy access. Speeding up urbanization, under an umbrella of national economic development, would help increase long-term access to energy.

- A universal energy service demands a range of approaches, with specific services for the extreme poor. A universal energy service should not only be oriented to the consumers who can afford the cost, but actually realize a general infrastructure for all the populations.

- Successes in disseminating solar technologies, such as those that Bangladesh, Sri Lanka, Nepal, and India have achieved, demonstrate

39 Household electrification level indicates the percentage of electrified households of all national households.

40 Administrative regions in China are separated by province (autonomous region), city, county, township, and village.

that off-grid programs, in association with the private sector and rural microfinance institutions, are realistic. Projects can be scaled up appropriately, with improved access to capital, development of effective and reliable after-sales service, customer-focused market development, and routine stakeholder participation.

- The Thai and Bangladesh experiences in rural electrification show that, besides the creation of a dedicated entity to implement rural electrification programs, involvement of end users in the distribution-network planning process, and a policy to subsidize low-income residential users, the electricity pricing policy would need to be such that the electricity revenue at least meets the operating costs of rural electrification. Furthermore, the economic growth of the country could provide a sound base for cross-subsidizing the residential users under rural electrification and the generation capacity of the grid system should not be a barrier to expand rural electrification.

- The Indian experience in rural electrification shows the key roles of commitment to targets, enforced through legislation, involvement of the rural communities in the decision-making process (which adds value and gives communities a sense of ownership of the process), and local management to have brought efficient billing and revenue collection, and thereby ensure the stable delivery of electricity.

- Off-grid projects encounter many sustainability challenges because most of these projects are located in remote villages. These challenges lead to the system's lower plant-load factor and low uptime. This leads to a higher generation cost, which users may not be able to afford.

23.8 Latin America Review

23.8.1 Introduction

In many Latin American and Caribbean countries the relationship between energy and poverty is either lacking or treated superficially in national development plans, energy policies, or poverty-reduction strategies. There is also little research on the linkages between access to energy services and national development goals, poverty alleviation and reduction, and environmental issues.

Despite high rates of urbanization, around 30 million people, of which 21.4 million are poor, still do not have access to electricity. Access to modern fuels for cooking is another major problem: either families do not have access to modern fuels or, if they have, it accounts for a disproportionate share of their income (ECLAC, 2009).

It is important to increase our knowledge of the relationships between poverty and energy. It is also important to show that if the goal is to provide access to modern forms of energy, energy policies cannot be approached from a macro view of the energy industry, nor should they be merely part of other issues, such as energy security, geopolitical issues, or climate-change impacts. Energy access policies should not be considered in isolation, but integrated into development policies, regional policies, and other general policies such as health and education.

It is remarkable that several LAC countries do not have policies oriented to reducing poverty and inequity, with the exception of social assistance (from fiscal funds) to alleviate poverty. Such assistance alleviates and reduces the pressures on poor populations, but do not create conditions to reduce or eliminate poverty. Although access to modern forms of energy, like electricity, is relatively high, poverty levels and inequity also remain significant.

23.8.2 Poverty and Energy Access

Approximately 200 million people currently live below the poverty line in LAC, of which some 133 million live in urban areas and 67 million in rural areas.[41] In this region, poverty is more an urban than a rural reality, but the share of urban and rural poverty differs widely across countries and subregions. In South America, about 70% of poor people live in urban areas, whereas only 48% of poor people are urban[42] in Central America (Table 23.11)[43].

Key qualitative differences exist between policy approaches aimed at improving access to energy by poorer populations in rural and urban areas. It is an issue that would need to be considered in the rural and urban contexts, as well as in the context of poverty in general.

Approximately 21.5 million poor people have no access to electricity in the region's 14 most populated countries (excluding Mexico). The region is characterized by highly heterogeneous energy resource endowments, levels of economic development, and Human Development Index across countries, and by very large socioeconomic asymmetries between the top and bottom income groups of the population within each country (see Chapter 19).

Available data show that poor households pay a much larger share of their income for energy services. The bottom income quintile of the population pays between 5% and 16% of their median monthly income for energy, while the top income quintile pays between 0.5% and 3% of their income (Figure 23.4).

The same situation is evident in the sample of Central American countries (see Chapter 19). The difference in energy use and energy expenditure

41 During a decade of reforms (1990–2000), the number of poor people increased by14% as a result of structural reforms (from nearly 210 million to 240 million).

42 Brazil alone accounts for approximately 50% and 40% of the total urban and rural poverty, respectively, in South America. In Central America, El Salvador, Guatemala, Honduras, and Nicaragua account for more than 70% of the total urban poverty, and more than 81% of the total rural poverty in that subregion.

43 See ECLAC, 2009 from where this section draws heavily.

Table 23.11 | Rural and urban poverty estimates in 2006.*

Country	Urban poverty (million people)	%	Rural poverty (million people)	%	Total poverty (estimate in million people)	%	% urban	% rural
Argentina	7.4	7.9	N/A	-	7.4	6	100	0
Bolivia	5.1	5.4	2.7	6.9	7.8	6	65	35
Brazil	46.8	49.8	15.6	39.4	62.4	47	75	25
Chile	2.0	2.1	0.3	0.7	2.2	2	88	12
Colombia	10.0	10.7	11.5	29.1	21.5	16	47	53
Chile	2.0	2.1	0.3	0.7	2.2	2	88	12
Ecuador	3.3	3.5	2.4	6.1	5.7	4	58	42
Paraguay	1.9	2.0	1.7	4.2	3.6	3	53	47
Peru	6.2	6.6	5.2	13.0	11.3	8	54	46
Uruguay	0.6	0.6	N/A	–	0.6	0	100	0
Venezuela	8.6	9.2	N/A	–	8.6	6	100	0
South America	**93.9**	**100**	**39.6**	**100**	**133.5**	**100**	**70**	**30**
Costa Rica	0.5	4.1	0.3	2.5	0.8	3	60	40
El Salvador	1.6	13.6	1.6	12.5	3.3	13	50	50
Guatemala	2.9	23.9	4.3	32.8	7.2	29	40	60
Honduras	2.0	16.3	2.9	22.3	4.9	19	40	60
Nicaragua	2.0	16.5	1.8	13.7	3.8	15	52	48
Panama	0.5	3.9	0.5	3.9	1.0	4	48	52
Dominican Republic (DR)	2.6	21.6	1.6	12.3	4.2	17	62	38
Central America + DR	**12.0**	**100**	**13.2**	**100**	**25.2**	**100**	**48**	**52**

Source: CEPAL, 2009.

* Estimates are based on reported percentages of urban and rural poor from the most recent household surveys available in each country. N/A = not available.

of the top income quintile is as much as three to six times that of the bottom quintile.

Despite the high level of urbanization and electricity coverage achieved by LAC countries, energy accessibility still remains very much an unresolved development challenge for many countries in the region. Lack of access to modern forms of energy sources disproportionately affects low-income groups in most countries, aggravating the large socio-economic asymmetries that remain a major development hurdle for the region.

A general lack of appropriate policies is the principle bottleneck that now impedes access to modern energies in LAC. In the power market, many countries have converted their state-owned monopolies into privatized systems over the past three decades. Many are unbundled competitive markets. These competitive markets place great emphasis on short-term demand with the capacity to pay, and place a premium on existing generation and new-generation investment that have very short construction lead times and low capital intensity. In such markets, the state has largely removed itself from the electricity business. The model does not tend to encourage aggressive electrification programs in rural areas, where profits are hard to generate (Organization of American States, 2004).

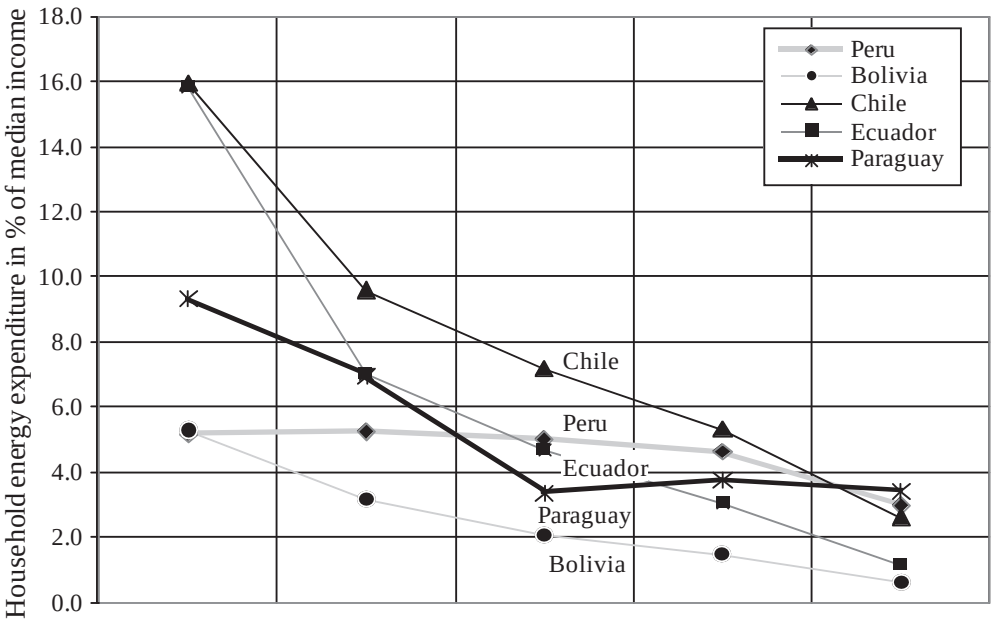
Energy affordability and the need to increase energy access for poor people still features as a low priority in the political agenda of most countries. Neither is part of the regional policy agenda, which has tended to focus on the issues of energy security in the face of higher oil prices, reducing the investment gap in energy infrastructure, and addressing the regulatory gaps and barriers that persist after the energy sector reform process of the 1990s.

23.8.3 Energy Access Policies in Rural and Urban Areas

The policy challenges for rural and urban areas are different in terms of alternative models, technology options, management opportunities, energy portfolios, financial transfers, and guaranteed utilities investments. The barriers that public policies must overcome are different in nature, dimension, level, and magnitude for rural and urban areas (Box 23.10).

In both areas, there is a deficit of information to address the energy-poverty-economy-environment linkage effectively. This is a serious obstacle to policy formulation, as it restricts clear characterization of the problems (lack of systematic information and diagnosis).

In remote rural areas of Latin America, the high cost of providing a grid electricity service and LPG for cooking combined with the low payment capacity



	Q1	Q2	Q3	Q4	Q5
Peru	5.2	5.2	5.0	4.6	3.0
Bolivia	5.3	3.2	2.1	1.5	0.6
Chile	16.0	9.6	7.2	5.3	2.6
Ecuador	15.8	7.0	4.7	3.0	1.2
Paraguay	9.3	6.9	3.4	3.7	3.4

Figure 23.4 | Energy expenditure as percentage of median income per quintile (Q1 to Q5) in South America. Source: ECLAC, 2009. © ECLAC, Figure 7.

and constraints on equipment availability, presents a major challenge.[44] Successful interventions are characterized by multiple policies, including:

- capacity development and technical support;
- subsidized payment and credit for equipment for off-grid solutions at both the household and community levels;
- subsidized monthly energy service bills to match the ability to pay;
- promotion of sustainable firewood use and improved stove/household ventilation programs;
- promotion of women's education and health programs; and
- promotion of community participation and integration into broader national poverty reduction.

Experience in Peru with programs that provide decentralized energy access solutions, such as single-household PV panels and batteries, shows better rates of success when families purchase the equipment and take responsibility for its maintenance through schemes adjusted to their ability to pay. Programs in which the same type of equipment was installed for free by public agencies, without transfer of property, show higher failure rates, with the equipment often non-operational after only a few years because of lack of maintenance. This experience highlights the importance of engaging active participation and financial responsibility of the target communities, adjusted to their ability to pay, to ensure the sustainability of decentralized energy access interventions.

In poor urban settlements, insufficient income and absence of credit combine with illegal occupation of lands, inadequate equipment, clandestine connections to electric power services, and difficult access to regular fuel distribution channels for cooking, heating, and water-heating purposes (e.g., LPG service, gas networks). All these factors prevent access through regular channels, which results in low-quality, informal services and/or deprivation of basic energy needs, with strong impacts on the education and labor prospects that are critical for successful integration into the urban economy. In urban contexts, energy deprivation in combination with inadequate access to sanitary and water services might also have a disproportionate impact on women's and children's health.

Paradoxically, in urban environments, high energy use levels may be found in poor families because they often use second-hand, low-efficiency equipment acquired at low cost in informal markets. This situation highlights the importance of incorporating equipment replacement and efficient use of energy into urban energy access programs. This should

44 The supply of electric power through local solutions, such as small hydropower stations or PV systems through solar panels, could be an alternative to grid extension.

Box 23.10 | Barriers Faced by Energy-access Policies in Rural and Urban Contexts

Problems and barriers in urban areas

- Insufficient or irregular cash income prevents paid access to available energy services and adequate equipment.
- Clandestine connections to electricity grids – associated with accidents, fire hazard, precarious connections, and equipment failures.
- Low-efficiency, second-hand household equipment creates high consumption and waste.
- Precarious or non-existing titling of housing and land properties prevents access to public services and credit through regular channels.
- Social marginalization and insecurity discourage private and public investments to extend existing grids into informal settlements.
- Failure to apply targeted public subsidies to extend service infrastructure that addresses poor settlements.
- Failure to apply cross-subsidies and block-tariff schemes to facilitate access by low-income clients.
- Failure to integrate energy-access projects into urban poverty-reduction programs.
- Resistance to using public subsidies for infrastructure investment.

Problems and barriers in rural areas

- Geographic isolation can render uneconomic the extension of electricity-grid coverage (>$1000–1500 per additional connection).
- Limited distribution of modern fuels (e.g., LPG) for caloric uses because of geographic isolation, distance to markets, and absence of distributing enterprises.
- Insufficient income/lack of credit prevents purchase of decentralized technology equipment (e.g., PV household systems, biomass and minihydropower systems for isolated municipalities).
- Failure of public investment to build the infrastructure required for energization.
- Failure to apply targeted public subsidies to induce the purchase of decentralized energy technologies by households and communities.
- Illiteracy and low levels of education and participation in programs.
- Failure to integrate energy access into rural development and poverty- reduction programs.
- Lack of political will and low priority of disenfranchised rural communities with weak political representation.

include mechanisms for financing new and more efficient equipment, as well as destruction of the inefficient equipment replaced.[45, 46]

Table 23.12 lists the most common types of energy access policies found in rural and urban contexts in LAC countries. Policies used in both contexts, such as subsidization of electric tariffs and household fuels (e.g., LPG, kerosene), are listed under general policies.

23.8.4 Selected Energy Access Policy Experiences in LAC

23.8.4.1 General Fuel Subsidies

Fuel subsidies as part of an energy policy are nominally justified as a means to provide energy access to populations that are otherwise unable to afford it. However, in reality, fuel-price subsidies in LAC are driven by political decisions, and are largely appropriated by affluent sectors of the population who are the largest fuel consumers. The available evidence does not point to any discernible positive impact of these generic fuel subsidies on improving energy access for the poorer population. Despite that, it is estimated that total public expenditure on fossil fuel subsidies in LAC countries amounted to US$25 billion in 2005, of which approximately 8%, or US$2.14 billion, was for LPG. Venezuela, Ecuador, and Argentina spend the largest amount in LPG subsidies[47] (Table 23.13). Uruguay, Brazil, Peru, Jamaica, Honduras, and Chile do not use this type of subsidy. A major opportunity exists in the region to reorient public expenditure away from these highly regressive subsidies, and toward more carefully designed subsidy schemes that specifically target only the poor beneficiaries.

45 Equipment replacement and rational use of energy are the focus of recent proposals in Argentina, Brazil, Colombia, and Cuba, and includes new labeling for refrigerators and the retirement of older, inefficient equipment (ECLAC, 2008).

46 For a more in-depth analysis, see ECLAC, 2009.

47 Transport fuels: diesel oil is subsidized in Venezuela, Mexico, Argentina, Ecuador, and Colombia. Fuel oil is subsidized in Mexico, Venezuela, Ecuador, and Argentina.

Table 23.12 | Policies for energy access in a sample of LAC countries.

Policies for energy access	Argentina	Brazil	Bolivia	Colombia	Chile	Guatemala	Paraguay	Peru
General policies								
Electricity tariff subsidies, general or targeted to poor households	√	√					√	
LPG or kerosene subsidies, general or targeted to poor households	√	√	√	√				
Promotion of private investments in energy-access solutions and/or equipment provision and service	√	√	√	√	√	√		√
After-sales service and maintenance of energy-access solutions							√	√
Promotion of productive and income-generating activities		√	√	√	√	√	√	√
Improved access to basic water and sanitation services for poor households	√	√		√	√			
Rural area policies								
Rural electrification through grid extension (extending electric grid to rural off-grid populations)	√	√	√	√	√	√	√	√
Rural electrification through decentralized renewable energy sources (e.g., PV, biomass, mini hydropower)	√	√	√	√	√	√	√	√
Equipment programs for poor households in rural areas (e.g., stoves, refrigeration, lighting, pumps)		√		√			√	√
Firewood-substitution programs (LPG, kerosene, and other fuels for cooking use)			√	√	√	√		√
Sustainable firewood programs (managed firewood use with improved stoves)		√			√	√		
Capacity development, participatory planning, and local stakeholder engagement in developing energy-access solutions in rural areas		√	√		√	√	√	√
Gender-specific programs			√			√		
Urban-area policies								
Regularization of clandestine electricity-grid connections	√	√						
Equipment replacement and rational use of energy programs for poor households in urban areas (e.g., refrigeration, lighting)		√						
Participatory planning and local stakeholder engagement in developing energy-access solutions in urban areas.		√						

Table 23.13 | LPG subsidies in LAC countries (2005).

Countries	LPG subsidy expenditure in 2005 (US$ million)
Argentina	597.52
Bolivia	35.39
Colombia	168.17
Cuba	73.39
Ecuador	488.89
El Salvador	53.35
Haiti	4.16
Dominican Republic	181.07
Venezuela	531.33
LAC	**2133.27**

Source: Ríos Roca et al., 2007.

23.8.4.2 Brazil: Targeted LPG and Electricity Subsidies for Poor Families

In Brazil, LPG is the main fuel used for cooking. In the late 1990s, as part of a general revision of public expenditure, the government proceeded with the removal of general LPG subsidies. To mitigate the price impact on low-income families from the withdrawal of LPG subsidies, the government created a new scheme in 2001, *Vale Gas*, to subsidize energy supply for low-income families. A gas voucher was introduced for LPG, which provided financial assistance to consumers with a per capita income of up to half the minimum wage. This program was intended to assist approximately nine million people, more than half of whom resided in the northeastern region.

To be eligible for this subsidy, families had to prove income shortage and enlist with the government's registry of poor families. From 2003, the Lula government maintained this program, incorporating it as part of other social support mechanisms, known today as *Bolsa Familia*. It has reached some 12 million families (almost 25% of all families in Brazil) at a cost of US$5.5 billion in 2008 (ESMAP/WEC, 2006).

Targeted electricity subsidies have been used to reduce electricity costs for poor consumers. Progressive rates (low rates for lower levels of consumption) were targeted at consumers who could provide evidence of financial need. In this case, the eligibility of families for subsidized rates was delegated to the utility companies, under the supervision of the National Electric Energy Agency, the regulatory entity of the Brazilian electrical system. In the Amazon region, targeted fuel subsidies are fundamental to increasing energy access. Since 1993, diesel oil has been subsidized through the *Conta de Consumo de Combustíveis* fund (Fuel Consumption Account) with resources collected from special taxes on all electricity bills for households in the interlinked system. This is an example of a cross-subsidization scheme between grid-serviced electricity consumers and off-grid diesel generator users in remote areas.

Incorporation of energy access into poverty-alleviation programs in Brazil

The lowest levels of energy access[48] are found in the north and northeast regions of Brazil, together with the lowest Human Development Indexes in Brazil. The 2000 National Census (Instituto Brasileiro de Geografia e Estatística, 2001) shows that 64% of households without access to electric lighting have a family income below two minimum wages. This figure increases to 89% for households below these minimum wage units. Since the 1960s, the Government of Brazil has invested in rural electrification programs, recognizing that energy access in isolated areas is central to reducing poverty and hunger, improving health, literacy, and education, and improving the living conditions of women and children. The federal Program for Energy Development in State and Municipalities began in December 1994 with the explicit goal to reach isolated regions that do not have grid coverage, mainly through PV systems and locally available renewable sources. The major focus was the electrification of about 50,000 schools without electricity and of water pumps in areas vulnerable to drought. This program was later incorporated by the Cardoso government (1995–2002) into the *Luz no Campo* program, run by *Eletrobras*, the state-owned electric utility. Its objective was to finance the electrification of one million new rural consumers over a period of three years through grid extension. In turn, the Lula government (2003–2010) maintained this program under the name of *Luz para Todos* as an integral part of the government poverty-alleviation policy *Bolsa Familia*. Official data show that as a result of the program 1,877,362 additional households gained access to electricity during the past five years.[49]

The major features in the success of the Brazilian programs include:

- political priority and government commitment to rural electrification programs since the 1960s;
- continued public investment and strengthening of program budgets through various administrations from 1995 to 2009;
- effective mechanisms for targeting the available subsidies exclusively to poor families in need, thus ensuring highly efficient public expenditure; and
- integration of the energy access program into the government's broader policy of social support for poverty alleviation.

48 Habitants without access (%): Brazil = 5.5, north = 17.6, northeast = 11.1, middle-west = 3.9, south = 3.1, and southeast = 1.9 (Ministero de Minas y Energía, 2003).

49 This section draws heavily from a paper elaborated by Suani Teixeira Coelho, Patricia Guardabassi, Beatriz Lora, and José Goldemberg.

Box 23.11 | Colombia's Act 142 (Régimen Legal de Bogotá D.C., 1994)

Colombia's Act 142 of June 11th 1994 established a regime for the provision of household public services. It sets out explicit social equity criteria, such as:

- continued expansion of public services coverage through systems that offset the insufficient payment capacity of users;
- proportional tariff rates for low-income sectors according to principles of equity and solidarity;
- subsidies to people demonstrating insufficient income;
- stratification of individual households according to a common national methodology and criteria, and clear identification of the households to be provided public services at the municipality level;
- public investment support, and use of other incentive instruments, to promote utility companies in departments and at the national level.

23.8.4.3 Colombia: Massive Gas-application Program 1997–2009

The use of cross-subsidy schemes helps lower income users to pay for services and covers their basic needs.[50] In practice, higher income households, commercial, and industrial users pay a surplus on the full cost of the public service. This is defined by the Solidarity and Redistribution Fund. These funds are used to subsidize the public service cost for the lower income users. Intermediate income groups pay the full price.

These principles have guided Colombia's massive gas application program since the mid-1990s. The program started by connecting lower income users, providing natural gas for household caloric uses. The plan increased the number of households using gas from 0.5 million in 1991 to 4.3 million by July 2007, and the number of municipalities covered from 191 in 2000 to 415 in 2007. Available data show that the program has continued to target low-income users as the primary beneficiaries. Of these 4.3 million households, 53% are in low income categories (strata 1–2) and receive subsidized rates, and 85% are in the lower half of income categories (strata 1–3). Only 15% of households fall into the upper income categories (strata 4–6). It is difficult to quantify the amount of state contributions to this plan, but it is widely known that the highest cost did not derive from the subsidies to poor people, but from an income transfer made by the state company *Ecopetrol* (producer of the natural gas) to another state company, Ecogas (distributor and transporter of the natural gas, which was privatized in 2007). It is difficult to assess if this model could be replicated in other countries, as it depended on the particular institutional framework in Colombia at that time. The main lesson from this policy experience is that when there is sufficient political will and state backing, it is possible to find formulae to achieve massive gains in bringing energy services to the lower income population (ECLAC, 2009).

50 Official Journal: Santafé de Bogotá, D.C., Monday, July 11, 1994. CXXX N° 41.433.

23.8.4.4 The Argentine Off-grid Electrification: an Example for a Medium Developing Country

Argentina has made significant progress in its efforts to reform the power sector. While it has a relatively high overall rate of electrification (over 95%), substantial numbers of the rural population still remain without electricity services (over 25%). The Renewable Energy for Rural Markets Project (PERMER) aims to provide about 35,000 remote rural households, 1750 public services (rural schools, health posts), and 500 productive uses with electricity through provincial 'off-grid concessions' that are negotiated or bid out for minimum subsidy and regulated by independent provincial regulating agencies. The concessionaire is free to choose the least-cost technologies applied to meet its obligation to provide universal service.

This project subsidy is about 50–60% and paid partly at the time of procurement of a new lot of systems and partly against met installation targets, to balance the advantage of a direct control of outputs with manageable working-capital costs to the concessionaire. Installations, service quality, and customer satisfaction are verified *ex post* by the regulator. The monthly fees paid by the user are for O&M costs and for recovering the concessionaire's share of investment costs.

To ensure that energy services meet the local demand, as well as to attract private sector interest, market studies were conducted for all interested provinces. The existence of such a market study is one of three preconditions for becoming a PERMER participating province entitled to subsidies from the bank loan.

The business model is changing 'from grid to off-grid.' The management and technical personal of the utility involved in the project is linked to the utility in charge of the grid-connected market. Various lessons have

been learned and the utility way of doing business has changed. Most of these changes are aimed at lowering the extremely high costs of operating and maintaining the very remote and dispersed systems. One common underlying element to most of these changes is an increased attention to the responsibility of local users, microenterprises, and subcontractors for O&M, fee collection, and new installations. This approach is a promising way to improve concession models and combine a variety of important advantages:

- Reductions on O&M cost as they can replace costly field visits by visits of the subcontractor.
- The subcontractors are closer to the market, both in geographic and social terms, and can hence react directly and in a more flexible way to individual customer needs.
- The majority of users are indigenous – and so are the subcontractors. This improves communication.
- Being present locally, the subcontractor has a better grip on potential reasons for payment default.
- This local social control works both ways because subcontractors feel responsible toward 'their users' for the overall service quality.
- Some of the users pay the subcontractor with goods instead of money, which reduces default rates and increases local market efficiency.
- Additional high-value employment and income is created in local microenterprises.
- One of the subcontractors has started to offer a variety of additional services in response to local demand.

The user is the central part of any off grid system; therefore borders blur between user and utility. One of the most interesting findings of a recent study on the emerging issues of service quality is that both the perception of responsibilities and the specific O&M arrangements for the individual off-grid systems have evolved over time, depending on the specific users and technicians.

Training is crucial. A full-time sociologist has been hired to improve user training and demonstration material for SHS. A training session is given to each user during system installation. The aim is to:

- improve battery treatment so as to decrease life-cycle cost and increase user satisfaction (fewer failures);
- avoid misuse of components (e.g., short-cutting fuses and charge controllers, use of inadequate loads) so as to reduce system failures (and the related costly repair visits!);
- improve the users' understanding of their systems and energy efficiency measures (i.e., to increase 'energy culture') and the roles and responsibilities of each player so as to improve overall user satisfaction; and
- ultimately to lower the default rates.

Regarding the regulator, two important ways for cost reduction were identified:

- Adopt adequate 'off-grid service standards.' Specific regulations for rural service have to be adopted to allow for the different service levels provided by off-grid systems. Regulations were simplified to consider the off-grid situation.
- The driving force behind all of the utility's improvements to its business model is the aim to decrease the high costs of visiting remote, decentralized systems. In any remote off-grid system, the user is by definition the only one who is always at hand. User behavior therefore decides about the ultimate quality of service, and interventions from the utility side should be avoided where possible. The most interesting improvement is the integration of independent local microenterprises as 'subcontractors' in the downstream part of the rural service-delivery chain.

23.8.4.5 Bolivia and Peru: Rural Electrification in Remote Areas

In Peru, electricity coverage in rural areas has made steady gains, increasing from approximately 8% in 1993 to 30% in 2007. The Government of Peru has announced plans to further extend electricity coverage to 5.6 million people through public investments of US$1.33 billion between 2008 and 2017 (Ministerio de Energía y Minas, Republic of Perú, 2008). In Bolivia, electricity coverage of rural areas rose from 6.8% in 1976 to 28.3% in 2001 (Espinoza, 2005). Through its latest 2002–2007 rural electrification plan (*Plan Bolivia de Electrificación Rural,* PLABER, 2003) the Government of Bolivia expected to expand this coverage to 45% by 2008, investing some US$170 million to connect 200,000 additional families. The estimated cost per additional rural connection in both countries runs slightly above US$1000 per household, increasing for more remote communities.

The experience of both countries clearly shows that gains in rural electricity coverage require a strong commitment of public resources to infrastructure investments over extended periods. It also shows that the support of international cooperation agencies and regional development banks[51] has played a key role in supplementing scarce national funds to tackle successfully the large social investments demanded by rural electrification.

51 Such as Corporación Andina de Fomento, InterAmerican Development Bank, etc.

The development of a market for decentralized energy technologies in rural areas requires large investments in pilot projects, technical assistance, technology transfer and diffusion programs, capacity development, and the engagement of local communities. Many of these extension activities have been funded through international cooperation projects. Bolivia has made steady gains in rural electricity coverage from about 12% in 1992 to over 30% in 2005.

In both countries, rural communities show a positive willingness to pay for energy services, with many installing diesel generators despite their relative higher tariffs. Around 25% of households in remote rural areas actively seek to install PV systems, through both private and international cooperation projects. Low rural incomes severely limit the ability to pay the full cost, so a key factor in the success of these programs is the design of appropriate financing schemes. Financing schemes generally take the form of a combination of a monthly service tariff (to be paid by the user) and a one-time subsidy paid by the government to install the equipment. Depending on the scheme and the ability to pay, a portion of the equipment might also be paid by the user through a combination of microcredit, tariff payments, or other means. Ideally, a project should catalyze the development of a self-financed local system, with paying users and service providers organized through a private or local community enterprise.

Financing schemes in successful projects are generally characterized by the following features:

- Rural households assume ownership and financial responsibility for part of the cost of the equipment that is transferred to them. This creates incentives to care for and maintain the equipment owned by the household (e.g., in-house equipment, such as batteries and lights).
- Sufficient public funds are assigned to the project to subsidize the capital and installation costs of the technology as required by the rural household's ability to pay. The public agency must also ensure thorough testing and certification of the technology prior to installation.
- Monthly service tariffs paid by rural households must be set at a level that reflects both the ability to pay and the coverage of local costs. Both are necessary to ensure the system's longer term sustainability.
- A private or community enterprise is established to collect tariffs, provide maintenance and technical support, and ensure the whole system's quality of service.

23.8.5 Lessons Learned

- Results depend on a proactive role by government in the energy sector, and in many cases through its own public utilities, to accelerate universal access to modern forms of energy.
- Definition of feasible and attainable targets for sectors without access, as well as possible resource availability, along with the target group's economic, social, and environmental condition.
- Specific support, particularly in rural areas, to facilitate the mobilization of local funds to contribute to closing the funding gap. The mobilization of these resources requires appropriate mechanisms and enabling institutional and legal frameworks, not only at national, but also at local levels.
- Adequate management models are needed to guarantee long-term sustainability for rural access to electricity and modern fuels. Examples of failure were related to the absence of or inadequate management of projects for off-grid or remote settlements energization.
- A specific pro-poor regulatory framework to protect poor communities and promote access to modern forms of energy at an affordable price and tariff.
- Scale-up investments targeted to decentralized energy systems. Successful examples and expertise around the world should be leveraged.
- The scope of energy use and investment subsidies in both rural and urban areas should be defined clearly.
- Allocate funding and resources to create local capacities and promote energy literacy to ensure the effective involvement of local actors and their organizations in the energy planning and decision-making processes. Capacity and knowledge are the key elements to empower poor people to participate in the energy debate – and in the production, implementation, operation, maintenance, and use of the local energy infrastructure.
- Energy for poor people would need to included, as a specific chapter, in an integrated framework of energy projections.
- Reasonable supply horizons would need to be guaranteed by means of callable investment plans.
- Capacity development and reinforcement would also need to go hand by hand in the development of pro-poor policies.
- Deeper integration and cooperation at the regional level could facilitate access to modern forms of energy at the same time as reducing energy costs, expanding the market, increasing possibilities for projects that are not feasible at national level, sharing energy resources, and promoting technological development.

23.9 Concluding Remarks and Suggestions

A substantial amount of analytical work has been carried out on the main ways to address the challenge of access to modern forms of energy. Some recent accomplishments include:

Table 23.14 | Examples of energy access – direct and indirect assistance.

Access investment type	Investments or grants in:	Objective
Direct	Modern fuels for cooking Rural, urban, and peri-urban electricity Productive uses of energy in homes and small businesses Energy efficiency for households, communities, or small businesses Institutional development and reinforcement	modern forms of energy for households and communities modern forms of energy for new or improved productive uses and small enterprise development Development of new institutions to support energy access Improvements in energy efficiency (household or building efficiency for residential energy)
Indirect	Development of information systems and data records Improvements in policies, strategies, and technical assistance Sector studies of energy-access issues Power plants, transmission, and other infrastructure that support the development of greater energy access	Facilitate improved investment for energy access Investments in supporting infrastructure necessary to extend new or improve quality to existing households Promote economic development that can help poor people in more indirect ways Generate information on energy services for poor people Development of policies and strategies to enhance energy access

- identifying and documenting best practices in rural electrification;
- mobilizing expanded investment from both the public and private sector;
- developing frameworks to regulate new institutional arrangements for modern forms of energy provision, including private electricity distributors that serve rural and peri-urban populations;
- developing methodologies and case studies that demonstrate the benefits of targeted energy service investments for poor people;
- improved understanding through surveys and other research on how poor people meet their energy needs in the rural and peri-urban context; and
- regional strategies for scaling-up energy access, focusing mainly on electricity.

The main areas identified as a priority for addressing energy access include the expansion of rural electrification programs in many developing countries through grid or off-grid programs, a greater attention to the policy reforms necessary to address energy for the urban and peri-urban poor, and a refocusing on the problems involved in the use of traditional fuels for cooking.[52] It is also important to address the more upstream investments necessary to expand energy access to poor people. These are issues highlighted as important in the transition to higher quality fuels and appliances for poor households in developing countries.

This development of knowledge, experiences, and proposals is an important contribution to the design and implementation of policy strategies and concrete actions. However, the figures show that major efforts are still needed to make universal access a reality.

International development agencies are committed to promoting affordable energy access in developing countries, but sometimes retain many of the old biases of previous strategies and policies. An energy strategy must start from a deep analysis of the need for energy by poor people. Energy access and affordability are multidimensional and context dependent, and the appropriate responses to these are equally diverse. In several cases 'energy' is essentially taken as synonymous with 'electricity,' which does not demonstrate an understanding of the full range of energy needs, and so cannot fully address energy access.

Past investments in programs such as rural electrification and renewable energy for rural areas have yielded significant achievements in terms of progress in countries that are committed to such programs, along with new intervention models that are also replicable elsewhere. In most countries, these investments must, of course, be complemented by the development of supporting infrastructure (Table 23.14).

Current priorities demand greater strategic direction, such as:

- Direct assistance to poor people to facilitate access to modern fuels and electricity through various measures and incentives.
- Reduce costs and increase efficiency in upstream infrastructure for urban, peri-urban, and rural populations.
- Improve, promote, and implement energy efficient programs oriented to poor people.
- Promote good governance, including transparent and pro-poor regulatory mechanisms.
- Removal of other key barriers, such as up-front costs.
- Develop specific institutional frameworks with fixed targets and adequate resources, both human and financial.
- Implement international financing mechanisms, based on soft loans, oriented to develop and subsidize the necessary infrastructure to facilitate access to modern forms of energy.

52 For reasons that need deeper analysis, the majority of the efforts are oriented to electricity and much less so to fuels for caloric uses.

Case-specific analyses are necessary to develop appropriate solutions. Some countries face major difficulties in addressing the problem because of the low level of development and weakness of the economic system.

23.10 Key findings and lessons learned

This chapter's discussions and analyses offer a range of lessons and insights:

- Although efforts have been made to improve access to electricity and modern fuels, the energy gap – both between developed and developing countries, and between wealthier and poorer people in many countries – persists, and is even widening.
- Governments and international organizations recognize the positive effects of access to energy services. However, very few countries have yet developed a comprehensive approach to improving access with a specific focus on poor people.
- There are significant gaps in our knowledge of energy services, as well as a poor understanding of the main reasons for, and barriers to, access to modern forms of energy.
- The structural reforms implemented during the 1980s and 1990s emphasize efficiency, but ignore social issues. This has helped create a non-friendly environment for energy access.
- Priorities could include the following:
  - Increase energy coverage for households and productive uses.
  - Enhance generation capacity by including regional projects and regional cooperation.
  - Address energy services for key public facilities, such as schools and clinics.
  - Push for better achievement of basic human needs, represented by energy services, such as provision of electricity for lighting, health, education, and community services, and modern fuels and technologies for cooking, heating, and sanitary uses.
  - Solutions would need to be tailored to individual country contexts, especially in relation to institutions, capacity, and energy resource availability. A mix of actions for each country would be driven by the availability of resources, plus the legal, regulatory, and policy environment, the institutional and technical capacity, the relative cost of implementation of the different solutions, and/or the sociocultural contexts.
  - Capacities should be developed and reinforced at individual, institutional, and systemic levels to enable feasible and affordable policies to be designed and implemented.
- The significant gains achieved in electricity coverage, for example in India, China, and Latin America, were mainly the result of strong political commitment and public investment programs executed through public utilities with clear development mandates.
- The transference of resources between the oil productive chain and the natural gas productive chain has financed infrastructure development and expansion in several Latin American countries.
- Levels of poverty, particularly in rural areas of LDCs, require that infrastructure investments be either subsidized or wholly executed through public funds, because the low income capacity of the target users prevents full cost recovery.
- Governments must acknowledge that extending energy access further to poor people will only result from a political decision that establishes clear mandates, targets to be achieved, and commitment of the required public funds over extended periods of time (decades). There is sufficient evidence that important changes will only be possible through political will at the highest level.
- International cooperation and development banks have played a key role in providing concessionary financing and grants to supplement national funds, making the undertaking of these large investments possible. This would hopefully continue.
- Investment and O&M expenditure on modern forms of energy represent a significant proportion of total investment and GDP in LDCs. Achieving universal access in these countries by 2030 will require international support, political compromise in sustainable development, and reduction of inequality.
- Effective targeting of direct and indirect subsidies has been a key to all the successful experiences of expanding access to electricity, modern fuels, and associated technologies to poor populations. It will not be possible to avoid subsidies if the targets are to be achieved. In many countries, significant opportunities exist to apply cross-subsidization and differentiated/block-tariff schemes in energy services across income groups, to enable adequate access and regularization of services to the poorest populations.
- Facilitating access to appliances was a key component for households and, in successful programs, allowed them to benefit from increased energy use. Energy services provision should include access to modern forms of energy and access to appliances.

The main lesson learned from past experiences on the implementation of strategies and actions for access to modern forms of energy and technologies is that there is some room for original or innovative proposals.

Key basic principles or enabling conditions that appear repeatedly in documents or proposals include:

- Providing universal access to modern forms of energy is a necessity, not a luxury.
- The need for good understanding of the energy services to be addressed, along with reliable analysis.
- It is imperative to transform the paradigm. Energy activities are not just another industry, but a system with strong socioeconomic and environmental dimensions, with direct impacts on the sustainable development of any country. Energy is not a commodity, but a strategic good. It is essential for economic, social, and environmental sustainability.
- Governments must make long-term commitments, with explicit and clear public policies oriented toward poor people.
- Several good practices can be replicated elsewhere in places that experience similar circumstances (policies and regulation, capacity development, technical standards, best-available technologies, financing and implementation approach, coordinated research and development).
- The need for soft funds and financing mechanism to develop infrastructure and to provide up-front costs for the potential consumers.
- Direct government involvement in implementation, through public utilities or private or non-profit organizations (e.g., NGOs, cooperatives) or adequate public-private cooperation.
- The oriented subsidies (direct or indirect) to create enabling economic conditions.
- Access to modern forms of energy for poor people should not only be conditioned to clean energy forms but also to clean appliances.

23.11 Policy Options and Some Recommendations

To achieve the overall goal of economic growth and poverty alleviation but avoid the pitfalls of poor planning and inappropriate targets is a daunting challenge in any context. Providing universal access to modern forms of energy poses its own set of additional institutional and policy challenges, which have historically hindered efforts to increase energy affordability and are a major reason why so many people remain without access to better energy services. Policy recommendations can take the form of general ideas or guidelines. Regional and national contexts should be considered in defining strategies, instruments, and measures.

23.11.1 Diagnosis and Information

A better understanding and a clearer diagnosis of the structure and functioning of energy systems, along with the needs (energy services) to be supplied, is needed. It has often been absent in the discussion of proposals and the role of public policies.

An information system on energy use will help to identify problems and barriers, and will promote understanding of local conditions, sociocultural behavior, and a system's ability to implement actions.

Section 23.3 remarks, adequate information on needs to be satisfied and priority energy services to be provided are the necessary initial step. Identification of barriers and problems to address energy affordability is a key issue to identify, design, and implement adequate strategies and measures.

Good policies and strategies need good diagnosis. Wrong or absent diagnosis could mean inadequate proposals. Support and funds to diagnosis and information would need to be part of the strategies.

23.11.2 Reform of the Tariff, Tariff Structure, and the Subsidy Systems

Subsidies are generally justified as a response to inequality and social expectations in energy provision (Barnes and Halpern, 2000; UNEP, 2002). However, their net effect can be positive or negative depending on the intended goals of the subsidy, and the way a subsidy is implemented.

An effective tariff and subsidy regime has to be transparent and minimize administrative costs to avoid gaming of the system and to maximize the benefits that accrue to the intended recipients (UNEP, 2002). The subsidies themselves would need to have some of the following characteristics:

- **Clear mandates**. Subsidies would need to have clear mandates and be appropriately financed to ensure that the financial burden is acceptable and properly allocated, and that the opportunity costs are not too high.
- **Targeted**. Subsidies could be designed so as to reach those most in need and to ensure that resources are not wasted. Lifeline tariffs can be tied to other aid programs to ensure they are meeting the recipients' needs.
- **Phased**. Subsidies would need to be established with clear guidelines for their phasing out, such as a sunset clause or performance-based milestones.
- **Market enhancing**. Subsidies that help develop and nurture a market early in its development can be very effective, while subsidies that can undercut a growing market should be avoided.

- **Flexible**. Subsidy programs would also need to incorporate flexibility to deal with the uncertainties that are an inevitable part of making changes to institutions and markets.

- **Complemented**. It needs to be complemented with funds toward solving the first cost capital financing problem (Barnes and Halpern, 2000). Up-front costs of equipment are, usually, the key barrier.

Generally speaking, social tariff and social prices are the instruments with which to address poor people. Two conditions are key elements in the definition and application of such social tariff and prices: to be sure that all the poor people that need the subsidy are included (guarantee of inclusion) and to be sure that people that do not need the subsidy are not included (guarantee of exclusion).

Finally, for economic sustainability of the system it is necessary that average costs of the total energy provided be covered by the average tariff or by the price recovered by the provider.

23.11.3 Innovation and Guarantee of Financing Mechanisms

Financing mechanisms are needed for every scale of energy intervention. Mobilizing affordable and genuine international, regional, national, and local funds is crucial. Sustainable energy access will not be achieved by occasional or intermittent donors and actions.

Existing and new financing mechanisms could be oriented so that they have a real impact in addressing energy access for poor people. This review process needs to be inclusive, and result in the modification of procedures and mechanisms to enable small and non-conventional energy programs targeted to poor people to receive adequate funding. Likewise, the proportion of pro-poor energy investments would need to increase consistently with the magnitude of the challenge at hand. This is urgent if the funding gap is to be bridged.

The mobilization of local funds should also be considered. International financial institutions and donors can play a facilitating role. The mobilization of these resources requires appropriate mechanisms and enabling institutional and legal frameworks not just at the national level, but locally too.

23.11.4 Changes in Regulatory Structure

Current regulations often act at cross-purposes to the efficient delivery of services through new and innovative technology and institutional options, such as the use of distributed generation (ESMAP, 2001; Morgan and Zerriffi, 2002). This is the result of both regulatory structure and regulatory practice in systems that have generally been put in place with centralized utilities in mind. It is difficult for such centralized regulatory systems to monitor effectively a large number of smaller operators. Similarly, the regulatory burdens on the smaller operators of a system designed for large utilities can be prohibitive. These regulatory problems can be handled in a variety of ways, including the creation of standardized licenses, the delegation of regulatory responsibility, flexible power quality and reliability standards, and tailoring regulations to different types of entities (Reiche et al., 2006).

23.11.5 Capacity Development and Strengthening

Capacity development can be understood as the processes of creating, mobilizing, enhancing (or upgrading), and converting the skills and expertise of institutions in the contexts required to achieve the specifically desired socioeconomic outcomes. Capacity development must be achieved through activities at the individual, institutional, and systemic levels. Capacity-development efforts at each of these levels are discrete elements of the capacity-development process (Bouille and McDade, 2002).

No single institution can have the capacity to resolve the complex governance, energy, and capacity-development challenges and their linkages to issues of equity, environmental sustainability, economic efficiency, and public sector management. The challenges are not static, but change in dimension, location, priority, and costs as the energy system evolves.

An interdisciplinary perspective and a multistakeholder approach are needed to address the multiple dimensions of access to modern forms of energy.

Resources would need to be allocated to develop local capacities and promote better knowledge of local energy. Local populations would need to be involved in energy planning and decision-making processes. Better understanding of the role of energy can contribute to the sustainability of systems and improve relations between the energy provider and the energy user. Target actors for capacity development should include government, the private productive sector, civil society, academia, consultant institutions, and the media.

23.11.6 Policy Alignment

Energy policy is part of a wider development policy and would need to be aligned with other sector policies and objectives. If these policies are misaligned, they can reduce the effectiveness of any given policy. Policy misalignments can occur when different energy policies work at cross-purposes or when government priorities that could benefit from an effective energy policy are not aligned.

While individual technology choices are made at the microlevel (that is, by an individual or small group of decision makers), these decisions

are influenced by policies at the macrolevel, generally, the government (Stewart, 1987). The impact of macropolicies on technology choice is the result of changing "firm objectives, resource availability and cost, markets, and technology" (Stewart, 1987). For example, high import tariffs on technology components can significantly drive up the price of distributed systems and so act as a barrier to access. Taxes can also change the relative pricing of traditional versus modern fuels, creating price pressures even on those without access.

At a broader level, there is a need to link rural and peri-urban energy supply more closely with rural development. This would shift the focus from minimal household supply to a more comprehensive approach to energy that includes productive activities and other welfare-enhancing uses of electricity. Ideally, the linkages between energy and other policy priorities, such as health, education, and poverty alleviation, should be recognized explicitly and local solutions that address these needs be encouraged and supported. By taking a more comprehensive approach, revenues can be increased because of the higher ability and willingness to pay by productive users, and the effectiveness of investments should be higher because of the link with welfare-enhancement goals. The new mix of customers and demand allows for natural market segmentation, which improves the viability of energy supply efforts.

To be effective, policies and programs within the energy sector geared toward low-income energy services also need to be aligned with other poverty-alleviation efforts. Provision of infrastructural services, including modern forms of energy, does not change the poverty equation. When development efforts fail, improvements to electricity supplies alone have little effect on local welfare. Work done in Peru found that providing a combination of services – electricity, water, sanitation, and telephones – had a greater impact on poverty reduction than that provided by a single service. Adding a fourth service resulted in welfare improvements that were seven times greater than those delivered by the second service.

Many populations experience an inability to pay for energy services. In some cases, such as in Lao People's Democratic Republic, villages have been connected to electricity for 15–20 years, but around a quarter of households remain unconnected (Independent Evaluation Group, 2008). Where purchasing power is the underlying problem, it is critical that provision of modern forms of energy be evaluated alongside other development options. Overall, given the low returns on investment in energy services, and in particular electrification, it is essential that public resources be concentrated on the investments that have the greatest impact on development. Poor people are more likely to benefit from an access to modern forms of energy approach that creates jobs and raises income, as opposed to a simple household connection.

23.11.7 Regional Integration and Cooperation

The traditional approach of limiting energy planning and service provision to the political frontiers could be a barrier for access to modern forms of energy. There are several reasons why nation-based planning is suboptimal:

- The geography of energy supply options does not necessarily correspond to political boundaries – the cleanest and cheapest energy source may lie across national borders.
- National energy markets are often too small to justify the investments needed for particular energy supply options.
- Cross-border energy supply often provides diversification of energy source – a key component in energy security and cost reduction.

Latin America offers several examples in which integration and cooperation among countries reduce energy costs and, indirectly, facilitate access to energy.[53] Africa, for example, has very good potential for such integration based on projects or interconnection. An integrated energy market, such as in the European Union, is not necessary. An expanded regional market could offer feasible technical options to reduce costs and still maintain the integrity of national markets. Bilateral or multilateral agreement on energy projects that share costs and benefits could be an enabling action to expand markets to low-income populations. The development of energy markets on a regional basis offers significant benefits, as the linking of national petroleum and electricity industries can help mobilize private and domestic investments by expanding market size.

Major benefits are associated with regional energy integrations: improved security of supply, better resource allocation, enhanced environmental quality, and wider deployment of renewable energy resources, all of which contribute to access to modern forms of energy and sustainable energy systems.

Africa has a regional diversity that offers substantial opportunities for integration. Regional integration is increasingly being seen as a way for individual countries that suffer from structural and economic weaknesses to join the global economy. Better macroeconomic conditions will facilitate access to energy.

23.11.8 Final Remarks

Overall, and on the basis of successful experiences of increasing access to modern forms of energy, no single approach can be recommended

53 Close to 100% of Paraguay's population has access to electricity. This was made possible by South America's two largest binational hydroelectric power plants: Itaipú, made and financed by Brazil, and Yacyretá, implemented by Argentina. As both countries need the energy and have the capacity to implement the project, they could afford the project. Paraguay provided 50% of the river and paid 50% of the investment in energy. Both projects enabled Paraguay to have full access to electricity, a very difficult task for the country to achieve alone. A similar situation exists in Central America and in the Caribbean, where the major oil-producing countries (Venezuela and Mexico) are cooperating with small, oil-importing countries in the Caribbean. For example, Venezuela and Cuba exchange oil for medical assistance.

above the others. What is clear, however, is that the current institutional arrangements and policies have met with mixed success, at best. Reforms are needed, at global and country level, to strengthen the feasibility of energy projects for poor people, expand the range of actors involved, open up the regulatory system, and allow for innovation. Several examples demonstrate that some of the main factors for success include:

- Political will and government priority;
- Continuing support, both financial and administrative;
- Effective mechanisms for effective targeting of policy interventions; and
- Integration of energy policies with other sectoral policies, particularly those dealing with poverty alleviation where these exist.

Success depends on regional, national, and local circumstances. In some instances, such as Nepal's Rural Energy Development Program (REDP), a decentralized and participatory decision-making process and a holistic development approach is very important. This goes together with a strong community-mobilization process that focuses on:

- organizational development,
- skills enhancement,
- capital formation,
- promotion of technology,
- environmental management, and
- empowerment of vulnerable communities.

Participation, transparency, consensus decision making, and inclusion of all households in the community, irrespective of class, color, creed, or sex, are the four pillars of good governance to ensure equal ownership and equitable sharing of benefits accrued from MH systems.

Challenges and economic, sociocultural, and political barriers require more elaborated strategies and a higher global compromise to satisfy GEA objectives. The key catalyst to improving access to energy in some Latin American and Asian developing countries is political will. The examples of India, China, Argentina, Chile, or Brazil all demonstrate that if a political decision is made, the results are positive. However, this has not been the case in many sub-Saharan Africa countries, in LDCs, and in those with a very low Human Development Index. In these countries, universal access to modern forms of energy by 2030 will not be achieved with microactions and isolated measures, unless they are integrated into a long-term national program with clear targets, dedicated and guarantee funds, adequate institutional frameworks, and robust strategies. An approach based on providing a few thousand solar lamps to rural settlements, or a PV with capacity of just a few watts, will improve the quality of life for poor rural inhabitants, but are not capable of real improvement in welfare and securing the inclusion of marginalized populations. They can be seen as intermediate actions, but should not be considered as a solution for access to modern forms of energy.

Reforming the way in which energy is financed and sustainably operated has a major potential to reduce inequality. Lifeline subsidies are needed, at the very least. There are conditions under which cross-subsidies can be effective, but this may require a different role for both higher level government agencies and the international system. Some principles, such as supporting energy planning, making investment capital available, creating incentives for commercial lending, promotional campaigns, and technical assistance, have already been identified for certain markets. Centralized agencies can also aid in coordination, in eliminating conflicts in mandates and programs, and in helping to build much needed local institutional and organization capacity.

The circumstances in developing countries militate that the energy path, especially for rural and peri-urban areas, be dissimilar to that followed by developed countries. This will require innovation and experimentation on both the technological and institutional levels. Lack of appreciation of such approaches at the policy level is curtailing progress, because many policymakers tend to follow conventional approaches without taking account of contextual differences.

We know that universal access to modern forms of energy at the household level depends on various factors, such as prioritizing energy access, long-term policy commitments by national governments to create strong institutional, regulatory, and legal frameworks, and financing from all available sources. It is important that governments facilitate support from national and international development organizations on the research, design, and development of appropriate technologies. Collecting, compiling, and sharing knowledge is equally important.

It is expected that governments will report on the progress they have made on addressing the energy access agenda in all its dimensions, including funding for small decentralized solutions, community capacity development, leverage of local indigenous financing, and achievement of national energy access targets, among others.

Last, but not least, the wide range of material analyzed shows that abundant ideas and proposals are available to address many different situations. What is absent are political decisions to implement them.

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