

DOUGLAS F. BARNES, EDITOR

The Challenge of Rural Electrification

Strategies for Developing Countries



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Edited by

Douglas F. Barnes

RESOURCES FOR THE FUTURE
Washington, DC, USA

ENERGY SECTOR MANAGEMENT ASSISTANCE PROGRAM
Washington, DC, USA

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To my family—Mary Ann, Andrea and Chris

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Preface

Most people in the world just have to flip a switch and they can use lights, televisions, computers, machines, tools, and many other appliances that enable them to read, obtain news, be entertained, and participate in productive work. Rural electrification had been quite successful in stimulating development in all developed and many developing countries, so this study was initiated to see why it has been difficult to reach the approximately 1.6 billion people who still do not have electricity. In this day and age it seems almost unthinkable that in Africa 90 percent of people in rural areas are without electricity. Even in growing economic powers such as India there are close to 400 million rural people without access.

The Challenge of Rural Electrification describes how to develop effective institutions, provide efficient and enabling subsidies, and keep distribution utilities afloat financially during a period of rapid expansion, all in ways that are politically acceptable to a wide range of constituents. The contributors to this volume document how a diverse set of countries in the developing world has met and conquered these challenges. This book can serve as a guide for countries embarking on the road toward implementing programs that provide electricity to difficult-to-reach populations.

This book is of particular interest to a wide range of people, including policy-makers, electricity distribution specialists, economists, and politicians, who have not yet achieved high rates of providing electricity to people in rural areas. In academic circles, those interested include historians, economists, political scientists, and sociologists, as the case studies touch on many aspects of these various disciplines. In fact, the authors of these case studies cover a wide range of disciplines, including engineering, energy, social science, and economic history.

When we first started this project, rural electrification was falling out of favor with many international financial agencies, in part because they perceived large public projects as going against the trend toward privatization of energy services. This was compounded by problems encountered in their own portfolio of rural electrification projects. In the private sector, approaches to rural electrification never seemed to take off because it is a difficult business. In its beginning stages, rural electrification is not a profitable business, and few private sector and sometimes even public sector companies are interested in making the investments needed to serve mainly poor rural people. As a consequence, there must be subsidies in such programs that encourage the development of commercially viable

service companies. One should not be surprised that this sometimes leads to political interference, poor subsidy design, and consequently poor performance of many distribution companies. Most recently, rural electrification and energy access in general have come back into favor with a somewhat different orientation. Governments are involved in promoting rural electrification in almost all instances. Today we also are seeing decentralized electricity services in many remote areas that were not possible many years ago.

In the earliest stages of this study, in a time when rural electrification seemed to be quite unpopular among development agencies, we decided to complete two case studies of successful programs and document the ways in which they were organized and implemented. After completing the first two case studies in Thailand and Costa Rica, it was clear that despite significant differences—Thailand has a publicly run program and Costa Rica involves distribution cooperatives—they faced similar problems. Also, during the preparation of these case studies, we found that there had been many successful programs around the world that were quietly and successfully providing electricity to rural customers, some of which were not even relying on any kind of financing from outside international agencies. Thus, we decided to document a broader number of successful programs to determine whether lessons could be learned from them. The project expanded slowly until we had documented enough programs—ten in all—so that we could be fairly certain of the reasons for successful rural electrification in the face of so many that had failed.

The case studies in this book provide evidence that there certainly are no simple solutions or magic formulas for successful rural electrification programs, as this study found a variety of models that can work, including those from public sector companies, cooperatives, and private firms. Instead, to be successful, countries must follow a set of fairly well-defined but rather flexible principles, including ways to approach subsidies, a clear path toward financial viability, cooperation with local communities, adoption of appropriate standards to achieve low cost electricity distribution, and an arms-length relation with the government.

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This book is the culmination of the work on rural electrification in developing studies financed and supported by the Energy Sector Management Assistance Program of the World Bank. We owe much debt and gratitude to the dedicated staff of ESMAP who over the years have encouraged us to prepare this book. Jamal Saghir and Ede Ijjasz-Vasquez have provided valuable support to bring this work to completion. We also are especially appreciative of the support of Dominique Lallement and Karl Jechoutek, both of whom have a keen interest in alleviating energy poverty and promoting energy development around the world. Richard Stern and Dennis Anderson must be given credit for starting the World Bank efforts on rural energy. Also, the innovative rural energy work of Willem Floor and Robert van der Plas provided a significant background for many of the findings in this book.

In addition, we would like to acknowledge the contributions of the original ESMAP support staff and the case study editors. The publications staff, including Heather Worley and Marjorie Araya, has been instrumental in assisting in the development of this joint publication with RFF Press. The support staff that coordinated and administered much of the research contained in this book includes Nyra Wallace and Maureen Cuffley. Norma Adams tackled the unenviable task of editing many of the original case studies. We thank Paula Berard for the editing and preparation of the manuscript. Finally, we also wish to thank Grace Hill and Miriam Dowd for the production and marketing of this book. They were helpful beyond expectations in completing this project in a timely manner.

I truly appreciate the comments and insights of those who provided peer review comments on an earlier version of this study. Karl Jechoutek provided a review that assisted in setting the framework for the book. Anton Eberhard provided advice for the conclusion and other parts of the work. A long time colleague, Andrew Barnett, not only gave constant support for the project in his role as an advisor to ESMAP, but also provided useful insights for the final editing of the manuscript. This work would have been impossible to do by myself. Within the World Bank, excellent comments were provided by Demetrios Papathanasiou and Fanny Missfeldt-Ringius. Also, I wish to thank all of the authors who not only wrote their chapters, but had to put up with my constant advice and recommendations for revising them for what seemed like a million times.

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The Challenge of Rural Electrification

CHAPTER I

The Challenge of Rural Electrification

Douglas F. Barnes

MORE THAN 1.6 BILLION PEOPLE in the world are without electricity. Most of these people are in rural areas of the developing world, where the pace of electrification remains painfully slow. Why is this so? Providing electricity to remote, rural people is often easier said than done. Well-publicized problems plaguing some programs have led to wariness about rural electrification among energy policymakers. Some highly subsidized programs, for example, have drained the resources of many state power companies, with highly damaging effects on their overall performance and quality of service. The result is widespread brown-outs and blackouts for their existing customers and a reluctance of the power companies to reach out and provide electricity service to the poor.

Rural electrification programs can undoubtedly face major obstacles (World Bank 1975, 1996). Low population densities in rural areas result in high capital and operating costs for electricity companies (Denton 1979; Fluitman 1983). Consumers are often poor and their electricity consumption low. Politicians interfere with the orderly planning and running of programs, insisting on favored constituents being connected first and preventing the disconnection of people not paying their bills. Local communities and individual farmers may cause difficulties over rights of way for the construction and maintenance of electricity lines.

Yet despite these problems, many countries have been quietly and successfully providing electricity to their rural populations. In Thailand, well over 90% of rural people have a supply. In Costa Rica, cooperatives and the government electricity utility provide electricity to more than 95% of the rural population. Again, in Tunisia, more than 95% of rural households already have a supply. Thus, there are many good examples of successful programs to counterbalance those that have experienced problems. This book focuses on the characteristics of successful rural electrification programs by examining the accomplishments and difficulties that have been overcome.

Rural Areas Still Lag Far Behind in Access to Electricity

Worldwide energy availability issues are under increasing scrutiny, and access to electricity services is a special concern. One reason for this scrutiny is the commitment of international development agencies to promote the Millennium Development Goals for the purpose of halving poverty by the year 2015 (United Nations 2003, Sachs 2005). Neither energy nor electricity is stated as a goal under the Millennium Development Goals, but electricity actually provides the foundations for most of them (Modi et al. 2006). Without access to modern energy services, it is generally agreed that the achievement of these goals would be difficult, if not impossible.

The growth in the number of people who have gained access to electricity over the past few decades has been quite remarkable. Today more than 1 billion more people have electricity compared to 25 years ago. But as impressive as this accomplishment is, population growth over the period has meant that big gaps in access to electricity remain. About 1.6 billion people—around a quarter of the world's population—lack access to electricity (International Energy Agency 2002). Moreover, under today's energy policies and investment trends in energy infrastructure, projections show that as many as 1.4 billion people will still lack access to electricity in 2030. In sub-Saharan Africa only 8% of the rural population has access to electricity, compared with 52% of the urban population. A similar disparity exists in South Asia, where only a little more than 30% of the rural population has access, compared with approximately 70% of the urban population. Indeed, four out of five people without access to electricity live in rural areas of the developing world, mainly in South Asia and sub-Saharan Africa.

Although higher income and mainly urban households now have access to modern energy, the world's poorest households do not (Table 1-1). With the exception of towns and cities in Africa, most urban areas in developing countries now provide electricity to their residents, although the reliability of this supply is sometimes intermittent. Thus, the problems of electricity access are now far greater in rural than in urban areas. Although urban population growth rates will continue to exceed those in rural areas, this actually means that the rural populations must become more productive and efficient at satisfying ever-increasing demands for food and other farm products.

In many African and South Asian countries, the rate of the number of people gaining access to electricity is even lower than rural population growth. In Africa, 9 out of 10 rural people do not have access to electricity or appliances. In South Asia, which has a large number of poor people, more than 800 million people do not have electricity. These dramatic figures have recently become a central issue in the debates over how to achieve improvement in education, reduction of diseases, and overall quality of life for rural people in developing countries.

The conclusion is that even though progress has been made, there still is a long way to go to raise the world's poorest populations above the poverty line. Without access to modern energy services—including electricity—it would be virtually impossible to meet the challenge of achieving the Millennium Development Goals or more generally to reduce poverty in the developing world. Having

Table 1-1. *Electricity Access in Developing Countries, 2005*

<i>Country or Region</i>	<i>Population without electricity (millions)</i>	<i>Percent of population with electricity</i>	<i>Percent of urban population with electricity</i>	<i>Percent of rural population with electricity</i>
South Asia	706	51.8	69.7	44.7
Africa south of the Sahara Desert	547	25.9	58.3	8.0
North Africa and the Middle East	48	85.8	91.5	77.5
East Asia	224	88.5	94.9	84.0
China*	8.5	99.4	100.0	98.9
Latin America	45	90.0	98.0	65.6
Developing countries	1,569	68.3	85.2	56.4

* For China, figures are for 2002.

Source: IEA 2006, WDI 2006, and author's calculation.

said this, there has been some controversy over the effect of rural electrification on development in the past (Barnes 1988), and it is still true that electricity is a necessary but not sufficient condition for development. Thus, the next section deals with the role of electricity in promoting both social and economic development.

Why Worry about Rural Electrification? A Review of Important Issues

Countries are often faced with a dilemma concerning the provision of electricity. Over the long term, the benefits of providing electricity to poor rural households can be quite high, as evidenced by the well known positive relationship between electricity consumption and gross domestic product. This correlation is mirrored by the relationship between a country's rate of electrification and the percent of households that are above the poverty line of two dollars per day (Figure 1-1). This figure illustrates that the rate of electrification is related to the percentage of a country's population that is above the poverty line. Their rates of electrification are higher than what would be expected given their level of development, but despite this relationship, the initial cost of developing the infrastructure is high and unaffordable for poor people. The benefits must be evaluated and compared to the costs involved in providing electric service. Building extensive central grid distribution systems with miles of medium- and low-voltage lines is expensive to light a few light bulbs in the rural areas that have low densities of consumers.¹

The social and economic benefits of rural electrification have been researched over the past 30 years. One notable review was conducted in the early 1980s covering several countries (USAID 1981; Butler et al. 1980; Goddard et al. 1981;

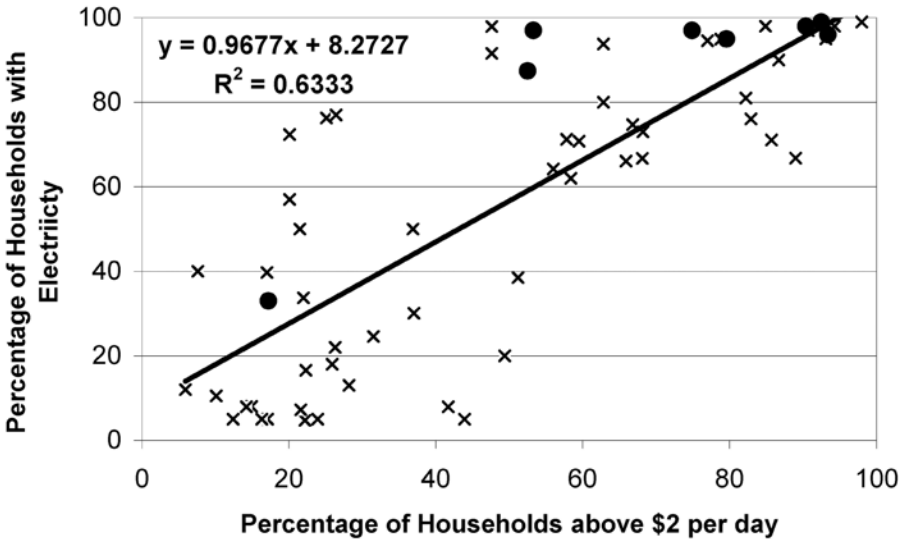


Figure I-1. *The Relationship between the Percentage of Electrification and the Poverty Rate for Developing Countries*

Note: The eight developing countries in this report are indicated by solid circles. Data for rural electrification rates are for 2002, and for the % households above poverty, they range from 2000 to 2004.

Source: World Bank 2002. Development Data Group, World Development Indicators database. Tables prepared on electrification rate for business renewal strategy. Energy and Water Department, World Bank, Washington, DC.

Madigan et al. 1976; Mandel et al. 1980). Intuitively, one can easily understand that in households with electricity, people are better able to undertake activities that require higher levels of lighting, such as reading and studying (Barnes et al. 2003; Samanta and Sundaram 1983). They can also listen to the radio or watch television, and attend to more household chores (World Bank 2004a, b). In contrast, the kerosene lantern or candles in the household without electricity emit a dull light inadequate for reading or close work (Nieuwenhout et al. 1998; Van der Plas and de Graaff 1988). In such households with no electricity, the family may retire early after a fairly unproductive evening.

Such accounts may seem to overstate the actual value of rural electrification, but they are typical of the expected benefits for rural areas anticipated by both politicians and those still living in rural communities without electricity. In this section, we review the evidence of the social and economic effects of rural electrification, but not the benefits versus the costs, as this is a completely different area of research (for a review, see Webb and Pearce 1985; Barnes and Halpern 2000; World Bank 2002b). In addition, there is discussion of equity issues and subsidies for rural electrification.

Importance of Social Effect and Household Benefits

The arguments for rural electrification often have centered on the transformative effect that it can have for rural households. At the micro level, the effect of rural electrification on a household can be substantial. At the macro level, the arguments for rural electrification have revolved around the productive work that can be done in rural areas with electricity.²

In rural households that adopt electricity, lighting is the first choice by households as they begin to use electricity. Virtually 100% of households with electricity use it for lighting, as electricity allows activities to continue through the evenings. Cooking is not changed significantly in most households with electricity, except in Latin America, where electricity is used for cooking in some urban areas. In general, rural households prefer the traditional wood, coal, and charcoal stoves to the more expensive electric stoves or even heating plates or coils. However, there is some emerging evidence that in households with electricity, women are spending less time in fuel collection and meal preparation, even though they do not change their cooking fuels (World Bank 2002a, 2004a). The apparent reason is that with lighting in the evening, women can prepare the main meal just before it is eaten rather than preparing some dishes during the day and then reheating them at night.

Women and children are prime beneficiaries of rural electrification. Lights and appliances had a significant effect on household work in the early stages of rural electrification programs in the United States, as appliance use reduces the drudgery of household chores. A study in India found that electric appliances helped decrease the amount of toil and thus increased the time available for family and leisure activities (World Bank 2004a). At a minimum, all households used electricity for lighting. The other major uses were space cooling (fans) and watching television. This report also established that in general women from homes with electricity were better able to balance paid work, household chores, and leisure than women from homes without electricity. Similarly in Bangladesh (Barkat et al. 2002), women in households with electricity spent less time on household chores. Other studies have found that lighting alone made a dramatic difference in one's ability to do household chores at night and to read for education and leisure (Lay and Hood 1976; Khandker 1996; Gordon 1997; Filmer and Pritchett 1998; Kulkarni and Barnes 2004). However, the socioeconomic background of the household often determined the trade-offs they made with their time and the extent to which they could enjoy the advantages of electrification.

To conclude, an overriding impression from some of the recent reviews is that rural electrification has a significant social effect. For instance, the positive benefits include increased appliance use and more reading—especially for children. The findings of the effect of electricity on migration are somewhat mixed (Herrin 1979), with no conclusive evidence. Education and electrification definitely appear to be mutually reinforcing programs (Saunders et al. 1978; Velez et al. 1983; Khandker et al. 1994; World Bank 1999; Kulkarni and Barnes 2004; Arcia 2000). In this section, the social benefits of electricity have been reviewed

without reference to the division of the benefits between social classes. In other words, the benefits of rural electrification may well be distributed unevenly among the rural population. The next section examines the equity of the effect of rural electrification.

Importance of the Economic Impact

Due to the importance of economics for rural life, a brief review of the economic effect of rural electrification is in order.³ This section concentrates on the effect of electricity on agriculture and on the growth of rural businesses. However, to a great extent the economic effect of electricity depends on government policies directed toward either household or productive uses. In some countries and among some donor agencies, the overemphasis on the economic benefits of rural electrification has meant a lack of proper perspective. This emphasis does not mean to deny the importance of electricity for economic development, but policies supporting both social and economic effects seem to lead to favorable program results.

For instance, the rural electrification policy in India since the early 1960s has focused on the promotion of electric pump sets, which has had a large effect on agricultural productivity (Das 1990; Bose 1994; Barnes 1988). This effect is in part due to the fact that India has in place an aggressive agricultural development program, including the dissemination of hybrid seeds, fertilizers, and other agricultural inputs, along with a policy to subsidize electricity for water pumping. Credit programs also have helped agricultural development in India, whereas in some other countries there are no similar programs to complement rural electrification.⁴

India's effort to improve rural development through electrification has been relatively successful, but it is not unique (Barnes et al. 2003). For instance, the growth of electric pump sets in Bangladesh is much lower than those experienced in India, but it has been higher than was expected at the beginning of the program (Barkat et al. 2002). However, no similar effect has been measured in other countries. For instance, one survey in a relatively rich rice-growing region in Indonesia found that the rate of growth of pump sets was low because most irrigation was accomplished through gravity-fed sources (Brodman 1982; U.S. Census Bureau 1980). This finding is similar to those in the rice growing regions in India (World Bank 2002a; Barnes et al. 2003). Also, the price of diesel fuel in Indonesia is heavily subsidized, making it less attractive for farmers with pumps to switch to electricity. Thus, the productive effect of rural electrification can be substantial, but the effect depends on factors such as government policy and complementary programs.

Businesses in rural areas of developing countries include home businesses, small commercial shops, grain mills, sawmills, coffee and tea processing, as well as brick kilns (for a review, see Cabraal and Barnes 2006). The effect of rural electrification on small businesses is determined by the nature of the local community, the complementary programs, and the ability of rural entrepreneurs. Although electricity is an important and often essential input that helps in the development of small rural industries, the other complementary conditions include access to

good rural markets and adequate credit. Perhaps because these complementary conditions are not present in all rural areas, the anticipated growth of industries in rural areas provided with electricity is somewhat slow (Zomers 2001). However, areas without electricity have an even worse record of business development. For instance, in a recent study in the Philippines, small home businesses were found to be more active in areas with electricity, contributing to family incomes (World Bank 2002b). The majority of these businesses are small general stores for food and other necessities.

Finally, an overemphasis on rural productivity can divert attention away from the household benefits. As indicated earlier, there are substantial social benefits of rural electrification, which accrue mainly in the evening hours, when small businesses and commercial establishments are not operating. Thus, the same investments can serve two complementary purposes at the same time.

The conclusion is that electrification is an important condition for the development of rural businesses and that under the right circumstances, it has resulted in significant economic growth. However, it is unrealistic to expect that it will produce an explosion of industry and commerce in a short time, especially in the absence of other development programs. Concerted effort is needed to coordinate rural electrification with other relevant programs. Without such complementary programs, the full socioeconomic effect of electrification probably will not be realized, and the required substantial capital investments may not be fully exploited. Electrification projects properly coordinated with such programs or implemented under the right regional conditions will increase productivity and improve the quality of rural life.

Distribution of Benefits and the Equity Controversy

The Achilles heel of many rural development projects is that their social and economic benefits are unequally distributed. To ensure the participation of the poor in development programs, the United States Agency for International Development (1981) many years ago adopted a policy to help the “poorest of the poor.” The World Bank has as its main goal to eradicate poverty. Questions have been raised over whether the “poorest of the poor” can benefit from large, capital-intensive projects such as rural electrification. Many critics of rural electrification claim that the expensive electricity distribution systems will serve only the wealthiest families and thus reinforce existing inequities and distribution of wealth. It is well documented that the adoption of electricity by rural households is highly dependent on income level. Thus, the rich will be able to partake of all of the benefits of electrification, such as the use of modern appliances and lighting. In contrast, the rural poor may not be able to afford electricity; in fact, they may not even be permitted to have access to electricity because their houses are of substandard quality.⁵ The implication is that considerable money allocated to rural electrification systems would be better spent on projects that more directly improve the lives of the rural poor.

Although equity is an important part of the work on rural electrification, many studies on rural electrification fail to deal with it in a meaningful way. Associations

between income and electricity often are reported as evidence that electrification results in an improvement in rural household incomes, when the causal relationship could be the reverse. Households with higher incomes may be those that chose to have electricity. On the other hand, poor regions are proclaimed not to benefit from rural electrification without a proper examination of the long-term benefits and disadvantages of electrification. It is declared that poor households do not directly benefit from electricity use, but unfortunately no attempt is made to measure indirect benefits, such as employment creation or the effect on women and children.

The empirical evidence that does exist suggests that the direct effect of rural electrification for rural households, especially over the short term, may worsen rural inequality. The poor are not totally excluded, but in just about all countries, the poor adopt electricity at a lower rate than do more wealthy households. For instance, in 1980 in the Philippines, it was estimated that households below the poverty level could not afford electricity (Mandel et al. 1980). However, a more recent Philippines survey found that whereas households above the poverty line adopt electricity at a much higher rate, nevertheless, many poor households that are below the poverty level do adopt electricity (World Bank 2002b). In higher income countries, such as Costa Rica or Colombia, the adoption rate of electricity also is much higher, meaning that the negative equity effect is much less pronounced. For instance, in Costa Rica, which is now at the end of its program, almost all households that are within the reach of electricity lines adopt electricity, and this figure includes those households considered below the poverty line (see [Chapter 2](#)).

Thus, on the question of household equity, the news is both good and bad for rural electrification. The bad news is that in countries with extremely low incomes or poor records of income distribution, the poor will not be able to afford electricity at first. In fact, those wealthy households that can afford electricity will be able to purchase more appliances, thus potentially widening the gap between the rich and the poor. This lack of affordability by the poor can be partially addressed through the use of appropriate subsidy policies. The good news is that for those households that adopt electricity, their overall quality of life is enhanced compared to nonelectrified households, and to some extent the gap between the middle and wealthy households is narrowed. Also, women and children as a group benefit more from rural electrification than men, which is somewhat uncharacteristic of those rural development programs not directed specifically toward women.

This discussion of equity naturally leads to an assessment of subsidy issues because it generally is accepted that without some kind of initial program subsidies, it is unlikely that rural electrification will be able to reach the world's poorest populations.

Making Rural Electrification More Equitable: Important Subsidy Issues

Most rural electrification programs in the world have involved some kind of subsidy. The issue of subsidy justification generally is not addressed in most of the country studies in this book, but, the type of subsidies and means of financing rural

electrification is covered in great detail within the chapters. However, it is necessary to touch on subsidy justification in this chapter because of its importance to encouraging success or sometimes dictating the failure of some programs.

Despite laudable objectives in many poorly managed programs, subsidies have often failed to meet their stated objectives of making services more affordable to the poorest families or households. All too often, subsidies have become the grist of politics and have been provided to those already with access to modern services. It is no coincidence that in developing countries the populations with access to energy services are the middle- and upper-income households. Even well-intended subsidy programs can have problems (Barnes and Halpern 2000; Komives et al. 2005). Subsidies have often been implicit, such as default or non-payment of electricity bills. They also have been untargeted, such as a subsidy for energy used by all. Another characteristic is that they have been indiscriminate, such as a subsidy for a quantity that is well above that needed by poor or rural populations. Finally, most subsidies become *complex*, or difficult to administer to targeted groups, and overly restrictive with respect to end use or technology, depriving users of choice.

The effective programs in this study can generally be considered as being based on good subsidy policies. Of course, some of the countries have performed better than others, but generally all have achieved a measure of success in relation to subsidy policies. What is the reason or justification for this statement? According to most subsidy theory, several criteria need to be reviewed to evaluate whether a subsidy is justified or not. We can call them the three Es—efficiency, equity, and effectiveness (World Bank 2002b).

Efficiency refers to maximizing the social (or economic) benefits under the assumption that even the best energy project has an opportunity cost. That is, is this an efficient investment for society? For this question, one must calculate an economic rate of return. For most projects, the anticipated rate of return is positive. Projections are developed, costs are estimated, and the benefits to users are calculated. We do not quantify the economic rate of return in the case studies involved in this study because we are examining only workings of different rural electrification programs, and not projects. However, most of the projects within the countries have had to pass a rate of return test to determine if the investment is good for society in general.

Equity refers to the efficacy of the subsidy. In other words, do the subsidies actually reach poor people who do not have electric service? Rural electrification is a process of providing new connections to households that have never had electricity. In the early stages of the program, the project generally does not reach the poorest households in society. However, this fact means that if a country already has 70% of households with electricity, then a rural electrification program is well targeted to reach the poor because it is providing access to the poorest 30% of society. It would be inequitable to leave those remote areas with no electricity and without access to the benefits enjoyed by the rest of society.

Effectiveness refers to the fact that justified subsidies have to be in a program that works because otherwise they are by definition poorly targeted. Nothing could be worse than pouring subsidies into a program that does not work

properly. Many rural electrification programs have suffered problems. Sometimes distribution companies would build the electricity lines and then would find one excuse after another to keep consumers from using electricity. India is an example of a country that has invested heavily in rural electrification, but in some states the program has not created the proper incentives for the electricity distribution companies—called state electricity boards—to serve a high percentage of rural households. There are many reasons for not providing service to rural consumers even after lines are built, but the main one is that electricity prices for consumers in rural areas often are set low, and companies actually have a disincentive to serve them.

The main emphasis of this study is on identifying the characteristics of effective rural electrification programs and insights that can be gained from the types of subsidies used in such programs. The case studies were selected based on the criterion that distribution companies within countries had reached a high percentage of their rural populations and provided high-quality service to consumers. The rationale for examining these best practices of rural electrification was that the problem programs garnered most of the attention of development practitioners and the best programs gained little fanfare.

So how did it happen that rural electrification was subsidized without running into significant political problems? The country studies make it clear that there would not have been any significant rural electrification without a political decision to take some kind of initiative to make electric supply more inclusive. Similar arguments have been put forward by political theorists who are developing democracy-enhancing approaches to political and social equality (Jechoutek 2005). The important point here is that it may be mainly the enabling environment that counts. The ability to make choices freely depends on the capacity to exercise equal rights as equally respected citizens. Having theoretical access to electricity may be of little use to villagers under the thumb of local elites who will keep them excluded from being able to improve their lives. States without a determination to mitigate overall inequality probably will not be successful in establishing equal access for rural electrification either. Thus, successful programs are more likely to emerge in countries with a longer and more complex view of development.

What Are the Challenges?

Expanding the coverage of electricity service and improving its quality poses formidable challenges. Some challenges are unique, but many are inherent to the rural environment. These are challenges with which industrial as well as developing countries grapple, and they must be addressed by any national rural electrification strategy or program.

Rural areas are characterized by low population density with a significant number of households that are poor. This density results in low levels of household demand for electricity, which generally is concentrated at evening peak times. The low population densities mean that electricity distribution costs must be spread over

relatively few people, resulting in high costs for each unit of electricity consumed. Demand normally matures slowly (over two to three years and even longer) as consumers wire their houses, invest in appliances, and make the switch from other fuels for lighting and cooking. As the demand grows, the cost per customer for rural electrification declines. Unfortunately, this progression is difficult to predict, making returns to investment in grid extension to poor rural people uncertain.

Thus, grid expansion costs are typically high in rural areas because loads to be served tend to be small and widely dispersed. The cost of rural electrification can, however, be minimized if design standards are modified appropriately, and the choice of technology is based on both financial and potential socioeconomic benefits to a community or region.

Operating and maintaining systems in rural settings poses additional difficulties. For large centralized utilities, retaining and supervising a cadre of technical staff is more costly and problematic in a rural setting. Larger distances make supervision difficult and expensive, resulting in low-quality maintenance, high levels of corruption, and high rates of absenteeism.

Most rural electrification programs involve some form of subsidy to encourage rural consumers to adopt electricity. This subsidy has caused two types of problems. The first is that because governments are providing subsidies to rural electrification, politicians feel that they have a right to intervene in the operation of the distribution company to get electricity to their constituents. After connection, they also intervene on behalf of their constituents to restore service that has been cut off due to lack of bill payment. This interference often makes the cost per consumer even higher and causes financial stress for the company providing the service. The second problem is that subsidies that are poorly designed can lead the distribution company away from a primary emphasis on serving consumers. Instead, they may maximize the amount of subsidy they can extract from the government with rural service as a secondary goal. Once such a consumer orientation is lost, the quality of service is sure to suffer.

Main power companies often have institutional difficulty meeting special demands of rural distribution (Zomers 2001). For integrated power companies, the rural consumer makes up such a small part of their business that the power companies often do not pay attention to the numerous possible ways to minimize costs of service to them. The result is that rural electrification becomes a tolerated loss-maker for the company, and ways are found to cut corners in terms of customer service. For instance, rural consumers more often than not are the first to be cut off when there are problems with power supply in developing countries.

Local community-level problems often provide an obstacle to rural electrification. For instance, the poles and lines cut across the rural countryside, and sometimes local elites object to having lines on their property or to the compensation methods that have been developed to pay for the rights of way. Thus, ways have to be developed to involve communities in the process of rural electrification.

Thus, the way to successful rural electrification is paved with problems to be solved. The chapters in this book illustrate how each country has devised solutions to these problems. Some countries have been more successful than others in meeting the challenges to rural electrification.

The Approach of This Study

The main goals of this study are to illustrate how a variety of countries have successfully addressed the problems inherent in having successful rural electrification and to draw lessons from these programs for countries that are just now beginning to tackle the challenge. By examining the many ways in which programs have succeeded, other countries at the beginning or in the middle of this long journey can benefit from this body of experience. These diverse experiences should make it possible for others to follow in their footsteps. Thus, in the conclusion of this study, we will describe the practices that should be emulated and those that should be avoided.

This study is the most complete compilation of rural electrification case studies ever put in one volume, and it is hoped that this body of work can provide both encouragement and guidance to those countries sincerely interested in and committed to providing electricity to their rural populations. Creating a viable market for rural services that includes appropriate and adequate incentives for private investors is a complex process. At the heart of the challenge is the fact that large investment capital is required, combined with significant benefits for countries but poor financial returns for electricity distribution companies. This challenge is even more daunting in that the achievement of the Millennium Development Goals is undoubtedly impossible without adequate availability of rural infrastructure.

Research Methods and Issues Examined in Country Studies

The method chosen to uncover and evaluate the best practices was to examine a particular set of issues for countries with successful programs. This method not only provided a description of how the programs achieved their goals within countries but also provided a way to compare across the countries. Thus, all case studies were conducted based on a similar set of issues or questions.

The authors of each individual country study conducted field visits, collected data, and conducted interviews with officials who are influential in rural electrification policy decisions. Each case study provides a history of the program, including the important decisions that were made during the course of rural electrification, as well as identifying and explaining all relevant issues affecting the rural electrification program for each country.

One significant issue involves how countries make it attractive for poor rural consumers to connect to the grid. Therefore, the studies include the policies for financing the initial connection charges to increase consumer access to electricity. It is also important to understand the pricing of electricity and how the distribution companies cover the high costs involved in rural electrification programs. The studies were expected to elaborate on any and all charges in monthly bills such as monthly fees for meter rent, along with the usual charges for electricity itself. On the investment side, there have been several ways to finance rural electrification to make electricity service more affordable by rural people. As a consequence, the source of the subsidies, including subsidized loans, cross-subsidies, and others have been examined in the chapters.

As indicated, many rural electrification projects have problems because of over-expansion to regions with little electricity demand. The reasons for this can be pressures to serve political constituents or just poor planning. Thus, it was important for each case study to examine the regional or village level of “objectivity” in fixing priorities for investments in rural electrification projects. This prioritization might be characterized by the degree of autonomy that the utility has in order to make appropriate decisions on distribution planning. The chapters provide details on the ways in which criteria were used for establishing priorities and goals, including how decisions are made on data collection and investment planning. Finally, another issue involves understanding the degree of coordination of the rural electrification program with other rural development or infrastructure initiatives.

The country studies in this report also examined how companies dealt with the typically lower levels of electricity demand that are found in rural areas. Attention was paid to how customers were billed and how the distribution company related to them. For instance, are there any programs to inform consumers about their service, about ways to use electricity efficiently, and about ways to use electricity productively? Many of the well-run programs have active monitoring and evaluation of their customers’ use of electricity.

The regulatory framework is also important for rural electrification (Reiche et al. 2006; Brown et al. 2006). The framework usually includes issues such as how rural distribution companies purchase power from the main grid company and, of course, how prices are set so that the companies can remain financially viable.

Thus, the method used to determine the best practices in rural electrification are both historical and qualitative in scope. The reviews stand on their own, but they also provide valuable lessons for how to accomplish rural electrification in a world with more than 1.6 billion people without electricity.

Successful Approaches in the Country Studies

This book focuses on rural electrification programs that have been successful. The main criteria for selecting countries for this study was that the countries demonstrated a significant level of growth of rural electrification during the past 20 years in ways that are financially sustainable. The eight developing countries that were selected for the study are listed in [Figure 1-2](#), and the time frame is for 1980 and 2000. Because they are so advanced, the United States and Ireland are not included in this figure. The lines in this figure represent the level of real per-person income as represented by gross domestic product adjusted for inflation and purchasing power⁶ and the percentage of people in rural areas with electricity from 1980 and 2000. As can be seen in the figure, all countries had real economic growth during the period, and this growth correlates with growing access to electricity by people in the rural areas. The countries with the highest levels of growth and high rates of rural electrification are Tunisia and China. The countries started at quite different levels of electrification, and this difference contributes to the diversity of experience that can be explored through the case studies. For instance, Bangladesh—a poor country—started at close to 10% of its population with electricity in 1980 and progressed to a little less than 30%. Both Thailand

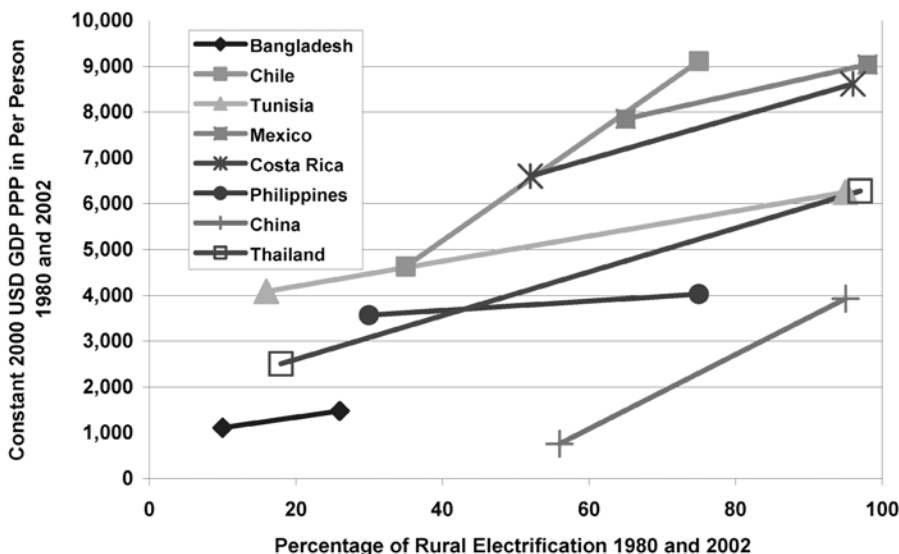


Figure I-2. Country Case Study Levels of Rural Electrification Development, 1980 and 2000

Note: Due to currency fluctuation, the data for the Philippines is from 1985 and 2000.

Source: World Bank statistics and data tables 2006.

and Tunisia had low levels of economic development in 1980 and progressed to quite high levels by the year 2000. They managed to provide electricity for almost all of their rural populations without electricity, even though they started at close to 20% in 1980. Some countries, such as Mexico, Costa Rica, and Chile, started at higher levels of development and made significant progress during the 20-year time frame.

The countries with successful rural electrification programs do not seem to follow one institutional model, indicating that rural electrification does not seem to be constrained by different ways of providing electricity to rural people. In this study, we have divided the case studies into three categories. The first category involves a model of rural electrification exemplified by the rural electric cooperative model that is derived from the experience of the United States (Ross 1972). Examples of developing countries following this model include Costa Rica, the Philippines, and Bangladesh. There is also a chapter on how the rural electric cooperative model was developed in the United States. The cooperative system of rural electrification has a great deal of merit. The people being served by the cooperative are the owners of the distribution company. However, the supervising agencies overseeing such cooperatives had the foresight to recognize that such companies must be run according to business principles.

A common path to rural electrification is through public companies. The chapters on successful public companies, the second category, include Thailand, Mexico,

and Tunisia. Ireland, a developed country, has a model public rural electrification program. Recently, many development specialists have tended to ignore the success of well-run public companies by insisting that companies must become private to be run efficiently. It is true that privatization of public companies is a worthy goal because many public companies are inefficient and driven by political agendas (van der Fehr and Millan 2003). However, many public-sector electricity companies were created because the private companies that they replaced were in the business of making profits rather than extending service to unprofitable markets made up mainly of the rural poor. So the case studies illustrate that there has been an interesting swing from the private sector serving mainly urban areas, to public companies overextending themselves, and now back to the private sector again. One of the most interesting conclusions of this study is that the institutional form is not as important as the adherence to strict business principles in operating rural electricity distribution companies.

In the third category, there are two chapters that involve private or decentralized electrification companies. Chile has had private-sector and cooperative electricity distribution companies for more than 20 years, and they have a unique subsidy program to encourage these companies to serve people in rural areas. Although definitely not classified as a private program, China's electricity distribution program developed in a decentralized manner. Local companies, mostly at the county level, were supported and nurtured by the central government to become full-fledged and often independent companies. These two chapters illustrate clearly that even with privatization or decentralization, most rural electrification programs involve some form of subsidies, and without them progress is likely to be limited. Even for private companies, a great deal of attention is necessary to get the right balance of providing subsidies to encourage expansion, while not creating a dependence on them. Most of the successful countries that make up the main chapters of this book also started off at low levels of rural electrification and had the patience and commitment to see the program through many difficult periods.

The question rightfully can be asked whether programs that have not been successful could also hold lessons for rural electrification programs. There are plenty of examples of programs with problems or that have not yet been developed. India is a good case of a program that has had significant problems because of an unsuccessful national development model of central public planning that was applied to rural electrification through large public state utilities. The financial commitment was and still is substantial in India, but the program does not satisfy most of the principles derived from comparison of the often innovative and well-managed programs detailed in this research. This may change with the current gradual dismantling of the "license raj" in India that began in the early 1990s and the resulting improvement in development pace has the possibility of translating into a better program for rural electrification. Many African countries provide similar examples, where a failed overall national development model shows equally disappointing results for promoting rural electrification. Currently, the development of infrastructure in Africa is an international issue that will not go away, and many of the lessons learned from the case studies are applicable to

these countries with low levels of rural electrification. For this book, it was felt that the main lessons are in successful programs and that such lessons can then be applied to countries either with problems or just starting down the path of developing their rural infrastructure.

The Importance of Rural Electrification

Well-planned, carefully targeted, and effectively implemented rural electrification programs provide enormous benefits to rural people. Indeed, once an area has reached a certain level of development, further progress in raising standards of living to socially and politically acceptable levels will depend on the availability of electricity. As restructuring of national power utilities gathers momentum around the developing world, it is essential that this idea is borne in mind and that the appropriate institutional frameworks and incentives are created to ensure that rural electrification takes place.

The fact that rural electrification programs have been implemented relatively smoothly and efficiently and have enhanced access to energy for a significant number of people in rural areas is a purely instrumental fact that should lead us to the bigger questions. Rural electrification, and for that matter also rural development programs as a whole, are one part of a major process of social, economic, political, and cultural transformation. In Amartya Sen's terms (2000), successful development can be observed when marginalized individuals and groups gain the freedom to make choices in all aspects of life and are able to improve their capabilities and "functioning" to exercise any freedoms obtained. Both individual freedom and social equity have to be advanced to arrive at a "successful" transformation and modernization of society.

Thus, successful rural electrification cannot be divorced from the country context. The recent work on rural development in Peru indicates that the combination of infrastructure services is much more effective than single interventions (World Bank 1999b), and yet most investments in this field involve single interventions. In addition, the evidence from this study indicates that the method of rural electrification has to fit in with national ways of achieving development. Cooperatives may be the answer in one country, whereas national public grid extension is the solution in others. Whatever the solution, the freedoms made possible by rural electrification and other infrastructure are often underestimated because of the concentration on single intervention models that lack coordination with other development programs.

The overall main message from this study is positive. There are major opportunities for increasing the pace and widening the scope of rural electrification. If these opportunities are grasped, it will enable large numbers of new consumers to enjoy the benefits of an electricity supply at acceptable costs and will avoid burdening national governments and power utilities with unsustainable subsidies. Although there is no "one way" to accomplish rural electrification, there is an underlying set of principles that need to be followed to have successful programs. These principles are exemplified in the following chapters.