# Modernizing Energy Services for the Poor:
# A World Bank Investment Review – Fiscal 2000–08

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(ESMAP)

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# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| **AFR** | Africa Region |
| **AMADER** | Agence Malienne pour le Développement de l'Energie Domestique et de l'Electrification Rurale |
| **APL** | Adjustable Program Loan |
| **BRAC** | Formerly known as the Bangladesh Rehabilitation Assistance Committee, BRAC is an NGO that works internationally through its economic and social programs |
| **CDM** | Clean Development Mechanism |
| **CEIF** | Clean Energy Investment Framework |
| **EAP** | East Asia and Pacific Region |
| **EC** | Electric Cooperative |
| **ECA** | Eastern Europe and Central Asia Region |
| **EDC** | Electricité du Cambodge |
| **ENV** | Environment |
| **ESMAP** | Energy Sector Management Assistance Programme (World Bank) |
| **GDP** | Gross domestic product |
| **GEF** | Global Environment Facility |
| **GoE** | Government of Ethiopia |
| **IBRD** | International Bank for Reconstruction and Development |
| **ICR** | Implementation Completion Report |
| **IDA** | International Development Association |
| **IDCOL** | Infrastructure Development Company Limited |
| **FEMA** | Forum of Energy Ministers in Africa |
| **ICR** | Implementation Completion Report |
| **IEA** | International Energy Agency |
| **IEG** | Independent Evaluation Group |
| **IFC** | International Finance Corporation |
| **IHDS** | India Human Development Survey |
| **kgoe** | Kilograms of oil equivalent |

| | |
|---|---|
| **klmh** | Kilolumen-hour |
| **kWh** | Kilowatt-hour |
| **LA** | District Heating and Energy Efficiency Services (a sector code) |
| **LB** | Mining and Other Extractive Industries (a sector code) |
| **LC** | Oil and Gas (a sector code) |
| **LCR** | Latin America and Caribbean Region |
| **LD** | Power (a sector code) |
| **LE** | Renewable Energy (a sector code) |
| **LPG** | Liquefied petroleum gas |
| **LZ** | General Energy (a sector code) |
| **MDG** | Millennium Development Goal |
| **MIGA** | Multilateral Investment Guarantee Agency |
| **MNA** | Middle East and North Africa Region |
| **MW** | Megawatt |
| **MWp** | Megawatts-peak |
| **NGO** | Nongovernmental organization |
| **OBA** | Output-Based Aid |
| **PAD** | Project Appraisal Document |
| **PBS** | *Palli Bidyut Samity* (a locally organized rural electric association in Bangladesh) |
| **PV** | Photovoltaic |
| **RDV** | Rural Development |
| **REB** | Rural Electrification Board (Bangladesh) |
| **SA, SAR** | South Asia Region |
| **SF** | Social Fund |
| **SHS** | Solar home system |
| **SIL** | Sector Investment Loan |
| **TA** | Technical assistance |
| **TR** | Transportation |
| **WBG** | World Bank Group |
| **WHO** | World Health Organization |

# EXECUTIVE SUMMARY

Today's levels of energy services fail to meet the needs of the poor. Worldwide, 2,5 billion people rely on traditional biomass fuels for cooking, and 1.5 billion people have no access to electricity. Unless investments in providing modern energy services are expanded significantly, this number is expected to actually increase over the next 30 years (IEA 2002). This lack of access to high-quality energy services is a situation that entrenches poverty, constrains the delivery of social services, limits opportunities for women and girls, and erodes environmental sustainability at the local, national, and global levels. Ignoring the situation will undermine economic growth and exacerbate the health and environmental problems now experienced in many parts of the world.

Providing high-quality energy services to the poor sounds as if it should be a relatively easy problem to solve. However, international organizations have experienced difficulties in the past developing programs that produce improvements in sustainable energy access. There are several reasons why the energy access problem been so vexing. First, energy is an expensive business, and poor people sometimes cannot afford the investments necessary (a cookstove or electrical connection) for improved energy service quality. These costs are bad enough for poor people in urban areas, but they become especially prohibitive in rural areas, where remote locations and low density of demand raise the costs and reduce the profitability for prospective energy providers. A second problem is the lack of technical capacity to support energy access. Regulatory and pricing issues appropriate for developed countries are often nonexistent or sometimes misapplied. The training, technical assistance, and capacity building needed to support energy access schemes add to the costs, with the result that energy companies must charge high connection fees and monthly rates that are unaffordable to the poor. Finally, energy access issues often involve a cross-sectoral solution. For example, energy programs to improve productivity require availability of credit and development of markets for energy goods and services.

This study focuses on the World Bank's role in energy access investments for the period between fiscal years 2000 and 2008. Developing and transition countries face huge investments in energy access in order to meet their commitments to achieving the Millennium Development Goals (MDGs). The purpose of this review is to create a tractable definition of energy access through

which it is possible measure and report the World Bank investments that reach the poor either directly through physical investments in infrastructure or more indirectly by means of policy, technical assistance, and other kinds of support that are part of World Bank projects.

## Focus of Study

The term *energy access* has various connotations to energy development specialists. For this review, we define *energy access* as relating both to physical proximity to energy infrastructure and to the policies and frameworks supporting the transition to better, reliable, and more efficient use of electricity and modern fuels. This viewpoint frames energy access as a development process—sometimes referred to as the energy transition—that starts with reliance on low-quality energy sources (straw, dung, candles) and finishes when high-quality energy sources, such as commercial fuels or electricity, are available. Access to these higher-quality energy sources allow for services (lighting, communication, cooling, pumping), which are not available at lower rungs of the energy ladder. This development process requires investment in physical energy infrastructure, supportive investment in energy access policy development and capacity building, and indirect assistance through policies and investment undertaken on an energy sector-wide basis.

Our experience is that the barriers and obstacles to providing energy access fall within several main categories, some more tractable than others. The Bank has been successful in addressing several obstacles, such as the management and targeting of necessary subsidies and the development of different business models for rural energy providers. Other problems, notably targeting community- and household-level energy access solutions and monitoring long-term access outcomes, have been more of a challenge for World Bank energy access practitioners. Areas that have been identified for which improvements are needed include monitoring project outcomes for cross-country comparability and developing approaches for addressing biomass energy problems.

This report focuses on the World Bank's portfolio of energy access-related projects approved during most of the past decade (FY2000–08). The objectives of the review were to compile an up-to-date data base on energy access-related assistance commitments and review current trends and patterns of energy access-related assistance. We also wanted to examine to the greatest extent possible the lessons that could be learned across regions, focusing on policy and project design recommendations. Finally, it was important to establish a solid methodology for measuring energy access in order to provide a baseline for future reviews of the investment portfolio.

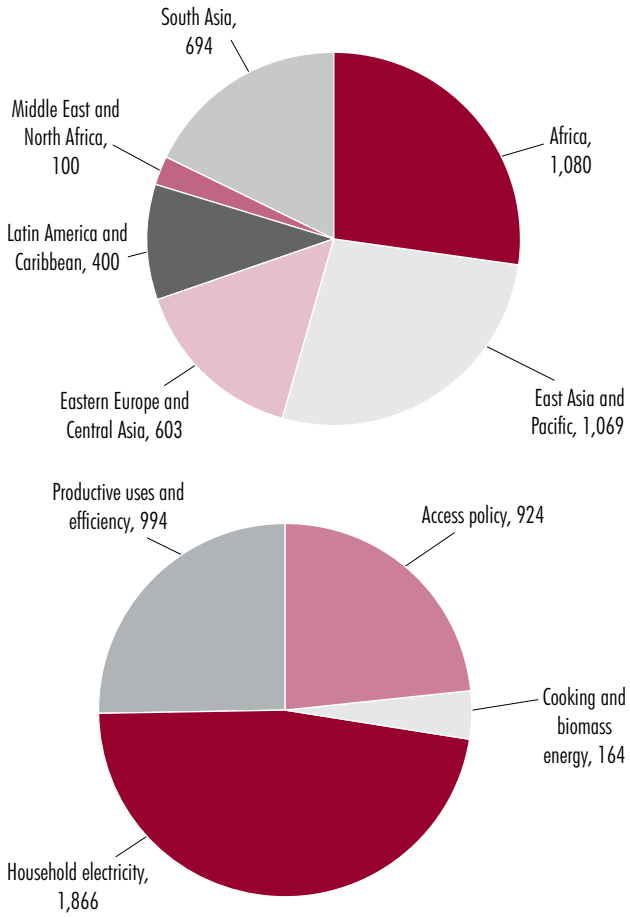
Review and analysis of energy access and poverty investments by the World Bank face several difficulties. The most basic difficulty is how to measure investments in energy and poverty. Many Bank projects have direct impacts on energy access, for example, cookstoves delivered or electrical connections made. However, just as many have indirect impacts as well, such as policies formulated, institutional capacity created, or training provided. A balanced rural energy program should include both direct investment in infrastructure, supportive investment in capacity for planning and maintaining the infrastructure, and indirect investment at the sector level accruing from other energy infrastructure investment.

We encountered several difficulties in identifying the energy and energy access-related items contained within the different investment and assistance instruments offered by the World Bank. It was quite easy to classify such projects as rural electrification, but much more difficult to evaluate the contributions to energy access of multipurpose loans that contain quite varied project components. As a consequence, in this review we concentrate on those projects directly reaching the poor or supporting capacity building expected to benefit energy-deprived populations. The reason for this is that assessments of energy access should include both physical

investments in infrastructure and also those that support such investments as planning, operational capacity, and policy.

We would like to point out that the figures presented in this study are quite different from those of the Clean Energy Investment Framework because of the different definitions and emphases of these two studies. The purpose of the Clean Energy Investment Framework (CEIF) report is to broadly classify projects or large project components into categories, such as low carbon, transmission and distribution, oil, gas, coal, thermal generation, and other types of energy investments. As a result, the CEIF report undertakes classification on a broader level according to its interest in carbon production and climate change (see Annex 1 for a detailed review of differences), which includes total generation and transmission investments. In addition, this access review is restricted to World Bank investments as reported in the World Bank annual report (World Bank, various years), and the CEIF report includes not only those investments, but also investments from the International Financial Corporation (IFC) and the Multilateral Investment Guarantee Agency (MIGA).

**FIGURE E.1: World Bank Energy Access Investment by Region and Type, FY2000–08**
*(US$ millions)*




## Overview of Energy Access Investments

During the last eight years, there has been an increasing emphasis on infrastructure lending partly as a consequence of the Infrastructure Action Plan (World Bank 2003). In addition, Africa was singled out as a priority region because it has fallen behind the rest of the world in its infrastructure development. This emphasis on infrastructure is evident in the total value of all World Bank projects with energy-related investments approved during fiscal 2000–08 (Table E.1).

The total energy investments were about US$20 billion, and the investments per year typically were less than US$2 billion through fiscal 2006. Since that time, lending has increased significantly to close to US$5 billion in 2008 (Figures E.1 and E.2). The lending is regionally diverse with Africa, Eastern Europe, and South Asia all above US$4 billion for the period. These three regions together accounted for more than 65 percent of the total value of projects, with Latin America and Caribbean, East Asia and Pacific, and the Middle East and North Africa accounting for the remaining 20 percent.

Lending for energy access increased, along with total energy lending (Figure E.2). This study estimates that total World Bank investments in energy access during fiscal 2000–08 have been about US$4

**TABLE E.1: Energy Project and Energy Access Investments, FY2000–08**
*(millions)*

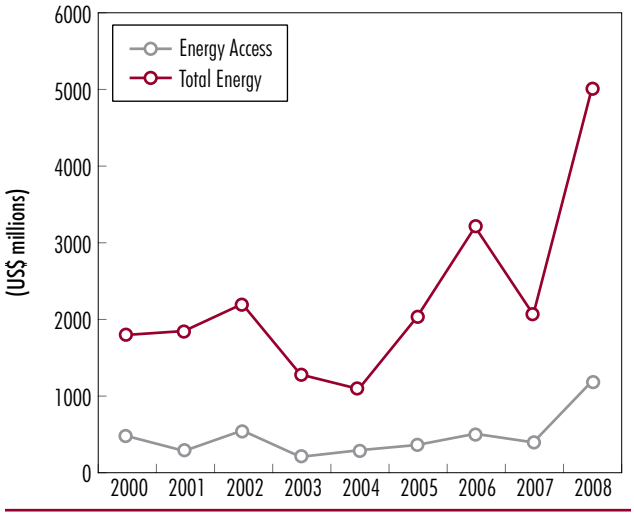
| | Energy projects | | | | Energy access investments by type | | | |
|---|---|---|---|---|---|---|---|---|
| | Projects | Total energy investments* | Total energy access investments | % access of energy investments | Access policy | Cooking and biomass energy | Household electricity | Productive uses and efficiency |
| Region | | | | | | | | |
| Africa | 141 | 4,658 | 1,080 | 23 | 345 | 36 | 687 | 12 |
| East Asia and Pacific | 80 | 3,510 | 1,069 | 30 | 65 | 1 | 621 | 381 |
| Eastern Europe and Central Asia | 140 | 4,605 | 603 | 13 | 52 | 9 | 2 | 540 |
| Latin America and Caribbean | 85 | 1,846 | 400 | 22 | 207 | 36 | 125 | 31 |
| Middle East and North Africa | 20 | 1,161 | 100 | 9 | 22 | 77 | 1 | 0 |
| South Asia | 53 | 4,431 | 694 | 16 | 230 | 4 | 430 | 30 |
| Total | 519 | 20,213 | 3,949 | 20 | 924 | 164 | 1,866 | 994 |
| Fiscal year | | | | | | | | |
| 2000 | 41 | 1,765 | 448 | 25 | 6 | 26 | 187 | 228 |
| 2001 | 45 | 1,817 | 246 | 14 | 40 | 0.6 | 33 | 171 |
| 2002 | 47 | 2,166 | 520 | 24 | 143 | 0.8 | 339 | 37 |
| 2003 | 45 | 1,249 | 169 | 14 | 24 | 14 | 122 | 8 |
| 2004 | 48 | 1,054 | 254 | 24 | 103 | 8 | 110 | 33 |
| 2005 | 69 | 1,992 | 326 | 16 | 52 | 8 | 253 | 13 |
| 2006 | 75 | 3,176 | 476 | 15 | 110 | 12 | 269 | 85 |
| 2007 | 66 | 2,031 | 359 | 18 | 238 | 0.4 | 84 | 35 |
| 2008 | 83 | 4,963 | 1,151 | 23 | 206 | 95 | 467 | 383 |
| Total | 519 | 20,213 | 3,949 | 20 | 924 | 164 | 1,866 | 994 |

*Source:* World Bank's Business Warehouse and project review.
* The difference from the Business Warehouse commitments is caused by adjustments in sectoral codes on some projects, as discussed in the text and detailed in Chapter 2.
** For projects not reviewed, commitments are based on the Business Warehouse with no adjustments. Accordingly, the grand total of the Bank's energy commitments reflects the Business Warehouse records. Totals may be off because of rounding.

billion, or approximately one-fifth of the total energy-related investments. As indicated above, the lending reported in the CEIF report for the period 2003–08 for World Bank investments is US$6.04 billion, which includes total investments in generation and transmission which, for methodological reasons, were not included in this report (see Chapter 4 and Annex 1).

The regional percentages of lending for energy access during the last eight fiscal years also follow a similar pattern. East Asia has many long-term rural electrification programs, and Africa has begun to make infrastructure as a priority for lending. Together these two regions received more than half the energy access-related commitments (Figure E.1). East Asia and Pacific also have the

**FIGURE E.2: World Bank Energy Access Investments by Fiscal Year, FY2000–08**
(*US$ millions*)




*Source:* Portfolio review.

highest rate of lending for energy access—at about 30 percent—followed by Africa and Latin America and the Caribbean, which are at the 20 percent level of investments in access (Table 3.1). Eastern Europe and Central Asia, along with the Middle East and North Africa, have low levels of lending for energy access, but this is not surprising, since most the access investments in these regions are for improving service rather than initiating new customers. However, South Asia at 16 percent of energy investments lags behind the other regions where significant numbers of people are still without access to electricity. This is somewhat a surprising, since South Asia, along with Africa, has the largest number of households without access to electricity services, which is probably true for other energy services as well. However, as indicated, the policy environment for rural energy in South Asia is quite challenging. Also, as will be indicated later, a large proportion of investments in South Asia have been for generation and transmission projects, which are not counted in Table E.1, but are necessary conditions for electricity access.

The main types of investments in energy access also have been classified by this review. They include policies to support energy access, rural electrification, facilitating the household energy transition to modern fuels, and improving energy efficiency and productive uses of energy. Policies to support the provision of modern energy access include institutional development, some types of energy policy reform, capacity building, and electricity master planning. To promote electricity in rural areas, there were investments in rural electrification via grid extension, off-grid community and household systems, and electricity funds for providing onlending for communities, nongovernmental organizations (NGOs), or the private sector. To encourage household to use better fuels for cooking, there was assistance to communities, small businesses, and households to transition from traditional fuels to modern fuels, including promotion of liquefied petroleum gas (LPG) or kerosene for cooking and the development of more sustainable supplies of biomass energy and improved cookstoves. Finally, there was support for productive uses and energy efficiency that reached households, businesses, and local communities, including improved energy efficiency in district heating and support to small and medium-size enterprises.

On an aggregate level, physical investment in electricity access accounted for almost half the total value of energy access-related assistance approved over the period, with more than US$1.8 billion in investments (Figure E.1 and Table E.1). Supportive investment in energy access, including policy development and capacity building, accounted for about one-quarter of investments in energy access, along with similar figures for energy efficiency and productive uses of energy. Most of the energy efficiency investments were in the Eastern Europe and Central Asia region. Finally, the support for promoting the transition to modern cooking fuels was quite small at less than 5 percent of lending. In general, these figures represent significant investments in energy access. The main area that lags behind the rest involves promoting the transition to more modern forms of energy for cooking.

The lending for energy access increased along with total energy lending (Figure E.2). This study estimates that total World Bank investments in energy access during fiscal 2000–08 to be about US$4 billion, and it is approximately one-fifth of the total energy-related investments.

Developments in the energy access lending portfolio of projects or project components have been quite promising. Assistance to Africa—the region with the lowest access rates in the world—is both significant and growing in terms of the size of investments and the breadth of the issues covered. Africa is also the region with the greatest reliance on biomass energy and "traditional" fuels; at present, it is receiving about one-third of the total World Bank investments for energy access.

In conclusion, progress in scaling up energy access in developing countries has been significant, but significant challenges remain. Of course, the World Bank is but one player in promoting energy access in developing countries. It is clear that coordinated approaches between international donors and the countries themselves will be necessary to tackle the challenge of providing modern energy services to the world's poorest populations. Nevertheless, from this review it is apparent in the coming years that a greater focus on problems of energy access and its role in development will be necessary.

## Financial Instruments and Energy Access

The main financial instrument utilized for energy access investments is World Bank International Development Association (IDA) funds. This is because energy access projects are mostly directed toward poor households. However, IDA is a general poverty alleviation fund, and allocations are made based on country size, population, and level of poverty. For larger countries, this is not such an issue, but for scaling up energy access in small countries, it has significant limitations. In small countries, IDA funds generally are dedicated toward one sector per year, and energy has to wait its turn for available resources. As a result, obtaining these funds for rural energy projects in small countries can sometimes be difficult.

Energy access projects also have a very high rate of using grant funds. Most grant funds available for energy access projects involve a specialized review procedure. Examples are the Public-Private Infrastructure Advisory Facility, the Global Environment Facility (GEF), and the Carbon Funds. Obtaining such grants requires an inordinate amount of time preparing proposals and satisfying multiple financing windows. Mobilizing the extra preparation financing and undertaking the range of tasks needed to prepare an energy access project makes for a protracted and complicated project preparation process. Energy access project development would benefit greatly from introducing more streamlined or simplified procedures.

As evidenced by the high level of grant funds in the World Bank's energy access investments, these various grant funds to support energy access have been very important for promoting energy access. However, it would be much easier if there were a dedicated grant fund for addressing the development of energy access for the poor in developing countries. Applying for such grant funds to support energy access would more directly address the issue of alleviating energy poverty without the trappings of environmental, global warming, or privatization issues. This is not to say that the other issues are not important, but it would make the application process for grants more streamlined and more directly related to an issue that is of great importance to the World Bank, and that is to alleviate poverty.

## Lessons Learned from Portfolio Review and Successful Projects

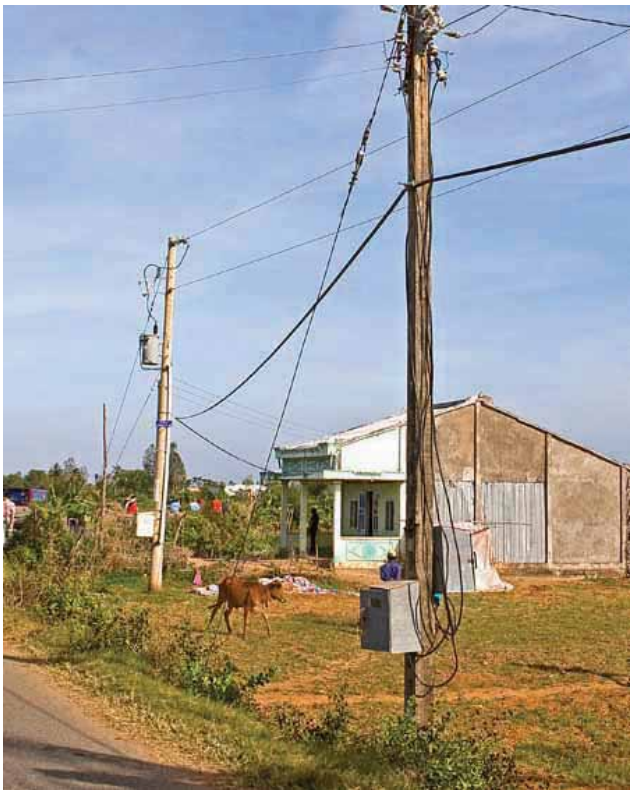
There are several lessons from both this portfolio review and the successful project that have emerged from this review. The first is that at the beginning of many energy access projects there is a period of high levels of technical assistance in which the Bank

assists governments in developing custom strategies to deal with providing energy to their poorest populations. The second is that both public support and private investments are important in many projects, but they take a different form depending on the country and its political realities. The third is that many projects have very low levels of monitoring and evaluation, so it is difficult to judge the development effectiveness of the projects and whether they support the MDGs.

## High Levels of Technical Assistance

For new countries that are politically committed to develop better access for their poorest populations, an initial period of analysis and strategy development is necessary. For instance, there is often a need to develop new institutions to implement a rural energy or electricity access program—and this is true whether the main program is going to be for grid or off-grid electricity. As an example, in the early Bangladesh rural electrification program, the Rural Electrification Board was developed to handle the entire rural electrification grid expansion program. This meant that the government had to be committed to both financial and institutional support for the program, which was a novel way of doing business for a country that in the past had relied almost exclusively on state-run utilities for electricity provision. When it came time in that last loan to support off-grid electrification, the task was given to an entirely different agency that would dedicate staff to developing and supporting mostly renewable energy options. The business models of these two enterprises are quite different, so different public support mechanisms were necessary.

The Bangladesh model is but one option in a wide variety of institutional, legal, and regulatory approaches to providing energy access to poor populations. Most countries have to develop an approach that coincides with their social-political realities. This is the case whether the projects are for grid or off-grid expansion of electricity, promotion of energy efficiency, or development of ways to encourage better cooking fuels. At the beginning of this process, laws must be changed, sometimes institutions have to be created or altered, and techniques to develop well-targeted subsidies that do not destroy business incentives have to be studied and implemented. These are not easy tasks, and they require a significant commitment by governments to undertake strategies and projects to help their poorest populations gain access to high-quality energy services.



Grid rural electrification in Vietnam (World Bank, Hanoi)

The good news is that after this initial high level of technical assistance to prepare the political, institutional, and financial landscape for energy access, much of the World Bank's investments in repeat projects are much easier to implement and are highly cost effective. In fact, it was somewhat surprising that the World Bank investments in energy access have been concentrated in countries with

repeat projects. Vietnam is a very good example of this. The first loan in 2000 spawned a series of investments over the decade to take the country to an over 90 percent electrification rate today. The interesting feature of these series of loans is that they are not repeat projects in the sense that they are the same, but in that they keep defining and solving implementation problems and issues that come up as the program evolves. The lesson is that there are significant levels of technical assistance to set up the framework for energy access investments that should not be underestimated in countries that want to embark on energy access programs, but this can be followed by a stream of projects that are easier to implement over subsequent years.

## Public and Private Investments in Energy Access

The rural access agenda is often thought to be a public agenda, but this is only partially true. The review of World Bank projects actually challenges this idea. There seems to be a need for public-private partnerships in many projects. To be sure, there are some purely public rural electrification projects in the portfolio, but there is also a large amount of investment in what might liberally be called the private sector. Taking the case of three large projects in the portfolio, the Bangladesh rural electrification program is based on publicly supported electricity distribution businesses that are called cooperatives. For the off-grid program, microcredit organizations are selling photovoltaic (PV) solar home systems (SHSs) and making three-year loans to recover the costs of the systems with competitive interest rates. In Vietnam, the latest project involves support for local electricity companies that collect revenue and maintain local system lines. The goal is to develop incentive frameworks to make these small private and sometimes semipublic businesses work more effectively. In Peru, the investments are actually going mostly to private distribution companies to promote electricity expansion in a way that is more financially viable for the involved companies. Even investments in purely public electricity companies often end up in the hands of private sector companies that produce electricity equipment or construct and maintain the electricity lines.

## Monitoring and Evaluation Needs Improvement

Monitoring and evaluation of the impacts of energy access projects is also still at a very basic level in most energy access projects. Projects often do not quantify the physical targets to be met, unless they are expansion projects with specific goals. Besides the usual physical way of measuring impacts, few projects measure the social or economic impacts in a comprehensive way. One significant exception to this is the Vietnam rural electrification project, which has a comprehensive monitoring and evaluation instrument associated with it, which was actually financed through independent trust funds outside the project. Given the current climate and interest in energy access issues, a better job needs to be done in tracking both the impact of the projects themselves and the yearly progress in meeting the energy access goals.

## Conclusion

This review of World Bank energy access investments reveals both strengths and weaknesses in approaching the goal of alleviating energy poverty and achieving the MDGs in developing countries. Progress has been made for World Bank financing for both energy and energy access during the last decade. Significant commitments have been made for addressing energy access issues in Africa, where the need is probably the greatest. Many highly diverse, innovative, and significant advances have been made in project design, including innovative subsidy models and private-public partnerships. The increasing amount of investments going to off-grid electrification compared to a decade ago is clearly a step in the right direction. Likewise, there have been problems as well. Cooking energy issues are widely discussed within the World Bank and at international forums, but more needs to be done to promote

World Bank lending in the areas of biomass energy and interfuel substitution. Also, project monitoring and evaluation has been modest at best; there is a real need to improve the assessment of project impacts on the poor. Energy sector reform projects still address energy access issues in a modest way, and the links between the benefits of reform and energy poverty need to be more clearly delineated in the project documents.

Much progress has been made both through investments by international development agencies and the countries themselves. Of course, the World Bank is but one player in promoting energy access in developing countries, and it is clear that coordinated approaches between international donors and the countries themselves will be necessary to tackle the challenge of providing modern energy services to the world's poorest populations. The number of people with electricity increases every year is keeping ahead of population growth, and some notable progress is even being made in the development of a new generation of improved biomass stoves. However, the rapid expansion of populations in developing countries and patterns of increasing urbanization in the form of slums means that the task of dealing with energy poverty will be a challenge for many years to come.

Cooking with Ecofogon stove, Nicaragua (PROLEÑA/ Nicaragua)

# 1

# ENERGY ACCESS AND DEVELOPMENT

Energy services for the poor have become a significant issue for those involved in energy and development. This lack of access to high-quality energy services is a situation that entrenches poverty, constrains the delivery of social services, limits opportunities for women and girls, and erodes environmental sustainability at the local, national, and global levels. Today's levels of energy services fail to meet the needs of the poor. Worldwide, 2.5 billion people rely on traditional biomass and solid fuels for cooking (WHO 2009) and 1.5 billion people do not have access to electricity (IEA 2006). Unless investments in providing modern energy services are expanded significantly, this number is expected to actually increase over the next 30 years. Ignoring the situation will undermine economic growth and exacerbate the health and environmental problems now experienced in many parts of the world.

Providing high-quality energy services to the poor sounds as if it should be a relatively easy problem to solve. However, international organizations have experienced difficulties in the past developing programs that produce improvements in sustainable energy access. There are several reasons why the energy access problem has been so vexing.

First, energy is an expensive business, and poor people sometimes cannot afford the investments necessary—such as a cookstove or electrical connection—for improved energy service quality. These costs become especially prohibitive in rural areas, where remote locations and low density of demand raise the costs and reduce the profitability for prospective energy providers. A second problem is the lack of technical capacity to support energy access. Regulatory and pricing frameworks and policies appropriate for developing countries are often nonexistent or sometimes misapplied. The training, technical assistance, and capacity building needed to support energy access schemes add to the costs, with the result that energy companies must charge high connection fees and monthly rates that are unaffordable to the poor. Finally, energy access issues often involve a cross-sectoral solution. For example, programs to improve productivity stemming from modern energy access require availability of credit and development of markets for goods and services.

For this review, we define energy access as relating both to physical proximity to energy infrastructure and to the policies and frameworks supporting the transition to better, reliable and more efficient use of

electricity and modern fuels. This viewpoint frames energy access as a development process—sometimes referred to as the energy transition—that starts with reliance on low-quality energy sources (straw, dung, candles) and finishes when high-quality energy sources, such as commercial fuels or electricity, are available and being used by households. Access to these higher-quality energy sources allow for services like lighting, communication, cooling, pumping, and others that are not available to poor households at lower levels of the energy transition because of the high cost of the infrastructure necessary to deliver the services. To achieve service availability for poor households, this development process requires direct investment in energy infrastructure, supportive investment in energy access policy development and capacity building, and indirect assistance through policies and investment undertaken on an energy sector-wide basis.

This report focuses on the World Bank's portfolio of energy access-related projects approved during a particular timeframe: the past nine fiscal years (FY2000–08). The objectives of the review are to compile an up-to-date data base on energy access-related assistance commitments and to review current trends and patterns of energy access-related projects. In addition, based on the analysis of the energy access portfolio, it is important to extract program, policy, and project design recommendations to stimulate practitioner discussion and guide future project preparation. This activity also should be useful as a baseline for future reviews of the World Bank's growing energy access portfolio.


Retailing kerosene stoves and lamps, Hyderabad, India (Douglas Barnes)

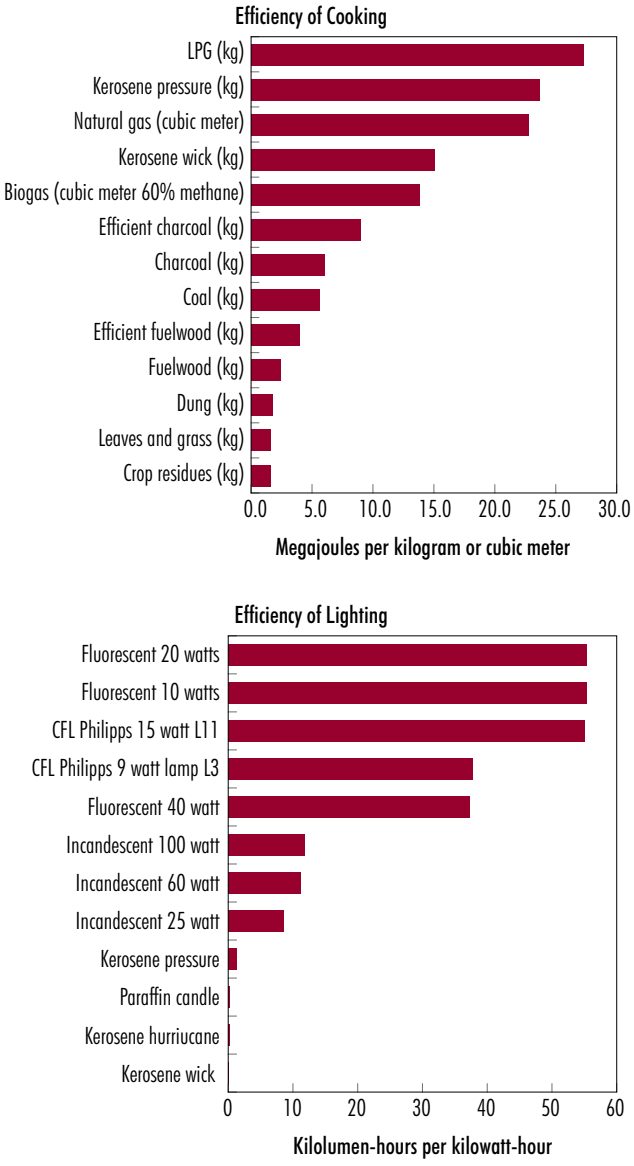
Before turning to the portfolio analysis, we examine the main issues involved in energy access and energy poverty, and what has been accomplished by international development agencies.

## What Is the Energy Transition and What Are the Benefits?

The search for energy access solutions that will improve the lives of those in developing countries must take into consideration the energy transition. The transition to modern energy progresses from biomass fuels used in traditional ways toward biofuels used more efficiently in modern cookstoves or to diesel, kerosene, and LPG fuels (for heat, cooking, lighting, and power). Ultimately this transition leads to gas and electricity produced locally or distributed by a distribution network (Figure 1.1). The energy transition can be smoothed and sustained by programs and investments that emphasize both affordability and efficiency. For cooking, gains in efficiency can be made in small steps. For example, a farmer using wood for cooking may be able to afford an improved biomass stove long before being able to afford modern commercial fuels, such as LPG. For lighting, the differences in efficiency are so large that the recommended path is to move quickly from candles or kerosene to some form of electric lighting. At each stage of development, the primary problem is matching the energy supply and service level to people's income and expressed needs.

For cooking, the great inefficiencies in the fuels that are used by poor people are interlinked with the problems of biomass energy collection, the

**FIGURE 1.1: The Energy Transition for Cooking and Lighting**




use of traditional biomass stoves, and the resulting indoor pollution and its consequences for human health. Many of the problems are either long term or somewhat invisible to policy makers, but they are very real in terms of time spent by consumers in dealing with cooking fuels. Women spend time collecting biomass supplies, which is a cost even if it is not measured in monetary terms. In addition, this biomass energy use syndrome means a life of poor health that is burdened by unpaid work and drudgery. The resulting environmental pressure also often leads to degradation of nearby forests and community land.

The transition to better stoves, along with efforts to promote petroleum cooking fuels, can provide many benefits to households dependent on the inefficient use of traditional cooking fuels. They include avoided health costs associated with the use of unventilated biomass stoves and thus offer society an economic benefit. The avoided illnesses and deaths that might be attributed to the use of improved stoves or petroleum cooking fuels may be significant. Among women and children worldwide, indoor pollution accounts for an estimated 1.5 million premature deaths each year (WHO 2006c). In India alone, the comparable figure is 400 000 (WHO 2007; World Bank 2002b). Studies in both India and Nepal reveal that nonsmoking women exposed to biomass smoke have death rates from chronic respiratory disease comparable to those of heavy smokers who are males (Modi and others 2005).

The costs involved in treating illnesses caused by indoor pollution, which must be borne by public health facilities, may also be significant. The easy conclusion is that the unvalued time spent collecting fuelwood could easily pay for an improved stove that saves fuel and thus collection time, along with any expense for purchased biomass. Although more costly, the transition to LPG for cooking would also have even greater benefits than adopting an improved biomass cookstove. The World Health Organization (WHO) recently developed some economic valuation methods for assessing time savings from fuel collection and cooking, avoided health costs, and environmental benefits (Hutton and Rehfeuss 2006; Hutton and others 2006; WHO 2006a). They found that for a typical South Asian household, the benefits of switching exclusively to improved stoves or from biomass to LPG amounts to about US$30 per year. Thus, the

benefits clearly outweigh the costs, but delivering high-quality stoves and fuels to poor people in ways that are affordable is not so easy, as will be illustrated later in this report.

The transition to better lighting by switching from kerosene lamps or candles to electricity is even more dramatic than those for adopting better stoves or cooking fuels (Box 1.1). Kilolumen-hours are a measure of lighting. The figures demonstrates that lighting with kerosene or candles produces far less than 1 klmh of lighting per kilowatt hour of energy compared to more than 10 klmh for incandescent lamps and about 60 klmh for florescent lamps. Thus, the immediate benefit of electrification comes through improved lighting, which promotes extended hours of study and reading and other household chores (Barnes 1988; World Bank 2002a, 2004; Barkat and others 2002; Barnes and Floor 1996), and in turn contributes to better educational achievements (Khandker, Lavy, and Filmer 1994; Khandker 1996; Gordon 1997, Khandker and others 2008). Lighting can also benefit many other household activities, such as sewing by women and social gatherings after dark.

For households that first received electricity either from the grid or from renewable energy sources, the most immediate change is a transition from kerosene or candles for lighting to the use electric lights (Box 1.1). The reason is that kerosene lamps and candles, the usual alternative to electricity in rural households, provide inadequate light for reading (Nieuwenhout, Van de Rijt, and Wiggelinkhuizen 1998). The significantly higher levels of lighting that electric lamps provide enable comfortable reading, which can improve education and school attendance. As a result of this reasoning, many of the World Bank projects on rural electrification used a method involving willingness to pay and consumer surplus to evaluate the benefits of rural electrification. Recently these methods were the subject of a major review by the World Bank's Independent Evaluation Group (World Bank IEG 2008). The study confirmed that the benefits of lighting from transitioning from kerosene to electricity are quite large and generally are well over US$10 a household per month, depending on household income and other factors.

**BOX 1.1: Making the Switch: An Example of the Benefits of Electric Lighting**

Making the switch to higher-quality, more efficient electric lighting can enable households to read and study during evening hours, increase productivity, and raise incomes and quality of life. Compared to candles or kerosene lamps, which households without electricity commonly use, electricity converts energy into lighting more efficiently. A candle or kerosene wick lamp emits about 12 lumens (a measure of brightness), a hurricane kerosene lamp 32 lumens, and a 60-watt lightbulb 730 lumens. Using a single 60-watt lightbulb four hours a day, a household consumes about 260 klmh of light per month. By contrast, burning a hurricane kerosene lamp four hours a night yields only 4 klmh per month but, depending on prices, can cost somewhere between one-quarter and as high as the same cost as electric lighting. The energy poor in Africa spend about US$17 billion a year on fuel-based lighting sources, such as kerosene lamps, that are costly, inefficient, and provide poor-quality light while polluting and posing fire hazards.

*Source:* Lighting Africa; Nieuwenhout, Van de Rijt, and Wiggelinkhuizen 1998; O'Sullivan and Barnes 2007.

These are just two components of the transition to modern energy services. The others would include moving from manual to mechanized irrigation, moving from human to motorized transportation, transitioning from battery-operated radios and televisions to those involving plug-in service, and sewing with mechanical machines or ones powered by electricity. We have presented the efficiency gains above as examples, but many others are possible.

It is also true that household assets and amenities offer a general reflection of a household's quality of life. It should be recognized that asset ownership is really a means to an end. For instance, the ownership of a television is for both entertainment and receiving important news and communications. Bicycles, cars, and motor scooters facilitate transportation to and from markets, social gatherings, and places of employment. Table or ceiling fans are not only essential for cooling off in a hot climate like India's, but they are also important for keeping away bugs and insects. The conclusion is

Girl studying with electric light (National Rural Electric Cooperative Association, International, NRECA)

that the energy transition can facilitate development through improvement in many different areas that are important for quality of life. The benefits include improvements in the following:

- Education.
- Health.
- Entertainment and communication.
- Comfort and protection.
- Convenience.
- Productivity.

The degree of these changes and the costs of achieving them can and should be the subject of continued work, but the real challenge has been in developing and implementing programs that can effectively address the barriers to assisting household to move toward better fuels and appliances that provide these many benefits.

## Energy Access Linkages to the Millennium Development Goals

The MDGs set in 2000 at the United Nations Millennium Summit outlined several time-bound goals in the areas of poverty, health, education, and the environment (Modi and others 2005). Although there was no direct reference to energy in the formulation of the goals, the need for access to energy, particularly modern energy, to improve overall welfare is well recognized in the development community. Hence, the World Bank has been promoting growth and development in the energy sector as part of a strategy toward achieving the MDGs. In this section, we will concentrate only on the main MDGs with fairly straightforward connections with energy.

Woman watching television in rural Vietnam (World Bank, Hanoi)

Student and small solar lamp in Bolivia (Deutsche Gesellschaft für Zusammenarbeit, GTZ)

The importance of energy in achieving the MDGs is evident for the goals of eradicating extreme poverty and hunger. Modern energy is important for home and business enterprise development in several different ways (Cabraal and Barnes 2006). One is that household lighting allows income generation during the evening hours. This is important because even households making one additional dollar a day can have a significant impact on welfare. The use of small machines can also improve household productivity, which can also enhance household income. In fact, small enterprises to provide local high-quality energy services can result in locally owned businesses and greater local employment. One common misunderstanding about the use of energy by the poor is that they pay proportionately more for their rudimentary energy services than more wealthy households that are using modern fuels, such as LPG and electricity. Once poor households have access to more modern energy or energy devices, they may actually even be able to reduce or at least maintain their level of energy expenditures while receiving far greater benefits from modern energy sources. In the field of agriculture, energy for irrigation can help improve food production and therefore promote better nutrition. In addition, access to modern energy opens the door to better food preservation, which enhances farm productivity and health and nutrition.

Increasing evidence shows that electricity is instrumental in improving the MDG of universal education (Barkat and others 2002; Asaduzzaman, Barnes, and Khandker 2010; Barnes 1988; Khandker and others 2008; World Bank 2002a; World Bank 2008a). The superior lighting provided by electricity creates a better atmosphere in the home, which can result in more time for studying in the evening and better school attendance. Not as well established, but intuitively feasible, is that electricity in villages and schools will help both the school environment where modern teaching equipment, such as projectors, printers, and copiers, can be used and also can assist in retaining teachers in the community. Teachers are not as likely to want to live in communities without electricity. Some schools may even have more modern heating and cooling systems that will make their educational atmospheres more attractive to children.

The promotion of gender equality and empowerment of women is also an important MDG. Energy actually frees up the time available to women and girls from what have been called survival or menial activities.

Computer lab in North Vietnam (World Bank, Hanoi)

Family have to eat and without modern energy they spend much time gathering firewood, fetching water, cooking, and processing food by hand. In this regard, more modern energy allows for clean cooking fuels and stoves that can reduce exposure to indoor air pollution and the improve health for all in the family. Other already-mentioned activities that can have beneficial impacts for women and girls involve education, improved productivity, and safety. For instance, high-quality lighting encourages better education, street lighting can improve the safety of women, and modern energy services offer scope for home enterprises that are typically run by women.

Decreases in child mortality and improved maternal health are also directly related to modern energy services, both in the home and in health clinics. There are several ways that energy contributes to improving health and reducing child mortality. In the home, indoor air pollution is one of the main contributing causes of respiratory disease, which accounts for up to 20 percent of the 11 million child deaths each year (WHO 2006a). The gathering and use of traditional fuels for cooking exposes young children to indoor air pollution, which can contribute to respiratory illness. Electricity can also contribute to lower child mortality (World Bank IEG 2008) through direct means, such as better water supplies that typically involve some form of water pumping, and more indirect means, such as mass media campaigns for heath programs promoted through radio and television.

The goal of ensuring environmental sustainability is also directly related to improved access to modern energy. It has already been mentioned that modern energy can help increase agricultural productivity through the use of machinery and irrigation. Over the long term, this actually takes pressure off of the environment because it means a reduced need to expand the quantity of land under cultivation, thus reducing pressure on ecosystem conversion. In addition, the use of traditional fuels, such as fuelwood, straw, and dung, for cooking can in some cases contribute to erosion, reduced soil fertility, and deforestation. Fuel substitution, improved efficiency, and energy crops can make exploitation of natural resources more sustainable. There is some recent evidence that the inefficient combustion of traditional fuels have some impact on climate, especially because the daily cooking routine gives off significant amounts of black carbon.

Many other linkages to the MDGs exist, but the primary ways in which energy affects the MDGs are fairly evident from much of the recent work on the impact of energy on development. The strongest linkages involve improving incomes to reduce poverty, removing indoor pollution from households to improve health, and creating a better environment for both studying and teaching to encourage better school attendance and improved education. These impacts are especially significant for women and girls, since they are the primary cooks and collectors of traditional energy in most developing countries. Thus, it is clear that improving energy access has some clear benefits for achieving the MDGs.

## Who Are the Energy Poor?

The MDGs implicitly indicate that a vast number of people in developing countries have no access to basic infrastructure services, including those provided by energy. In fact, there is still a debate over whether poor people lack access to modern energy services because they are poor and whether energy can help lift people out of poverty. The basic question is how much energy consumption is adequate or whether there a level of energy consumption that a household requires to maintain a bare minimum livelihood. This concept has been grappled with by many involved in energy issues with diverse points of view and methodologies (Krugman and Goldemberg 1983; Pachauri and Spreng 2004; Foster, Tre, and Wodon 2000; Saghir 2005). This issue goes along the same rationale of specifying a minimum expenditure (called an *expenditure poverty line*) that a household needs to remain or become nonpoor. Just as the expenditure poverty has been defined in quite a few ways, *energy poverty* can be defined in several

ways. Therefore, we will discuss several alternate measures of energy poverty line before discussing the approach taken in this paper.

One of the simplest measures of the energy poverty line focuses on a household's ability to cook using modern fuels and access electricity for lighting (Modi and others 2005). The minimum energy need according to this measure is 50 kgoe per capita per year (40 kgoe for cooking and 10 kgoe for electricity). This measure is clearly very basic and does not include energy use for other purposes, such as transport and heating or cooling.

A second measure of energy poverty emphasizes on the proportion of household expenditure spent on energy expenditure (Pachauri and Spreng 2004). The rationale for this expenditure-based approach is that poor households spend a large part of their total expenditure on energy, because some basic forms of energy expenditure (cooking, for example) are absolutely necessary. A cutoff point of 10 percent of total expenditure is frequently mentioned in the literature as the energy poverty line and, applying that to our data, we get an energy poverty line expenditure of about Tk 1,003.60 per capita per year. A criticism of this approach is that it focuses on energy expenditures, not on energy content. Since energy expenditure can vary by the region, the price and type of energy used, and the type of appliances used, it cannot consistently represent the actual energy content and is much more representative of a wider basket of goods and services.

Some approaches to measuring energy poverty line are more complex and rely somewhat more on the technical provision of energy services. One such approach was developed by Bravo and others (1979), and will be referred to as Bravo measure from now on. The Bravo measure classifies human energy needs into two groups: direct and indirect. Direct energy includes provisions for cooking, lighting, heating and cooling, preservation of food, hot water, ironing, and pumping of water, plus recreation and social occasions. Indirect energy needs refer to energy that is embodied in additional goods and services that households use. The Bravo measure goes into considerable detail to quantify a household's direct energy needs, considering variations in energy sources and their efficiencies, urban and rural areas, and climate conditions. For instance, for rural households in Bangladesh, with its tropical climate, the direct energy need according to the Bravo measure is 329 kgoe per capita per year. Since we are concerned only with a household's minimum energy requirement, the direct energy needs proposed by the Bravo measure are more than enough to satisfy the basic minimum needs for rural households in Bangladesh. Goldemberg (1990) goes even further to consider a wider range of energy-using activities.

These measure of energy poverty, even after taking into account energy source efficiencies and climate conditions, are too general to be applied, unaltered, to a specific country, since they do not consider country-specific information, need patterns, and common practices. For example, energy for heating and cooling, preservation of food, or recreation is hardly considered a basic need for a rural population in Bangladesh. All in all, we feel that these two measures do not appear to reflect adequately the market conditions that govern the delivery of energy services to rural households in Bangladesh.

Another measure calculates the energy poverty line based on the types of energy used by households at or below the overall expenditure poverty line already estimated for a country (Foster, Tre, and Wodon 2000). The basic assumption behind this measure is that poor households in terms of per capita expenditure are also likely to be energy-poor. That is, the energy poverty line is related more to consumption expenditures than to technical requirements. The steps involved in developing this measure are fairly simple. The expenditure poverty line is determined first, following one of the standard techniques. Next, households are selected whose per capita total expenditure falls within a certain range (10 percent is most commonly practiced) of the expenditure poverty line. Finally, the average per

capita energy consumption for these households is calculated, which is the energy poverty line for the sample. Expenditure poverty line measure yields, from our data, a poverty line energy consumption of 232 kgoe per capita per year.

The definition that we propose in this paper is fairly practical and is as follows. Since energy is a necessary commodity, a household tries to maintain at least some basic minimum level of energy consumption, which is the energy poverty line. In an attempt to determine that basic minimum energy requirement, our approach investigates how a household's demand for energy changes with the change in other major welfare indicators, such as income. We can estimate the household's or a community's basic minimum energy demand in two ways. One way to observe that change is to examine the energy demand function. However, for households that are energy poor and are only meeting their basic needs for energy, the relationship between energy uses and these factors should be quite weak. These households try to maintain their basic need for energy, regardless of the status of their education. asset level, or community goods.

Practically speaking, this means that depending on the level of income in the country according to recent surveys (Khandker and coauthors 2009) about 40–50 percent of the population can be considered energy poor. This means that about one-half of most populations have access to modern energy and can afford to purchase it while the other half are dependent on more traditional forms of energy. This is a somewhat more conservative definition of energy poverty than has been utilized in the World Bank's *Clean Energy Investment Framework* (World Bank 2006a), which has taken a broader view of energy assistance as it relates to the energy poor that includes all aspects of energy infrastructure, such as transmission and generation, as an investment in energy access. As will be indicated later, this is a difference in emphasis, since such investments are necessary conditions for investments in energy access (see Chapter 4). In this paper, however, we take a somewhat more conservative view that investments need to more directly impact those who are considered energy poor.

## What Are the Key Dimensions of Energy Access?

The lack of access to high-quality energy services around the world is a situation that contributes to poverty, constrains the delivery of social services, limits opportunities for women and girls, and often erodes local environmental sustainability. However, the investment needs are quite large. Developing and transition countries face significant investments in energy access in order to meet their commitments to achieving the MDGs. The International Energy Agency (IEA) estimates that developing and transition countries as a group face cumulative investment requirements in their energy sectors (oil, natural gas, coal, electricity) of US$2.4 trillion (in 2000 dollars) for the period 2001–10 and US$3.2 trillion for the period 2011–20 (IEA 2004).

A substantial amount of analytical work has been carried out by the World Bank and other development organizations concerning the primary ways to address the issue of energy poverty. Some recent accomplishments by World Bank energy practitioners include the following:

- Identifying and documenting best practices in rural electrification.
- Mobilizing expanded investment from both the public and private sectors.
- Developing frameworks to regulate new institutional arrangements for the provision of modern energy, including private electricity distributors serving rural and periurban populations.
- Developing methodologies and case studies to demonstrate the benefits of targeted energy service investments for the poor.
- Improved understanding through surveys and other research on how the poor meet their energy needs in the rural and periurban context.

- Regional strategies to scale up energy access, focusing mainly on electricity.

This analytical work provides the framework for the later operational review of World Bank projects. However, the main areas identified as a priority for addressing energy poverty and energy access involved several important areas. They include expanding rural electrification programs in many developing countries, giving greater attention to the policy reforms necessary to address energy for the periurban poor, and refocusing on the problems involved in the use of traditional fuels for cooking. Finally, it is also important to address the more upstream investments necessary for the expansion of energy access to the poor. These are issues that are highlighted as important in the transition to higher-quality fuels and appliances for poor households in developing countries.

The focus to this point has been on the direct investments in energy access. However, indirect investments are also necessary that are in a sense necessary conditions for energy access. Rural electrification programs must have adequate generation and transmission in a country. The use of LPG for cooking requires the available of an LPG supply. Even off-grid electricity requires a regulatory framework and a supply system that make the use of renewable electricity possible. The indirect investments necessary to support new energy access or improvement in the quality of energy services is somewhat difficult to estimate. For instance, how much of an investment in a power plant is really an investment in energy access? Such difficult questions will be addressed, although they cannot be fully resolved.

### *Electricity Access*

Most of the 1.5 billion people without electricity access live in rural areas (Table 1.1). Projections show that, given today's energy policies and investment trends in energy infrastructure, as many as 1.4 billion people will still lack access to electricity in 2030. In some regions—Sub-Saharan Africa in particular—rural electricity access is at a very low starting point compared with the urban population. A large urban-rural disparity also exists in South Asia, where less than one-third of the rural population has access. 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.

The rate of improvement in electricity access varies considerably among regions. Rapid progress in electrification in East Asia, especially China, account for most of the global gains in electrification since 1970. According to the IEA, electricity has been extended to 700 million Chinese since 1970. In contrast, the population without electricity access in Africa has more than doubled over the same period, and in South Asia has grown by one-third. Excluding

**TABLE 1.1: Electricity Access in the Developing World, 2005**

| Country or region | Population without electricity (million) | % of population with electricity | % of rural population with electricity |
|---|---|---|---|
| Developing Asia | 930 | 72.8 | 65.1 |
| Sub-Saharan Africa | 547 | 25.9 | 8.0 |
| North Africa and the Middle East | 48 | 85.8 | 77.5 |
| Latin America and the Caribbean | 45 | 90.0 | 65.6 |
| Developing countries | 1,569 | 68.3 | 56.4 |

*Source:* IEA 2006.

East Asia and Pacific, the number of people without electricity increased steadily from 1970 to 2000.

### *Approaches to Grid Rural Electrification*

A myriad of problems—technical, institutional, managerial, and financial—can combine to create conditions where efforts to extend access have a net negative impact on a country's development agenda. In Bangladesh, India, and Pakistan, for example, the combined effects of low tariffs, unmetered service connections, poor collection practices, and weak overall operating performance have created a growing financial crisis in the energy sector. In Pakistan, operating losses in the main power company consume 1.4 percent of gross domestic product (GDP), an avoidable fiscal drain equivalent to 75 percent of the national education budget (World Bank 2005c).

These problems, however, are not without solutions. In a recent, *The Challenge of Rural Electrification*, Barnes (2007) illustrates how a variety of countries have successfully addressed the problems of rural electrification. The results point toward a set of characteristics that characterize successful rural electrification programs. In addition, today some countries are facing issues of how to deal with problems in the last stages of their rural electrification programs. In Brazil, China, and Mexico, the remaining rural households are in very remote areas that are a real challenge to reach through traditional grid expansion. Therefore, these countries require innovative ways to reach the remote and very poor people without creating a financial strain on the companies involved in the program.

Although their institutional forms vary, as a general rule successful grid extension programs require financially and technically strong utilities. To ensure sustainability, distribution companies must address the issue of increased technical losses and low revenues in creative ways. In Tunisia, for example, the utility reduced the capital costs of rural grid extension by shifting engineering standards and by using capital subsidies provided by the government (Cecelski and others 2007). Extending the grid to rural industries or commercial consumers can also promote economic growth while increasing revenue that can be used to maintain lower prices for residential and other rural consumers (Cabraal and Barnes 2006). Giving priority to major load centers and productive facilities helps improve financial viability.

### *Approaches to Off-Grid Rural Energy*

Off-grid electricity is also necessary because the expansion of grid electricity will require decades to reach remote populations. In the short and medium terms, the only way to reach many of these

Solar home system, Brazil (Innovation for Development and South–South Cooperation, IDEAAS)

households without electricity is through single households systems and small electricity providers, using both renewable and conventional energy sources. Although these approaches to electricity provision may sound straightforward, in practice they have been difficult to implement.

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. Off-grid projects in both countries have taken advantage of private sector institutions, NGOs, and microfinance institutions that operate in rural areas. They also have required centralized institutional support. In Bangladesh, through grants and loan support to microfinance organizations and NGOs, the number of household photovoltaic systems has exceeded 150,000. 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 SHSs and village microhydropower grids provide electricity to 3 percent of all Sri Lankan households.

Small grid systems have varied widely, from microhydropower to locally generated private distribution. To grow and thrive, such systems often require external technical and financial support. Cambodia's experience illustrates the potential for countries where large-scale grid extension is not feasible in the foreseeable future. In addition, there are very successful small community grid electricity systems in Nepal and Sri Lanka that rely on local microhydropower. Off-grid electricity has the drawback of high cost compared to grid electricity in urban areas, but there does appear to be a significant willingness to pay for energy services in many remote or rural areas where access to conventional energy services is lacking.

### *Periurban Electricity and Urban Poverty*

Almost 85 percent of the world's urban population has access to electricity. Indeed, in some parts of the 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 percent of population growth over the next 30 years will occur in urban areas. Thus, fast population growth and urbanization, coupled with rising demand for electricity, are exerting tremendous pressure on infrastructure and creating strong demand for new investment. In the Middle East and North Africa, for example, the World Bank expects demand for electricity to grow by an average of 6 percent a year to 2010 (World Bank 2004b). Unless appropriate steps are taken to meet that growing demand, the urban poor will surely lose ground in access to electricity.

In urban areas, extending electricity access to the poor is a matter first and foremost of getting the policies right. The infrastructure is generally already in place in most of the large urban centers of the world, except Africa, so energy companies need to make relatively fewer new capital investments. Even with the lower capital costs and higher incomes in urban areas, however, poor people still often cannot afford the connection fees or monthly rates. As a consequence, 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, since serving poor populations often calls for special policies, investments, and innovative technical and financial solutions.

In recent years, there have been several international forums to address the issue of periurban electricity problems (Rojas and Lallement 2007). The findings of this work include that the poor pay extremely high prices for electricity—often to illegal entrepreneurs. Safety issues are often ignored by such entrepreneurs, and service levels are often very poor. The solutions to these problems are not insurmountable. They include involving NGOs or smaller bill-collecting agencies. However, implementation has been lagging behind in many countries, and there is a need to address these issues more directly.

### *Populations Dependent on Traditional Fuels*

Households' use of modern energy and efficient appliances for heating homes and cooking food has significant environmental benefits. The environmental consequences of biomass use, first put before the international community several decades ago as the "other energy crisis" (Eckholm 1975) involve indoor air pollution and degradation of local commons. Fuel collection leads to a deterioration of the local environment and depletion of biomass, meaning ever longer walks to collect fuel. In India, the time spent collecting fuel per household is estimated at nearly one hour per day. (World Bank 2004a) In Haiti, for example, the overall decline in forested areas resulting from charcoal production for urban use is well documented (Stevenson 1989; Lewis and Coffee 1985).

Large gaps also remain in access to modern fuels, such as kerosene and LPG. Nearly 2.4 billion people in developing countries still rely on wood, agricultural residues, and dung for cooking and heating (Table 1.2) and, as indicated earlier, 3 billion people rely on solid fuels that include coal (WHO and UNDP 2009). Without greater efforts these numbers are forecast to grow to 2.5 billion by 2030 (IEA 2006).

All these people must contend with the disadvantages of traditional fuels. Cooking and heating with such fuels as biomass are far less efficient than cooking with such modern fuels as kerosene or LPG. As indicated, the net calorific value of wood, for example, is four times lower than that of kerosene and LPG. Women and children must spend hours gathering biomass fuels. The recent instability in the price of petroleum fuels actually in some cases has caused households to switch back to traditional fuels. Quite a bit of work is actually going on recently to bridge the gap between the inefficient use of traditional fuels, such as wood, straw, and dung, by promoting improved stoves. Stove programs around the world have had an uneven history, but there are some recent developments involving more durable efficient biomass stoves that are encouraging for the future.

## World Bank Support for Promoting Energy Access

The World Bank assumed a leadership role for energy and poverty with the 1996 publication of the strategy document *Rural Energy and Development: Improving Energy Supplies for Two Billion People* (see Box 1.2) and the 2000 publication of *Fuel for Thought: Environmental Strategy for the Energy Sector*. These

**TABLE 1.2: Populations Reliant on Biomass for Cooking and Heating by Region, 2004**

| Country or region | Millions | % of population |
|---|---|---|
| China | 480 | 37 |
| Indonesia | 156 | 72 |
| India | 740 | 69 |
| Rest of Asia | 489 | 65 |
| Brazil | 23 | 13 |
| Rest of Latin America | 60 | 23 |
| North Africa | 4 | 3 |
| Sub-Saharan Africa | 575 | 76 |
| All developing countries | 2,528 | 52 |

*Source:* IEA 2004, 2006.

**BOX 1.2: The World Bank's 1996 Rural Energy and Development Action Plan for Broadening Access**

The 1996 rural energy study provides a comprehensive review of progress in broadening energy access. After an extensive review of rural energy issues and obstacles, the strategy recommended the following actions:

- Development of regional, country, and local ownership and commitment to efforts to broaden energy access.
- Systematic inclusion of rural energy in Bank assistance programs.
- Promotion of best practices and innovation in project design and implementation.
- Dissemination of innovations and best practice.
- Establishment of partnerships with donors, NGOs, and other organizations.
- Implementation of special initiatives on Africa.
- Improvement of the Bank's capacity to deal with rural energy issues.
- Monitoring of progress on achieving objectives.

*Source:* World Bank 1996.

reports reflected on the remarkable global progress during the 1970s to 1990s when access to electricity and modern fuels was extended to more than 1 billion people worldwide. However, the work also identified fairly significant gaps in the international commitment to continue extending both modern and renewable energy services to the world's poorest populations.

In the last decade since these studies, the World Bank has become increasingly active in the area of energy and poverty reduction. However, in the late 1990s and early in this century, the World Bank reduced its commitment to the energy sector because of a misperception that private companies would take over most necessary investments in the energy sector, which was reflected in a decline in overall World Bank energy lending. As time passed, it became clear that public and private approaches to investment in infrastructure were necessary. By beginning of the new century there was a renewed commitment of the World Bank to energy lending. In 2001 the World Bank energy sector set the tone for continued energy sector investments with a new strategic approach. This was followed in 2003 by the "Infrastructure Action Plan" (World Bank 2003) that clearly outlined a plan of action to reengage in the investment in infrastructure.

The work on energy and development that emerged from energy sector in the early 2000s included four business lines. One of the business lines was helping the poor directly, through facilitating access to modern fuels and electricity, and promoting energy-efficient and less polluting end-use technologies. The other energy business lines included improving macroeconomic and fiscal balances; promoting good governance and private sector development, including transparent and propoor regulatory mechanisms and removal of barriers to private participation; and protecting the environment, through the removal of barriers to renewable energy, through investment in energy efficiency, and promotion of clean fuels. Broadly speaking, these business lines are still intact today.

Part of the reason for the renewed support for the World Bank to become involved in infrastructure was the difficulty in getting businesses to serve the poorest populations. The obstacles already have been reviewed here, but they are worth repeating. The difficulties in developing energy services for both poor and remote populations include low incomes, poor affordability, low business volumes, and others. However, during the last 10 years many new models for serving these populations has been development both from the traditional energy companies, small and medium-size enterprises, and NGOs. As a consequence, many of the recommendations of the late 1990s that were passed over during the decline in infrastructure lending at the turn of the century have now grown with the success of many innovative programs.

More recently, the World Bank has deepened its commitment to assisting the poor with energy needs by developing a possible new initiative. This program addresses the financing needs of energy access for the poor that has been identified as a priority for the World Bank ever since the work on *Rural Energy and Development* (Box 1.2; World Bank 1996*), Fuel for Thought* (World Bank 2000*)*, and more recently the *Clean Energy Investment Framework* (World Bank 2006a). This initiative would move from sector work to project support

and would provide the necessary financing for both short- and long-term assistance to help alleviate energy price shocks for the poor and to improve energy access and reduce the long-term vulnerability of the poor to unstable prices (Box 1.3).

Most international development agencies are now fully committed to the alleviation of energy poverty and promoting energy access in developing countries. Past investments in such programs as rural electrification and renewable energy for rural areas have yielded both significant achievements in progress in countries that are committed to such programs and new models for intervention that are applicable to countries around the world. Of course, these investments must be complemented by the development of supporting infrastructure in most countries. This study will review the level of past investments that directly and indirectly support energy access and will make recommendations for a way forward.

## Conclusion

This chapter examined progress by the World Bank's energy access practitioners in addressing the practical sector problems associated with energy and poverty alleviation. This provides a background to the central focus of this study, which is a review of the World Bank's energy access investment portfolio for the period FY2000–08. Although considerable strides have been made during the past 10 years, an enormous energy access challenge still lies ahead, along with room for improvement. In particular, we note the significant differences in extending access to modern energy. In East Asia and Pacific and Latin America and Caribbean, significant progress has been made over the past decade, and near-universal access is anticipated within another generation. In other regions, particularly Africa and South Asia, progress is slow or even stalled. Clearly, in order to meet the MDG challenge, it will be necessary to significantly scale up the pace of energy access investment and find effective ways for delivering improved energy services.

There is reason for optimism, even among countries about to embark on providing electricity to their poorest populations. With strong government commitment and effective institutions to implement programs, electrification and other forms of modern energy can provide rural people enormous social and economic benefits. To be sure, they cannot solve all development problems. However, there cannot be progress without modern energy. Effective solutions are available that can facilitate progress toward greater and more equitable access to modern energy.

**BOX 1.3: Energy for the Poor Initiative**

Recently the World Bank Group developed a proposal to establish a Vulnerability Financing Mechanism to coordinate the provision of rapid assistance to the poor in developing countries to cope with high oil prices or the combination of high oil and food prices. The goal is to set up a multidonor trust fund that will finance social safety net programs through project financing or direct budget support. The trust funds would be used to develop short- and long-term programs.

*Short-Term Programs*

In the short term, by providing rapid assistance to help protect the poor in the countries that are most seriously affected by high and volatile energy prices. This assistance will be provided to countries implementing or expanding cost-effective safety net programs. The measures will be to increase the income of the poor or reduce their consumption expenditures without resorting to inefficient or untargeted subsidies through support for capacity building and financing of projects. The mechanisms will include targeted cash transfers, workfare programs, targeted measures that reduce expenditures by poor households, and technical advice to set up the associated delivery mechanisms.

*Medium-Term Programs*

Loans, credits, and grants will be provided directly to beneficiary countries over a three-year period to develop and implement multiyear programs (energy investment projects and enabling sector policies) to enhance energy access and also reduce vulnerability to future energy price shocks. This will be done through the deployment of renewable energy technology, including hydropower, the expansion of energy access (using grid extension, as well as off-grid and minigrid applications), and the diversification of sources of energy supply diversification.

*Source:* World Bank 2008a.

# 2

# MEASURING INVESTMENTS IN ENERGY ACCESS

Any review of energy access and poverty investments by the World Bank offers several methodological challenges. Basically three different types of investments relate to energy poverty. The first involves projects that have direct impacts on energy access, including rural electrification, improved energy efficiency of households, and access to high-quality cooking or heating fuels. The second involves factors that guide such direct impact investments, which includes policies, support for institutional capacity development, and training to deliver the services properly. Finally, other infrastructure investments are, in essence, necessary conditions in order to extend energy services to the poor. This latter type would include portions of such projects as generation or transmission.

Another challenge in measuring energy access is that many World Bank projects have multiple goals, and only subcomponents deal with energy or energy access. For instance, it is quite easy to classify such projects as rural electrification if they are entirely dedicated to improving energy access. It is much more difficult to evaluate the contributions to energy access of multipurpose loans that contain varied project components, some of which do not even deal with energy. Thus, in this review we decided to identify energy access investments at the project component level rather than at the project level, since this is a much more accurate measure of investments in energy access.

The review concentrates on those projects directly reaching the poor or supporting capacity building expected to benefit energy-deprived populations. The reasoning is that assistance to energy access includes both physical investments in infrastructure and supportive investments in planning, operational capacity, and policy. For those large infrastructure projects supporting energy access more indirectly, we have developed a way to allocate the proportion of the investments supporting energy access. As a consequence, this review is a very detailed and accurate review of the direct and, in some cases, indirect support investments in energy access. Energy access is broadly considered to include any activities that directly or indirectly promote, facilitate, or enable modern energy services to households, communities, or local institutions. Because of the difficulty in measuring them, the upstream investments that are necessary conditions for improving energy access through networks, such as generation and transmission, are not estimated in the tables in this chapter. Rather, they are

examined in a later chapter in this study that deals with measurement issues (Chapter 4). Thus, this review of energy access not only covers the physical aspects of access to modern energy services, but also the technical assistance, support for institutions and policy reforms, and indirect access and poverty benefits resulting from sectorwide lending instruments and large-scale energy infrastructure.

## Defining Energy Access Investments

The focus of this study is on energy investments that support new delivery or improvement in the quality of energy services for households, communities, or local enterprises that are without access to a specific type of energy (Table 2.1). This means that the production or transmission of energy services is not considered energy access, unless all or part of that energy reaches the households, communities, or local enterprises. Any type of fuel can qualify as long as it meets the criteria of improving the energy use of households according to transition described earlier—that is, a transition from "traditional" to "modern" use of energy. With this approach, modern energy access can include the provision of energy-efficient and clean-burning cookstoves, even though they still may burn biomass fuels, such as straw or dung.

As indicated, some investments in energy access enhance the prospects for or the conditions of energy access without actually delivering a connection or cookstove. In our review of the Bank's lending portfolio, we found many components that support the actual investments in infrastructure providing energy access. Capacity building is often necessary even before an energy access program can begin. This may come in the form of assistance to households or communities, or it may involve setting up an institution to provide support services for public companies, businesses, or NGOs that are involved in one way or another in providing energy access. Finally, there may be a need to support the development outcomes of energy access projects, which might include such activities as enabling the availability of microcredit to invest in income-producing uses of energy.

The study carefully considered whether to include generation and transmission as an energy access investment. This is not an easy issue because, although generation and transmission investments are necessary, they are not sufficient conditions for electricity access in developing countries. Because of the difficulties

**TABLE 2.1: Examples of Energy Access—Direct and Indirect Assistance**

| Access investment type | Purpose of investments or grants | Classified or not classified as energy access investment |
|---|---|---|
| Direct | • Cooking and biomass energy<br>• Household electricity<br>• Productive uses and energy efficiency<br>• Community social support centers, such as schools and health clinics | • All investments in new or higher-quality energy for households<br>• All investments in energy for new or improved productive uses and small enterprise development<br>• All investments in new or higher-quality energy for communities |
| Indirect | • Improvements in access policy and technical assistance<br>• Power plants, transmission, and other infrastructure that supports development of greater energy access | • All investments facilitating improved investment climate for energy access<br>• Only incremental energy investments in supporting infrastructure necessary to reach new households or improve quality to existing households (could not include in tables because of mixing of funds, but see Chapter 4 for discussion) |
| None | • Energy services for factories, buildings, and other entities that already have access to high-quality energy services | • Not classified as an investment in energy access |

*Source:* Portfolio review.

involved in estimating the exact contribution of generation and transmission, for this review we decided to keep a narrower definition of energy access results in a slight underestimation because of the exclusion from the analysis of investments in large generation and transmission projects without energy access components. However, we analyzed the impact of including a portion of generation and transmission (see Chapter 4), as contributing to energy access. The results are significant, but not large, since they would result in a 2–3 percent increase in the overall energy access investments. However, it was decided to limit this analysis to those energy access investments that can be estimated directly from the project component of World Bank investment loans.

Finally, the technical assistance grants within projects are counted as energy access investments, but general sector work conducted either by the energy anchor or Regional energy operations are excluded. This is because it would be very difficult to track these investments in an objective or satisfactory way from 2000 to 2008. Thus, the framework for the analysis of energy access investments is all the World Bank investment projects from 2000 to 2008.

## Review Procedures and Definitions

This review focuses on the World Bank's approved projects and operations for fiscal 2000–08. One unique feature of this review of World Bank project investments is that it not only has examined all projects regardless of sector, but it has also broken down the project investments according to project components. It would be methodologically difficult to have an accurate picture of project investments without the details that comprise the components of the projects. As a consequence, this review has developed a fairly precise way of categorizing energy access investments.

The source of the primary data for this review is the investment projects of the World Bank that are contained in its investment data base called the Business Warehouse (see Annex 2 for a list of projects relating to energy). The Business Warehouse is the investment data base for the World Bank, and it includes data on project loans (from the International Bank for Reconstruction and Development, or the IBRD), international development assistance (from IDA), grants (from the GEF), Social Funds (SFs), the Carbon Fund, Loan Guarantees, and others. However, it does not include MIGA or investments that are part of the portfolio of the IFC. Thus, this review is restricted to the investments of the World Bank.

This Business Warehouse investment data base classifies projects according sector type and the approving sector board. For each project, there is an identification of the investment percentage that relates to energy. In fact, there are many nonenergy projects containing energy access activities, especially in the areas of the Environment (ENV), Rural Development (RDV), and Transportation (TR). For instance, rural development projects might include generators for schools, irrigation pumps for water supply, or other energy investments. The opposite is also true. An Energy Sector Board may have rural development components that have little or nothing to do with energy.

The projects that were selected for this review include all that have even the smallest energy component in them. Thus, the project data base has projects in which 100 percent of the investments are for energy and others with as little as 10 percent or 20 percent energy investments. After identifying projects with energy related activities, a detailed analysis of Project Appraisal Documents or their equivalents (Box 2.1) was conducted down to the component level. In many instances, even at the component level, allocation of energy and nonenergy investments was necessary.

The main types of energy investments found in the World Bank project document included four main themes. The first theme includes *policy work and capacity building that supports the provision of modern energy access*. For policy work and capacity

**BOX 2.1: Energy Portfolio Review Coverage**

The energy access portfolio review relies on data available in the Project Appraisal Documents (PADs), Implementation Completion Reports (ICRs), Staff Appraisal Reports, and program documents from the World Bank's Business Warehouse. The review covers formal lending and grant projects, including investments, adjustment loans, sector reforms, and emergency operations approved by the Bank's Board of Directors between July 1, 2000, and June 30, 2008. The portfolio review covers all operations, regardless of the Sector Board, containing one or more energy-related components. The main sector codes are as follows:

- District Heating and Energy Efficiency Services (LA).
- Mining and Other Extractive Industries (LB); Oil and Gas (LC).
- Power (LD).
- Renewable Energy (LE).
- General Energy (LZ).

The investment data base of the World Bank classifies projects according to both sector type and the approving sector board.* As expected, most energy-related components fall under the Energy and Mining Sector Board, but projects were also found under ENV, RDV, and TR. In addition, we also found that some projects under the Energy Sector Board have nonenergy codes. For this review, we followed the project classifications found in the Business Warehouse, but in some cases made adjustments in the case of our energy access estimates. However, all adjustments are fairly minor in scope.

*Source:* World Bank Business Warehouse and this portfolio review.
*Many nonenergy projects comprise energy access activity (such as reforestation) aspects, especially in the areas of ENV, RDV, and TR.

building, the review identified seven categories generally focused on planning, policy, reform, strategy development, and capacity building at all levels. The categories include strategy development, rural electrification master planning, policy frameworks for the biomass energy sector, rural energy strategy, heating sector reforms to promote energy efficiency in buildings, technical assistance for project management, capacity building for private sector enterprises, capacity building for energy sector public agencies, and capacity building for local communities.

The second major theme involves *investments in electricity access infrastructure*. Investment in electricity infrastructure was a principal modality of Bank assistance. For this type of direct investment, there were four distinct categories: grid-based periurban electrification investments; grid-based rural electrification investments; off-grid rural electrification investments; and electrification funds.

The third theme consists of the World Bank's *general assistance to communities, small businesses, and households for cooking*. Seven categories of activities fell into this class. On the biomass supply side, the projects or project components included reforestation activities, sustainable community-managed forest management systems, and improvement of forestry, agricultural, and pastoral production. On the demand side relating to forestry, components involved the provision of energy-efficient cooking stoves. Finally, some project components covered cooking fuels and interfuel substitution, both for improving the household quality of life and for reducing pressure on biomass resources.

Finally, quite a few Bank energy projects were involved with *productive uses and energy efficiency that reaches households and local communities*. The portfolio review identified six categories of such assistance, including the following: investments on energy efficiency innovations in buildings and heat supply; provision of fuel-saving technologies for building isolation; energy efficiency investments for energy access; expansion and upgrade of power grids for productive uses; education and training on energy use for productive purposes; and productive uses of investments for energy access.

The advantage of having investment figures for the above themes at the project component level is that classifying project components is easier, and a more accurate picture of energy access investments by the World Bank emerges. However, it was necessary to deviate somewhat from the Business Warehouse, as is indicated in the next section.

## Business Warehouse and Portfolio Review Differences

The definitive source of information on lending and assistance for energy is the World Bank's Business Warehouse. The Business Warehouse keeps track

of all energy investments, regardless of sector. However, the categories used by the Business Warehouse are not sufficient to identify the type of energy access assistance contained in each project and project component. The Business Warehouse uses general categories, such as the oil and gas or power sector. At this level of aggregation, it is difficult to separate out those activities that involve large-scale energy supply or infrastructure projects from those focused on delivering energy access to households and communities. Therefore, this review of energy access assistance is based on the projects identified in the Business Warehouse. With this list of projects, the individual project components in Project Appraisal documents were examined to determine whether or not they were directed toward improving energy access. These project components were then categorized according to the categories defined in the previous section to arrive at an overall level of World Bank financing. In this way, the figures presented in this study are more accurate down to the level of the project component.[1]

The figures in this study are similar, but somewhat different from those presented in the World Bank annual report (World Bank, various years). This review covers all investment and adjustment projects of the World Bank, including the IBRD, IDA, GEF, Carbon Fund, and Loan Guarantees projects.[2] The World Bank annual report also uses the data in the Business Warehouse when reporting the World Bank's energy assistance. However, the energy assistance data reported in this review differ from the data in the annual report in two ways (Table 2.2). First, this review includes information on GEF, Carbon Fund, and Loan Guarantee projects. The World Bank annual report presents information on IBRD and IDA projects for FY2000–05, along with IBRD, IDA, and Guarantee projects for FY2006–08. Second, it reclassifies some energy-related investments that were classified as public administration, law and justice, and the forestry sector in the Business Warehouse as energy sector investments. This is to avoid underestimating the Bank's contribution in energy sector.

The energy sector codes in the Business Warehouse actually determine the proportion of investments going to energy in the World Bank's investment portfolio. However, strictly following the sector codes of Business Warehouse will underestimate the Bank's contribution in energy sector. For instance, some forestry work also has been reclassified as work on the energy sector if the project is related mainly to energy. As an example, a project in Senegal has classified the local forestry management under the forestry sector, when the forestry management is for the production of fuelwood. Finally, we exclude the work on nonenergy mining (such as copper or other minerals), since we are mainly interested in how energy access relates to the portfolio of energy projects. The implication of these adjustments is that the energy access figures are slightly higher than those found in the Business Warehouse.

In the aggregate, all these adjustments are rather small, and they actually improve the assistance figures presented in this report. These adjustments have the effect of increasing somewhat the amount of energy assistance shown in the report in comparison to the amount reported in the World Bank annual report.

## Comparison with Investment Figures from the Clean Energy Investment Framework

The figures compiled for energy access under the Clean Energy Investment Framework (CEIF update

[1] Some very small changes between the time the project appraisal documents are published and the time the projects are approved have been made. For example, the commitment of one guarantee project in the Lao People's Democratic Republic was decreased by 16 percent, together with another when that project's entire financing package was finalized. However, as indicated, mostly this reclassification was very minor, and it was aimed at improving the figures on energy access. The total combined effect of these three factors increases the investment amount by approximately 1.45 percent, and actually provides a more accurate picture of energy access investments.

[2] As indicted previously, this review does not include IFC and MIGA projects.

**TABLE 2.2: Comparison of Energy Investments: Annual Report Compared to Energy Access Review**

| FY | Carbon offset | GEF | Guarantees | Special financing | IBRD and IDA | Grand total from Business Warehouse | Total in World Bank annual report | Total in Access Project Review* |
|---|---|---|---|---|---|---|---|---|
| 2000 | 0.0 | 56.0 | 60.3 | 13.5 | 1572.4 | 1702.1 | 1572.4 | 1764.6 |
| 2001 | 0.0 | 6.3 | 244.0 | 2.5 | 1530.7 | 1783.5 | 1530.7 | 1817.1 |
| 2002 | 3.5 | 32.6 | 115.0 | 5.9 | 1974.6 | 2131.6 | 1974.6 | 2166.0 |
| 2003 | 0.0 | 40.5 | 75.0 | 1.5 | 1088.5 | 1205.4 | 1088.4 | 1249.4 |
| 2004 | 8.3 | 45.4 | 30.0 | 0.0 | 966.5 | 1050.2 | 966.5 | 1053.6 |
| 2005 | 35.4 | 57.0 | 253.9 | 1.4 | 1568.8 | 1916.5 | 1822.7 | 1992.3 |
| 2006 | 18.4 | 34.5 | 0.0 | 0.0 | 3030.3 | 3083.2 | 3030.3 | 3176.0 |
| 2007 | 54.5 | 115.1 | 160.0 | 5.6 | 1624.0 | 1959.2 | 1784.0 | 2031.0 |
| 2008 | 20.7 | 92.3 | 0.0 | 21.9 | 4180.4 | 4315.4 | n.a. | 4963.5 |

*Source:* World Bank Business Warehouse 2000–2008; World Bank, various years.
* The total of the project review includes the adjustments from the reallocation of investments.

reports) are based on a different definition from those analyzed in this study. The term energy access for this report relates to the physical proximity of people to infrastructure and to the policies and supporting technical activities that are geared toward encouraging people to move to cleaner, more efficient, and in general more modern fuels. This definition frames energy access as supporting the transition from low-quality or inefficient use of energy sources to higher and more efficient uses. The CEIF has the dual purpose of tracking clean energy and energy access investments, with the focus on how to support investments in developing countries that reduce risks from climate change and achieve low-carbon growth. These two quite different focuses actually lead to different ways of classifying energy access in the Bank's lending portfolio.

The differences in the calculations of energy access are based on the underlying purposes of these two reports. The goal of this energy access review is to classify the various components that make up or lead to energy access, including rural electrification, biomass energy, heating reforms and building efficiency, and promotion of modern fuels, such as LPG for cooking. Accordingly, a thorough review of World Bank projects at the component level has been undertaken for determining energy access. The purpose of the CEIF report is to broadly classify projects or large project components into categories, such as low carbon, transmission and distribution, oil, gas, coal, thermal generation, and other types of energy investments. As a result, the CEIF report undertakes classification on a broader level according to its interest in carbon production and climate change (see Annex 1 for detailed review of differences). In addition, this access review is restricted to World Bank investments, as reported in the World Bank annual report (World Bank, various years), and the CEIF report includes not only those investments, but also investments from the IFC and MIGA.

The difference in the financial figures reported in this review and those of the CEIF are mainly due to the treatment of generation and transmission as energy access in the CEIF updates and their qualified exclusion in this study. The issues involved in estimating generation and transmission are detailed in Chapter 4 of this report. According to the CEIF review, total World Bank investments in energy access between 2003 and 2008 were US$6.04 billion, while the figures from this review say US$2.75 billion. As indicated, most of this

difference is due to generation and transmission investments.

## Conclusion

This component-level review of formal project documents allows for much a more accurate portrayal of the status of energy access in the Bank's energy lending portfolio. This review found that it is quite common for energy access to be part of a project, for instance, an improved stoves component in a rural development project, in which only there is only a very small investment in energy access compared to the larger project. Another example is that including a US$200 million transmission loan with a US$5 million dollar rural extension component would lead to an overestimation of World Bank assistance to energy access. However, in other cases the entire project may involve energy access. Many rural electrification projects fall into this category. As a result, this review adopts a more accurate way to account for the World Bank's energy access investments through the review of not only every project, but of every energy project component from 2000 to 2008.

In the next chapter, using the method described in this section, we review the World Bank's energy access lending. It must be kept in mind that the figures in the next chapter represent the direct lending in energy access and the supporting indirect lending, such as policy reform and institutional support. Thus, policy reform that supports energy access is included in this review of investments. They do not include necessary upstream investments, such as power plants and transmission lines; this issue is addressed in a later chapter. This detailing of investments in energy access at the component level should provide a reasonably accurate picture of both past achievements and future directions of World Bank lending.

# 3

# THE WORLD BANK ENERGY ACCESS PORTFOLIO

The World Bank has made some significant achievements in promoting energy access in developing countries. In many countries, the continued lending for rural electrification programs through a series of projects has contributed greatly to providing electricity access for many people. For instance, from 1987 through the present day, the Lao People's Democratic Republic has had a series of four rural electrification projects that have significantly increased access to electricity. Likewise, in Vietnam a series of four projects has increased electricity access levels from 60 percent to more than 95 percent today. These are countries that have been committed to providing electricity to their rural populations. However, in other regions and in other areas of rural energy, the achievements have been less dramatic. At present, the World Bank is just beginning to address the massive challenges in Africa. In South Asia the policy environment for rural energy has been quite challenging, despite government commitments to move forward on energy access issues. Also, ways to provide financing for biomass energy and cooking fuels are only now being addressed. Thus, the challenges are many, but the successful programs can provide a path to greater achievements in the future.

This review covers the World Bank's energy access lending over the period for fiscal 2000–08. The levels of investments over this period increases significantly as the World Bank became more involved in the energy sector and energy access shared in this improved investment climate. The focus of this review is projects and investments that involve energy-related assistance that reaches communities and households in developing countries. The center of attention of this review is on those that either have no energy services or have only access to poor-quality services. This is achieved by first presenting an overview of total energy and energy access investments by the World Bank. This is followed by a discussion of thematic areas of access investment, including policy and capacity building, direct investments to promote a transition to modern energy for households or communities, and energy for productive uses and energy efficiency. Because investments in generation and transmission are necessary conditions for energy access, we describe a provisional approach to quantifying how such indirect assistance might reach the energy poor in a Chapter 4.

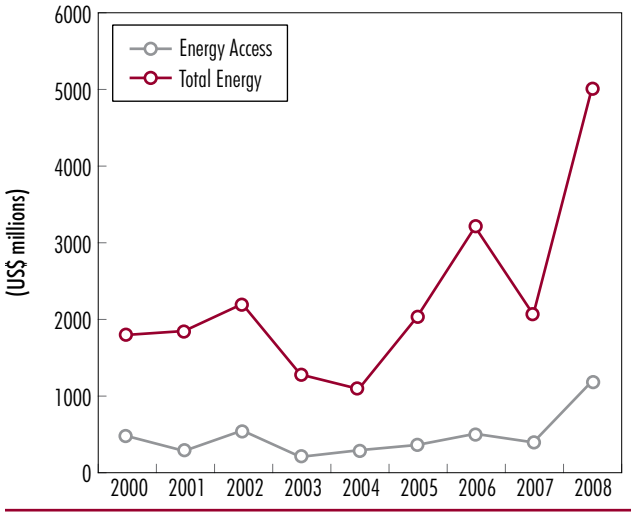
## Overview of Energy Access Investments

During the last nine years, an increasing emphasis has been placed on infrastructure lending partly as a consequence of the Infrastructure Action Plan (World Bank 2003). In addition, Africa was singled out as a priority region because it has fallen behind the rest of the world in its infrastructure development. This emphasis on infrastructure is evident in the total value of all World Bank projects with energy-related investments approved during fiscal 2000–08 (Table 3.1). The total energy investments were about US$20 billion, and the investments per year typically were less than US$2 billion through fiscal 2006. Since that time, lending has increased significantly, rising to close to US$5 billion in 2008 (Figure 3.1). The lending is regionally diverse with Africa, Eastern Europe, and South Asia all above US$4 billion for the period. These three regions together accounted for more than 65 percent of the total value of projects, with Latin America and Caribbean, East Asia and Pacific, and Middle East–North Africa accounting for the remaining 20 percent.

Lending for energy access increased along with total energy lending (Figure 3.1). This study estimates that total World Bank investments in energy access during fiscal 2000–08 were about US$4 billion—approximately one-fifth of the total energy-related investments.[3]

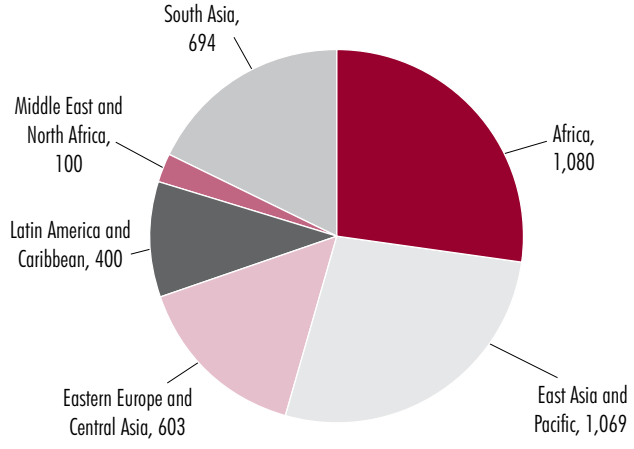
The regional percentages of lending for energy access during the last nine fiscal years also followed a similar pattern. East Asia and the Pacific has many long-term rural electrification programs, and Africa has begun to make infrastructure a priority for lending. Together these two regions received more than half the energy access-related commitments (Figure 3.2). East Asia and Pacific also has the highest rate of lending of energy access at about 30 percent followed by Africa and Latin America and the Caribbean, which are at the 20 percent level of

**FIGURE 3.1: World Bank Energy Access Investments by Fiscal Year, FY2000–08**
(*US$ millions*)




*Source:* Portfolio review.

**FIGURE 3.2: World Bank Energy Access Investments by Region and Type, FY2000–08**
(*US$ millions*)




*Source:* Portfolio review.

[3] As indicated above, the lending reported in the CEIF report for the period 2003–08 for World Bank investments is US$6.04 billion. This includes total investments in generation and transmission, which for methodological reasons were not included in this report (see Chapter 4 and Annex 1).

**TABLE 3.1: Energy Project and Energy Access Investments, FY2000–08**
(*US$ millions*)

| | Energy projects | | | Energy access investments by type | | | | |
|---|---|---|---|---|---|---|---|---|
| | Projects | Total energy investments* | Total energy access investments | % access of energy investments | Access policy | Cooking and biomass energy | Household electricity | Productive uses and efficiency |
| Region | | | | | | | | |
| Africa | 141 | 4,658 | 1,080 | 23 | 345 | 36 | 687 | 12 |
| East Asia and Pacific | 80 | 3,510 | 1,069 | 30 | 65 | 1 | 621 | 381 |
| Eastern Europe and Central Asia | 140 | 4,605 | 603 | 13 | 52 | 9 | 2 | 540 |
| Latin America and Caribbean | 85 | 1,846 | 400 | 22 | 207 | 36 | 125 | 31 |
| Middle East and North Africa | 20 | 1,161 | 100 | 9 | 22 | 77 | 1 | 0 |
| South Asia | 53 | 4,431 | 694 | 16 | 230 | 4 | 430 | 30 |
| Total | 519 | 20,213 | 3,949 | 20 | 924 | 164 | 1,866 | 994 |
| Fiscal year | | | | | | | | |
| 2000 | 41 | 1,765 | 448 | 25 | 6 | 26 | 187 | 228 |
| 2001 | 45 | 1,817 | 246 | 14 | 40 | 0.6 | 33 | 171 |
| 2002 | 47 | 2,166 | 520 | 24 | 143 | 0.8 | 339 | 37 |
| 2003 | 45 | 1,249 | 169 | 14 | 24 | 14 | 122 | 8 |
| 2004 | 48 | 1,054 | 254 | 24 | 103 | 8 | 110 | 33 |
| 2005 | 69 | 1,992 | 326 | 16 | 52 | 8 | 253 | 13 |
| 2006 | 75 | 3,176 | 476 | 15 | 110 | 12 | 269 | 85 |
| 2007 | 66 | 2,031 | 359 | 18 | 238 | 0.4 | 84 | 35 |
| 2008 | 83 | 4,963 | 1,151 | 23 | 206 | 95 | 467 | 383 |
| Total | 519 | 20,213 | 3,949 | 20 | 924 | 164 | 1,866 | 994 |

*Source:* World Bank's Business Warehouse and project review.
*Note:* For projects not reviewed, commitments are based on the Business Warehouse with no adjustments. Accordingly, the grand total of the Bank's energy commitments reflects the Business Warehouse records. Totals may be off because of rounding.
* The difference from the Business Warehouse commitments is caused by adjustments in sectoral codes on some projects, as discussed in the text and detailed in Chapter 2.

investments in access (Table 3.1). Eastern Europe and Central Asia, along with Africa and the Middle East have low levels of lending for energy access, but this is not surprising, since most the access investments in these regions are for improving service rather than initiating new customers. However, South Asia at 16 percent of energy investments lags behind the other regions where there are still significant numbers of people without access to electricity. This is somewhat surprising, since South Asia, along with Africa, has the largest number of households without access to electricity services, which is probably true for other energy services as well. However, as indicated, the policy environment for rural energy in

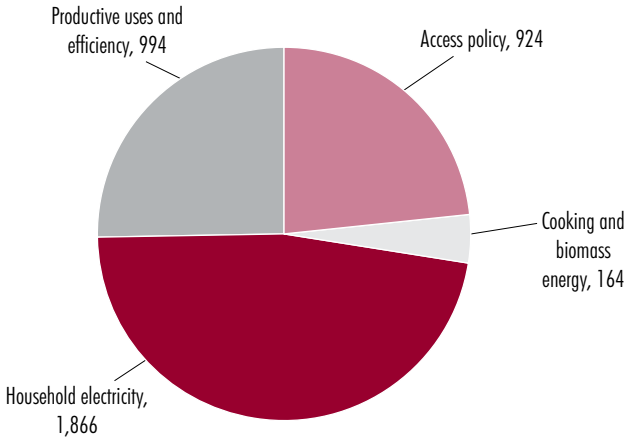
South Asia is quite challenging, but the Government of India, with World Bank assistance, has made major investments in generation and transmission during recent years.

## Thematic Patterns of Investment in Energy Access

The main types of investments in energy access also have been classified by this review. They include policies to support energy access, rural electrification, the household energy transition to modern fuels, and improvements in energy efficiency and productive uses of energy. Policies to support provision of modern energy access include institutional development, some types of energy policy reform, capacity building, and electricity master planning. For promoting electricity in rural areas, there were investments in rural electrification through grid extension, off-grid community and household systems, and electricity funds for providing onlending for communities, NGOs, or the private sector. For encouraging households to use better fuels for cooking, there was assistance to communities, small businesses, and households to transition from traditional fuels to modern fuels, including the promotion of LPG or kerosene for cooking and the development of more sustainable supplies of biomass energy and improved cookstoves. Finally, there was support for productive uses and energy efficiency that would reach households, businesses, and local communities, including improved energy efficiency in district heating and support to small and medium-sized enterprises.

On an aggregate level, physical investment in electricity access accounted for almost half the total value of energy access-related assistance approved over the period, with more than US$1.8 billion in investments (Figure 3.3 and Table 3.1). Supportive investment in energy access, including policy development and capacity building, accounted for about one-quarter of investments in energy access, along with similar figures for energy efficiency and productive uses of energy. Most of the energy

**FIGURE 3.3: World Bank Energy Access Investment by Type, FY2000–08**
(*US$ millions*)




*Source:* Portfolio review.

efficiency investments were in the Eastern Europe and Central Asia region. Finally, support for promoting the transition to modern cooking fuels was quite small at less than 5 percent of lending, In general, these figures represent significant investments in energy access. The main area that lags behind the rest clearly involves promoting the transition to more modern forms of energy for cooking.

## Access to Household or Community-Wide Electricity

The main categories of electricity access are grid rural electrification, off-grid electrification, periurban electricity provision, and rural energy funds. The majority of the financing for electricity access was invested in rural electrification programs. Rural electrification involves about 70 percent of the financing for electricity access (Table 3.2). The off-grid electricity projects comprise just under 20 percent of investments in electricity access; this is especially the case in Africa. This is influenced by the low level of infrastructure in Africa, so most attempts to provide electricity must face the fact that grid

**TABLE 3.2: World Bank Investment in Electricity Access by Region and Category, FY2000–08**
**(*US$ millions*)**

| Region | Grid periurban | Grid rural electrification | Off-grid electrification | Rural energy fund | Total |
|---|---|---|---|---|---|
| Africa | 76.6 | 381.4 | 150.5 | 78.2 | 686.8 |
| East Asia and Pacific | 19.0 | 562.7 | 31.1 | 8.3 | 621.2 |
| Eastern Europe and Central Asia | 0.0 | 1.2 | 1.0 | 0.0 | 2.2 |
| Latin America and Caribbean | 0.0 | 79.0 | 46.4 | 0.0 | 125.4 |
| Middle East and North Africa | 1.0 | 0.0 | 0.0 | 0.0 | 1.0 |
| South Asia | 33.9 | 287.3 | 83.9 | 24.6 | 429.8 |
| Total | 130.5 | 1,311.6 | 313.0 | 111.1 | 1,866.3 |
| % of Total | 7 | 70 | 17 | 6 | 100 |

*Source:* Business Warehouse and project review.

expansion is not possible in many regions. There were significant programs for off-grid energy access in Bangladesh, which was part of the grid electricity project, and in Nepal and Sri Lanka. In East Asia, the Philippines is attempting to reach very remote areas with a project that involves the participation of the private sector in providing rural electricity services.

To summarize, rural electricity has been following both the traditional path of grid expansion and, more recently, off-grid electrification and electricity funds. There are many promising new approaches to rural electrification, but at present, the grid expansion projects through either government-run electricity companies or some form of local electricity organizations are the predominant investments in providing new electricity access. In this section, we examine in some detail many of the larger or more successful programs that have been promoted by investments in electricity access.

### *Regional Grid Rural and Periurban Electrification Projects*

The World Bank IEG (2008) recently stated that "where the Bank has had a series of dedicated projects, it has made a significant contribution to increases in (rural electrification) coverage." The Bank has several important rural grid electrification projects in most regions of the world where electricity access is a priority, and some of the main projects are reviewed in this section.

The IEG's statement is no truer than for a series of projects in the East Asia and Pacific region. In Vietnam during the last decade, the World Bank has been engaged with multiple projects, and the rate of rural electrification has improved from 60 percent in 1998 to 86 percent in 2006, and now is well over 90 percent. The East Asia and Pacific region had the highest levels of investment in rural electrification with several large projects in Vietnam. Two projects alone (Rural Energy Project and Second Rural Energy Project) represent about US$370 million of the more than US$560 million invested in the region. At its inception, the Rural Energy Project, which was initiated in 2000, was expected to provide electricity to about 450,000 households and to include 278 of the poorest communes in the country. At completion of the project in 2005, this goal was exceeded in the project area by 39 percent, and a total of 4.5 million new households had access to electricity as part of both the World Bank project and other government programs.

With continued engagement of the electricity authorities, new issues were identified by the end of

the first project. Many of the electricity distribution companies in Vietnam were very small, so the Rural Electrification Plan (Second Rural Energy Project) was launched in 2005 with funding for scaling up local reform activities. The major objective was to ensure reliable electricity delivery at the retail level by converting the small local electricity management companies to more formal local distribution utilities. These entities own about two-thirds of the low-voltage distribution in Vietnam. Another problem the country faced was that the medium-voltage networks bringing electricity to these local distributors was fairly weak. Thus, a new project was initiated in 2009 to deal with these medium-voltage distribution issues. With the continued engagement of the World Bank, over 10 or more years, access to electricity has improved dramatically, and there are now plans to deal with "the last mile" of electricity lines in the upcoming years.

In Africa the challenges in scaling up energy and electricity access result mainly from extremely low access to electricity over most of the countries in the region. Since electricity is necessary for economic growth, scaling up electricity access is one of the priority areas for the region. Several activities can be highlighted. One major sectoral activity is the Action Plan for Energy Access Scale-Up in Africa. Under the project, the outreach efforts on a variety of energy issues have been supported by Africa's energy policy makers through the Forum of Energy Ministers in Africa (FEMA). One innovative project under the scale-up activity has involved the development of a sectorwide approach to resolving energy issues that takes a larger view of issues and facilitates coordination of donors.

One of the larger programs to improve access to electricity in Africa is in Ethiopia, which accounts for US$260 million out of a total of about US$380 million of World Bank financing in this areas. Ethiopia is one of the most populous countries in Sub-Saharan Africa and also one of the poorest. Although the country has abundant resources and good potential for development, poverty is prevalent and often linked to environmental and natural resource degradation. Currently, about 17 percent of the population lives in areas with electricity (that is, areas with some form of electricity supply for residences and businesses) and less than 2 percent of Ethiopia's rural population have access to the grid. In a country with more than 85 percent of its population living and working in the rural sector, this lack of modern energy severely restricts social and economic development.

The Government of Ethiopia launched its Universal Electricity Access Plan in 2005 with a budget of about US$1.0 billion. It is designed to provide electricity to most rural towns and villages over a 10-year horizon through extension of the grid. The initial objective was to provide electricity to approximately 50 percent of rural towns over five years, with a long-term view to connecting virtually all towns and villages to the grid in a 10-year horizon. The Electricity Access Rural Expansion Project I was launched in 2006 to help implement the first stages of the Universal Electricity Access Plan. The project planned to bring electricity to rural towns and villages with about 1 million inhabitants who currently live in areas without any significant supply of electricity. The Electricity Access Rural Expansion Project II (US$130 million) complements the earlier project. It is planned to bring grid and off-grid full electricity access to 295 towns and villages, and will provide limited services, such as lighting or electricity to schools and clinics benefiting a total population of 1.8 million inhabitants.

In Latin America, the rural electrification programs are well advanced compared to other parts of the world. However, many countries are either gearing up to serve their "last mile" customers or to extend service to people living in very remote areas. This is the case for Peru where the government was committed to expanding electricity coverage in rural areas both in the high mountains of the Andes and in the jungles along its border with Brazil. However, Peru was encountering several problems. An existing government program that was perceived by the electricity distribution companies to be promoting electricity in ways that were not

financially sustainable. The second problem was that after privatizing electricity distribution and selling off many concession areas, many of the concessionaires were returning their franchises to the government because of poor returns on their investments. As a result, the government initiated a World Bank—and GEF-assisted Rural Electrification Project in August 2006 to assist local distribution companies in reaching rural populations using well-targeted subsidies. The aim was to finance projects that would be financially sustainable after receiving a subsidy of a substantial part of the capital costs (World Bank 2006c). The project objective is to provide financing for investments in subprojects to supply new electricity service to about 160,000 rural households, businesses, and public facilities, such as schools and health clinics (serving about 800,000 people), using both conventional grid extension and renewable energy sources. The project promotes an improved strategy to promote the involvement of public and private distribution companies and to broaden the involvement of additional actors in project development.

From the start of the project, distribution companies working in rural areas have shown a great deal of interest in the project. The number of responses for the first two rounds of financing was high enough to disburse 40 percent of the total available funds. After only a few years, disbursements are moving along quite well. As a result, there have been discussions on replenishment of the funds, both from the Government of Peru and the World Bank.

South Asia lags behind some of the other regions in supporting rural grid electrification, but it has one of the Bank's most successful and innovative programs. The Rural Electrification and Renewable Energy Development Program in Bangladesh accounts for about US$200 million of the total World Bank investments of US$387 for the period. The project was implemented by the Rural Electrification Board (REB) of Bangladesh, and it is actually the fourth project in a series of loans that have taken place periodically since 1980. The REB supports implementation of rural electrification through locally organized rural electric associations called *Palli Bidyut Samities* (PBSs). A PBS is an autonomous organization registered with the REB, and it owns, operates, and manages a rural distribution system within its area of jurisdiction. Its members are its consumers, who participate in its policy making through elected representatives in its governing body. The REB's role is to provide PBSs with assistance in initial organizational activities, training, operational and management activities, procurement of funds, and acting as a liaison between PBSs and the bulk power suppliers, such as the Bangladesh Power Development Board and the Dhaka Electric Supply Authority.

The first PBS was established in 1980 to operate in Dhaka, and as of 2007 a total of 70 PBSs are working in some 46,000 villages in 61 districts and serving more than 7 million rural customers all over Bangladesh (REB 2007). Since the inception of the REB, rural electrification has grown significantly—starting from less than 10 percent connectivity in 1977, 61 percent of villages have received electricity by 2007. Under the REB's program, about 800,000 new rural customers get electricity every year, which is an extraordinary accomplishment for a poor country like Bangladesh. REB consumers are mostly domestic users of electricity, although the REB also serves industrial and commercial customers, and provides connections for irrigation pumps. There also was an off-grid component of this project, which is described later in this chapter.

The grid periurban projects are a very small part of electricity access financing. Many of the projects are actually part of larger rural electrification projects that have a component for providing electricity to towns with existing grids or multisectoral projects. One example of a project focusing initially on towns and expansion of electricity coverage at the periphery of urban areas can be found in Eritrea. In this country, the urban-rural access gap is particularly high, with just 3 percent of rural households electrified compared to 86 percent of urban households. The Eritrea Power Distribution and Rural Electrification Project includes access-related

components that will extend access to electricity to some 30,000 new households, including creation of a Rural Electrification Fund to catalyze additional donor funding and a capacity building component to assist the Eritrea Electricity Company in planning future rural electrification investments. Total access-related assistance under this project is US$14.5 million.

Periurban and slum electrification is a growing area of concern for the development community, and more projects may be implemented in the future. The treatment of periurban electrification issues in most cities that already have mature electricity companies often must be treated differently. The reason is that these areas have a high concentration of poverty, and they are often areas that have high informal losses of electricity.

### *Off-Grid Electrification and Rural Energy Funds*

Extending the national grid to remote rural areas remains a challenge in many developing countries. Complementary off-grid solutions using renewable energy applications can bring the benefits of electricity service to many more low-income rural households. For the past several decades, the World Bank has financed the extension of grid electricity systems in the rural areas of many developing countries, working largely through electricity distribution companies. The pace of this extension has been slow, however, often lagging behind population growth.

Reaching remote populations requires innovative, cost-effective solutions that complement national grid extension efforts. To this end, the World Bank has supported various off-grid programs since the early 1990s, most of which have been based on renewable energy technologies and supply schemes. In Asia and Latin America and the Caribbean, these programs have emphasized the involvement of the private sector and community-based NGOs. In this section, we review several of the main projects that have involved predominantly off-grid electrification. In many cases, off-grid electrification is also dealt with through the development of a rural energy fund that is meant for local communities, private companies, or NGOs. This is a quite different model from providing investments to traditional electricity companies.

One example of a very successful project involving grants and investment funds for renewable energy is in Nepal. Off-grid power generated by microhydropower plants provides a large number of rural households with electricity for lighting, milling, and other needs. Such systems not only help in poverty alleviation, but also have direct local environmental benefits by reducing diesel consumption and the use of dry cell batteries. Aside from environmental benefits, the microhydropower plants also help promote different local electricity-based enterprises and create employment at the village level. They also help children's education, as well as adult education programs, by providing high-quality lighting into the night, allowing increased hours of study. Presently only about 600 MW of the 43,000 MW of economically viable hydropower power potential have been developed. These abundant and locally available renewable energy resources can be developed with appropriate technologies. Generating and storing electricity derived from these rich local energy resources can

Solar lighting in a retail store, Sri Lanka (Dominic Sansoni)

provide lighting for people outside the small grid area, which brings potential health, education, social, and economic benefits to these people.

Microhydropower development in Nepal has a long history, and in 2003 the World Bank, under its Power Development Project, has been providing investments of US$70 million for improving rural access to electricity services. The project supports the development of microhydropower minigrids to meet the electricity and motive power needs of the rural people of Nepal through the provision of subsidy assistance and program technical support that is implemented by Alternative Energy Promotion Centre, Nepal, under the Ministry of Environment, Science and Technology, which has been promoting clean energy technologies throughout the country with significant contributions to sustainable development by reducing greenhouse gas emissions. Much of the program is implemented through communities and NGOs, while the primary beneficiaries are rural communities. Special considerations are given to vulnerable groups, such as women, Dalits, and indigenous people.

This project provides a subsidy that covers approximately 35–55 percent of the total investment for a plant. In addition, the project also provides technical training, market information, and business development support services to the users, mostly households in rural Nepal, some of which have organized themselves into communities that own the microhydropower plants and that are responsible for their upkeep. Participating communities also are required to provide cash or in-kind contributions to support the projects. The demand from communities has been quite high, and available funding has been increased from its original level. It is anticipated that 15,000 kW from 750 microhydropower plants will be installed between 2003 and 2010, providing access to electricity to an estimated 142,000 households.

Because of the success of the earlier project, more recently in 2007 to support the work of the original project, there have been new funds allocated from the Nepal Village Micro Hydro Carbon Offset Project. The project provides assistance to reduce greenhouse gases by replacing kerosene for lighting and diesel fuel for agro-processing, as well as other productive use applications. This is one of the first examples of support of household energy through the carbon funds of the World Bank.

Another example of a successful off-grid electricity project in South Asia is from Sri Lanka. In Sri Lanka the Renewable Energy for Rural Economic Development (RERED) Project was launched in 2002 to promote both off-grid electricity and microhydropower production of electricity for both grid and off-grid purposes. The project built on the experience of the Energy Services Delivery Project financed by the World Bank and GEF from 1997 to 2002. This earlier project provided rural energy access through SHSs, small grid-connected hydropower projects, and off-grid village hydropower systems. The project's main focus was for commercializing rural energy grid and off-grid options with an emphasis on renewable technologies. This was implemented by financing and grant mechanisms for SHSs and other solar energy applications in rural areas through private companies, NGOs, and microfinance institutions (Box 3.1). The idea was to make long-term funding more available for energy projects, as

**BOX 3.1: Financing Solar Home Systems**

The most popular solar home system (SHS) financing model under Sri Lanka's Renewable Energy for Rural Economic Development Project is consumer credit through the microfinance institutions that work closely with solar companies. Through their dealer networks, the solar companies sell SHSs and offer operation and maintenance services. The business model is structured through a memorandum of understanding between the microfinance institution and the solar company, key features of which are a buyback scheme and identification of the consumer service responsibilities of the two parties. Following this model, the Sarvodaya Economic Enterprises Development Services—the project's key partner in SHS financing and a recognized leader in off-grid energy services delivery in remote rural areas—financed more than 60,000 systems during 2002–06.

*Source:* Govindarajalu, Elahi, and Nagendran 2008.

well as microcredits for small consumers. The project provides technical assistance for business development, feasibility studies, and regional trade shows, as well as longer-term financing for developers through the participating credit institutions.

At the time of its implementation, because this was quite a new concept for the World Bank, the way the project was administered in the early stages was adjusted. However, the model is now well established and works quite well. The administrative unit of the Development Finance Corporation of Ceylon Bank manages the credit program. The administrative unit monitors suppliers' compliance with global technical specifications and service standards for SHSs and solar lanterns—thus providing the basis for consumer education and protection—and investigates unresolved consumer complaints.[4] The administrative unit also approves loans contingent on evidence of installation or design approval by a chartered engineer (for village hydropower systems). Beyond its quality assurance role, the administrative unit facilitates stakeholder discussions to solve implementation problems. Quarterly stakeholder meetings are organized to welcome new members, discuss innovative approaches and procedures, and review ongoing assignments and project performance.[5]

The success of this program has resulted in an extension of the project in 2007. Currently, the program comprises 11 partner credit institutions: 5 commercial banks, 2 licensed specialized banks, 2 leasing companies, 1 finance company, and 1 microfinance institution. The approved credit institutions can refinance up to 80 percent of their loan amounts. The loans are repayable in 15 years. These credit institutions in turn offer households, community-based organizations, and private developers subloans with which to finance SHSs, village hydropower systems, and minihydropower projects. The subloans have a maximum maturity of 10 years and do not exceed the useful economic life of the equipment financed. Since 1997, the off-grid component of the credit program has received about US$38 million in IDA and GEF support, including some US$3 million in technical assistance.

Solar lantern and cooking in India (unknown)

In Bangladesh a different approach was taken. As indicated in a previous section, the Rural Electrification and Renewable Energy Development Project represents US$190 million out of a total of US$280 million in World Bank energy access investments in South Asia. The project contains financing for two different approaches to rural electrification. One that has already been described is a large grid electrification component. The second approach concerned the initiation of an off-grid electricity fund in an existing development bank. This fund is similar to the one described above in Sri Lanka.

The off-grid electrification component of the Bangladesh Rural Electrification and Renewable

[4] Suppliers are granted free market entry, provided that the systems they sell meet project specifications and honor warranty and service requirements.

[5] Minutes of these meetings are posted on the project website (*www.energyservices.lk*).

Energy Development Project has succeeded beyond expectations. The delivery of SHSs to new customers has reached an unprecedented rate of more than 7,000 rural households per month. Since the beginning of the program in 2003, more than 270,000 SHSs have been installed, far surpassing the expected 50,000 by 2008. Given that the original target was met three years early at a cost savings of about US$2 million,[6] the World Bank has increased its funding for an additional 70,000 systems, and the loan has been extended as well. In addition, other donor agencies have begun to finance the program. For instance, the German Agency for Technical Cooperation and the German Agency for Financial Cooperation have also come forward with funding for the project.

The rural energy fund has been quite successful, so it is important to understand how it works. The fund is administered by the Infrastructure Development Company Limited (IDCOL), a nonbanking financial institution. IDCOL offers participating organizations—microfinance institutions and other NGOs and private sector institutions that meet program eligibility criteria—both credit and GEF grants with which to purchase SHSs (Asaduzzaman, Barnes, and Khandker 2010. The participating organizations sign an agreement with the IDCOL that provides for refinancing up to 80 percent of the loans. Among the participating organizations is Grameen Bank and BRAC, the largest and most successful NGOs in the country. IDCOL offers the participating organizations soft loans with a 10-year maturity and 2-year grace period at an annual interest rate of 6 percent. Households must make a down payment covering at least 10 percent of the system costs. On receipt of the down payment, the participating organizations enter into a sale or lease agreement and install the systems. The participating organizations extend households credit on various terms and conditions, with tenors ranging from 1 to 5 years at annual interest rates of 8–15 percent using a declining balance method. They also are responsible for maintaining quality and providing after-sales service (Box 3.2).

Although the initial project phase focused mainly on SHSs, IDCOL recently expanded available financing to include biomass electrification, biogas cooking fuel, and other rural energy services. The GEF-financed grants for SHSs are provided on a declining scale—from US$90 per system initially to US$50 today—which encourages commercial market development. The private operators use a small portion of the grant—from US$20 initially to US$10 today—for institutional development, while the rest is directed toward capital cost buy-down. The investment program is complemented by a strong cost-shared technical assistance program that features awareness-building training for participating organization staff members and consumers.[7] IDCOL covers 80 percent of training costs, while the

**BOX 3.2: Insuring PV System Quality and After-Sales Service**

Various stakeholders play important roles to ensure quality standards for the Rural Electrification and Renewable Energy Development Project in Bangladesh. The private operators purchase PV panels, batteries, and other components approved by the Technical Standards Committee. Vendors submit required documents, warranties, and product-testing certificates to the committee for its examination and approval. Once it approves a vendor's products, the participating organizations can buy them directly from the vendor and set up their own terms of purchase and payment. Most vendors, eager to cooperate with the private operators, offer delayed payment terms to facilitate higher sales volumes. The private operators arrange for user training in operation and maintenance, regular after-sales service, and the timely handling of customer complaints. IDCOL routinely inspects the installed systems and shares its findings with the private operators, who agree to correct any problems. Representatives from all private operators—16 at present—participate in monthly operations committee meetings, where they share progress and work together to solve problems. Finally, IDCOL and the committee conduct joint technical audits to verify whether vendor-supplied equipment meets their stated standards.

*Source:* Govindarajalu, Elahi, and Nagendran 2008.

[6] Planned IDA/GEF program funding was US$18 million, including US$2.87 for technical assistance.

[7] Issues range from SHS configuration and positioning, installation, and maintenance to guidelines for system monitoring and inspection and microcredit marketing methods.

participating organizations contribute the remaining 20 percent. In addition, IDCOL provides logistical support and implements a media campaign to promote the use of SHSs throughout the country.[8]

Many more SHS customers have been reached as a result of using existing service delivery channels put in place by the project's key participating organizations, including such microfinance institutions as Grameen Shakti (Grameen energy group, which is part of Grameen Bank) and BRAC. The project has operated on the premise that such organizations, having already gained the confidence of rural residents, can function as trusted sources of SHS delivery; those trained as SHS vendors can function even more efficiently. In addition, their collection history has been strong enough to develop a credit line. The main challenge—overcome by investing in initial technical assistance—has been to ensure that the participating organizations gained sufficient training in SHS technology, supplier selection, and after-sales service.

In Cambodia, the development of a rural energy fund came out of the realization that there was already a group of private entrepreneurs that were serving small towns and villages. Cambodia has one of the lowest electrification rates in Asia, with only 12 percent of households connected. Electricity costs are among the highest in the world, reflecting Cambodia's recent turbulent history and lagging investment in infrastructure of all types. There is no national grid, since Electricité du Cambodge only serves the Phnom Penh area, and rural towns are supplied through isolated systems. The idea was to continue encouraging these entrepreneurs, but make it possible to both improve their service and lower their costs.

The Cambodia Rural Electrification and Transmission Project provides an integrated approach to power sector development in the country. The access-related investments include a rural electrification component cofinanced by IDA and GEF to bring affordable and reliable grid-based electricity within the reach of rural consumers. This is to be done in a way that is uniquely Cambodian, with government-supported private sector development of rural and renewable electricity markets. In addition, there are investments for institutional development, strengthening of the capacity of sector institutions, and creation of a rural electrification fund to support the development and strengthening of rural electricity enterprises. Overall the project will reach 100,000 households through minigrid systems and 12,000 SHSs. Total access-related assistance is US$25.6 million, including GEF grant financing of US$5.75 million for renewable energy-based, off-grid electrification.

In Africa, rural energy funds were developed through several projects in West Africa. Probably the most successful of the various projects is the Mali Household Energy and Universal Access Project. The periurban grid projects, in many cases, have involved multisector approaches to electricity access, and have focused on improving both access and the quality of service. The project was designed to increase access to basic energy services for isolated low-income populations, as part of overall efforts to achieve economic growth and reduce poverty reduction.

In Mali, barely 1 percent of the rural population has access to electricity. Most rural households meet their lighting and small power needs with kerosene, dry cell, and car batteries, with an average household expenditure of US$4–10 per month. More than half the 5,700 villages of Mali have a school or health clinic or both, but most communities are without any form of modern energy. The Mali Household Energy and Universal Rural Access Project is designed to increase access to basic energy services. The project places primary emphasis on electricity, but in addition has addressed such issues as deforestation and the use of traditional energy for cooking. Overall IDA financing is US$35.65 million with an

[8] For details, visit www.idcol.org.

additional US$3.5 million GEF grant. The energy services delivery component of the project envisioned the creation of private sector electricity services for more than 41,000 rural households, enterprises, schools, health clinics, and water supply projects.

Decentralized energy supply investments using renewable energy in minigrid and household configurations will be facilitated by a GEF-financed Rural Electrification Fund operated by a new apex rural energy agency called Agence Malienne pour le Développement de l'Energie Domestique et de l'Electrification Rurale (AMADER). Despite an initial slow start, the project implementation is now progressing well. By 2006 about 13 private operators had their rural electrification business plans approved by AMADER to allow a cumulative number of connections of about 14,500 households. Many of the approved projects are what is called multifunctional platforms. They are diesel engines that rest on a standard platform and that can be connected to equipment for cereal grinding mills, battery charging, dehusking, water pumping, welding, and carpentry equipment. They can also involve electricity generators for small grid systems that can power public lighting and sometimes rural households. This is an innovative way to provide packing of rural electricity service to remote communities.

Uganda is taking a somewhat different approach to providing rural energy under the Energy for Rural Transformation Program. Energy for Rural Transformation is being implemented in three phases. The first phase or project, which closed in February 2009, succeeded in establishing a new framework and supporting initial investments for access expansion that emphasizes private sector participation. Phase II will support a scale-up built on the Phase I foundation. Phase III will maintain the Phase II momentum toward a large-scale access rollout program. ERT helped establish a Rural Electrification Fund, operated by a Rural Electrification Agency, which is engaging the private sector as operators of publicly financed grid extension. The Rural Electrification Agency is also seeking private equity, first through expansion of the initial publicly financed extensions, and in the future through cofinancing of the initial investment.

Energy for Rural Transformation is also providing "indirect" access to the benefits of electricity through the electrification of rural schools, health clinics, and water supply. These cross-sectoral investments are being implemented by the relevant ministries which, under the program, have developed standardized designs for solar PV systems, along with long-term maintenance arrangements. The maintenance contracts require the presence of solar suppliers in the local district, which has the related benefit of extending solar PV sales outlets more deeply into rural areas. Phase I has provided GEF grants for both institutional and household PV installations.

Overall, Phase I installed 1.4 MWp against a target of 0.32 MWp. Even so, most of these were institutional installations, with household sales falling below expectations. For this reason, a PV Target Market Approach was piloted under Phase I, which will be scaled up in Phase II. This target approach will seek to achieve significant sales of PV systems by focusing on those most likely to want and to be able to finance the purchase of those systems, in contrast to a generic market development approach initially promoted

Solar home system in Qinghai, China (World Bank, Beijing).

under Phase I. The key features of the target approach are active oversight by the Rural Electrification Agency; the use of grassroots NGOs, community-based organizations, and finance institutions; capacity building for solar PV dealers; the use of microfinance institutions; and an enhanced capital subsidy, including both GEF and IDA components.

Notwithstanding the country's commendable progress on reforms and private investment, Uganda has suffered chronic power shortages over the past three years. The lack of adequate and reliable power is consistently cited as being among the top five constraints for Uganda's economic growth. Electricity service quality, availability, and reliability have been major impediments to sustained investment and growth. While Energy for Rural Transformation has been successful in attracting private investors for small power and independent grid projects, equity co-investments for grid extension have not come forward, at least partly because of the power shortage situation.

## Energy Access Policy and Capacity Building

Policy development and institutional building often are prerequisites for having a successful program that promotes various types of energy access projects. This study identified four general categories of such support for energy access. The types of activities that went into these categories were as follows: investments in rural electrification master plans, policy frameworks for biomass energy, the development of rural energy strategies, and heating sector reforms. As shown in Table 3.3, the total support for this type of work was close to US$1 billion for the years 2000–08. There were some regional differences, but by far the category that received the largest amount of investments was support for public sector capacity building.

Capacity building and strategy development are mainly in dedicated energy access projects, which have already been reviewed in this report. The nature of this work involves the support of studies essential for promoting energy access. Capacity building and proper policies are crucial to promoting energy access in developing countries. Policies that are geared mainly toward urban areas can actually hinder the provision of high-quality energy services to people without access to electricity or high-quality cooking fuels. In some cases, significant taxes that have been levied on imported solar panels or other electrical equipment must be addressed. In many parts of the developing world, there are significant taxes on LPG, which is a common fuel used for

**TABLE 3.3: Energy Access Policy Development and Capacity Building, FY2000–08**
(*US$ millions*)

| Region | Local community capacity | Private sector capacity | Public sector capacity | TA and project management | Other | Total |
|---|---|---|---|---|---|---|
| Africa | 26.8 | 31.6 | 240.2 | 35.6 | 11.1 | 345.4 |
| East Asia and Pacific | 8.8 | 13.6 | 33.3 | 9.5 | 0.7 | 65.8 |
| Eastern Europe and Central Asia | 6.3 | 1.3 | 23.3 | 21.7 | 0.0 | 52.5 |
| Latin America and Caribbean | 11.4 | 5.0 | 170.6 | 17.2 | 1.7 | 207.5 |
| Middle East and North Africa | 0.0 | 0.0 | 21.9 | 0.3 | 0.0 | 22.2 |
| South Asia | 16.5 | 0.0 | 184.2 | 29.9 | 0.2 | 230.8 |
| Total | 69.7 | 53.2 | 673.3 | 114.1 | 13.7 | 924.1 |

*Source:* Portfolio review.

cooking. Countries face many problems related to energy, but it is important to have policies and institutions in place that will support rather than work against the promotion of access to high-quality energy services by those who need them the most.

These sector reform projects that lay the groundwork for energy access projects comprised more than US$600 million or two-thirds of the total work on capacity development and policy support for energy access. Most grid and off-grid rural electrification projects have a section in them on institutional development and policy reform as well, but of course the main financing in these projects is for the actual implementation of infrastructure development. In addition, it should be remembered that this review covers only project investments; it does not cover sector or grant funding by the energy regional programs and by ESMAP.

Some sector loans have supported energy access in a fairly substantial way. One project is the Kenya Energy Sector Recovery Project. The project deals with many of the underlying reasons why energy access and high-quality electricity service was not available in the country. In Kenya the reality is that only about 15 percent of households and just 4 percent in rural areas have access to electricity. The project contains four major components. The first one is to support the restructuring of Kenya Power and Light through capacity building and the development of policies to make the company financially viable. This was considered necessary for both the provision of high-quality service to existing customers and for supporting future expansion programs that are only now being assessed. The second component was for developing feasibility studies for possible importing of LPG to deal with household energy issues, and also the development of renewable geothermal electricity generation. The third component was to support power generation which, as indicated, indirectly supports energy access. The final component was for upgrading and reinforcing the electricity distribution networks, which is directly related to energy access. Under this component, there would be an additional 400,000 household connections to the grid, mainly in periurban areas. The goal was to increase the electrification rate from 15 percent to 20 percent overall. World Bank investments for access-related components in this project were US$12 million.

Private sector lead approaches would seem difficult in Africa, but several projects in the regional portfolio stress private sector-led business models for urban and rural electrification. An example is in Mozambique, where only about 6 percent of households located mostly in the capital Maputo have access to electricity. The government plans to supplement the traditional main grid expansion approach by encouraging private sector participation and forming public-private partnerships. The Mozambique Energy Reform and Access Project will support this process through institutional development, investments in grid-based periurban electrification, financing for independent grids in rural areas, and development of a renewable energy program. A strategy of building private sector capacity to provide energy access recognizes the limited capacity of state supported electric utilities, as well as the difficulty in mobilizing investment for both grid extension or off-grid energy development. This project has faced many implementation challenges, but it illustrates that energy access issues can be directly addressed as an issue in sector reform projects.

## Household and Community Energy: Cooking, Heating, and Lighting Efficiency

The energy transition for cooking and other biomass energy-related activities has been identified as a policy priority for the World Bank since the late 1990s. These types of projects, however, have been perceived to be very difficult to finance for a number of reasons. According to one line of thinking, household energy for cooking is considered a type of activity more appropriate for rural development projects than for the energy sector. Biomass energy is also often collected from the environment, so it does not show up in national accounts of energy

expenditures. Therefore, the value of these projects is sometimes invisible to national policymakers. As a consequence, countries sometimes do not want to borrow for modernizing cooking practices, but would rather spend investment dollars on large infrastructure projects, such as grid electricity, energy generation, or others.

Notwithstanding the difficulties in making investments in improving cooking patterns in developing countries, there are several reasons that cooking energy should be more of a priority for the World Bank investments. A significant amount of World Bank and international sector work has identified the transition to more modern forms of energy for cooking as a significant priority both for environmental and health reasons. Cooking with biomass energy in traditional stoves is documented to be associated with significant health issues in developing countries (WHO 2006c, 2007). The literature on the relationship between indoor air pollution caused by cooking smoke is growing yearly, generally substantiating past work that respiratory illness is not only a major cause of illness and death in developing countries, but is also related to the use of traditional fuels for cooking.

From fiscal 2000 through fiscal 2008, only US$164 million out of total energy access investments of around US$4 billion—about 4 percent of lending for energy access and less than 1 percent of total energy lending—was invested in promoting the transition to more modern cooking fuels (Table 3.4). Certainly this may be to the result of a variety of good reasons but, given the dimension of the problem, this is one area of energy access lending that should be considered underfunded. The regional lending patterns are also quite distinct. In Africa both improved cookstoves and improved forest management have been supported. In Latin America, programs have focused on better cookstoves as well. Finally in North Africa and the Middle East, the transition to modern fuels, such as LPG and gas, has been the primary focus of investments in household energy.

Several interesting projects have supported the access to better household fuels for cooking. The Benin Energy Services Delivery APL (2004) is a multisector project that involves electricity development, rural electrification, and biomass energy. Besides improving the electrification rate from 22 percent to 30 percent, this project dedicated US$7.2 million of IDA financing to support sustainable biomass use for cooking energy. This activity includes fuelwood supply management systems, community-based sustainable forest and natural resource management, and production and marketing of 30,000 improved fuelwood

**TABLE 3.4: World Bank Cooking Fuels and Household Energy Efficiency Assistance, FY2000–08**

| Region | Reforestation | Community forestry | Improved forestry production | Efficient cookstoves and lightbulbs | Interfuel substitution | Total |
|---|---|---|---|---|---|---|
| Africa | 0.2 | 9.8 | 11.4 | 10.1 | 5.1 | 36.6 |
| East Asia and Pacific | 0.0 | 0.0 | 0.0 | 1.1 | 0.0 | 1.1 |
| Eastern Europe and Central Asia | 0.0 | 0.0 | 0.0 | 0.0 | 9.1 | 9.1 |
| Latin America and Caribbean | 0.0 | 0.0 | 0.0 | 36.6 | 0.0 | 36.6 |
| Middle East and North Africa | 0.0 | 0.0 | 0.0 | 8.9 | 68.3 | 77.2 |
| South Asia | 0.0 | 0.0 | 0.0 | 0.9 | 3.4 | 4.3 |
| Total | 0.2 | 9.8 | 11.4 | 57.6 | 85.9 | 164.7 |

*Source:* Portfolio review.

and charcoal stoves for urban households use. This project was recently approved for additional financing.

The Senegal Sustainable and Participatory Energy Management Project is regarded by many as a best practice for dealing with household energy-related issues in Africa. This project was initiated before 2000, so it is not covered by this study. However, because it has been a reference for many projects that followed, it is relevant for this review. The background is that in Senegal, forest-based traditional fuels, such as firewood and charcoal, are the main household fuels used for cooking purposes (World Bank 2005a). The use of charcoal is mainly in urban areas. Over the years, the charcoal industry in Senegal has resulted in a gradual loss of forest cover, which has degraded the ecosystem's carbon sequestration capacity, and a significant transfer of wealth from the rural communities to a few city-based fuelwood traders. These negative impacts have disproportionately affected rural women and children.

The project adopted a comprehensive approach by tackling both the supply and demand of fuelwood through mapping forest resources, preparing participatory and sustainable forest management plans, and training communities on how to implement them. The idea was to protect more than 300,000 hectares of forests in the Tambacounda and Kolda regions, and provide a buffer zone around the Niokolo-Koba National Park. On the demand side, the project is promoting interfuel substitution and the use of improved stoves for cooking. Finally, the institutions were strengthened by engaging civil societies that have an interest in improving the lives of women and improving economic opportunities at the village and regional levels. Villages agreed to protect forests in the projection zone by adopting a resource management plan. In return they were allowed to take control of the production and marketing of traditional biomass fuels in ways that were sustainable. By 2004 about 20 percent of Senegal's fuelwood consumption was derived from such sustainably managed forests.

The highlights of the project involved the development of sustainable community-managed forests over an area of close to 400,000 hectares, which supplied more than 370,000 tons per year of sustainable fuelwood to local markets. This was accomplished through establishing incentives for sustainable forest plans. Rural people profited from selling sustainable fuelwood to traders; it was estimated that participating villages gained about US$40,000 over the period of the project. More than 30 percent resulted from women-led economic activities. The project also encouraged a transition to kerosene and better wood stoves, which helped about 250,000 families in the principal urban and periurban areas of Senegal.

## Energy Efficiency and Productive Uses

Energy efficiency and productive uses can also be characterized as improving energy access, since it has a direct impact on households, communities, and small enterprise. These investments include improvements in buildings efficiency, installation of efficient equipment, and the enhancement of the energy delivery network itself. These improvements were generally for apartment buildings and improved quality of heating vital for life in cold climates. The portfolio review identified close to US$1 billion in investments, and financing was mostly in energy efficiency (Table 3.5). Countries in Eastern Europe and Central Asia and East Asia and Pacific had significant investments in both building energy efficiency and fuel-saving technologies. In this section, we review projects in both regions that exemplify the type of investments necessary to improve energy efficiency in buildings.

In East Asia the China Heat Reform and Building Energy Efficiency Project is designed to improve the efficiency of buildings through a combination of technology demonstrations, along with the development of frameworks for regulating building energy efficiency and capacity building for organizations charged with managing the sector. Some highly complex issues had to be faced in

**TABLE 3.5: World Bank Investment in Productive Use and Energy Efficiency, FY2000–08**
(*US$ millions*)

| Region | Building energy efficiency | Building fuel-saving technology | Power and productive uses | TA and productive purposes | Total |
|---|---|---|---|---|---|
| Africa | 4.3 | 0.0 | 0.0 | 8.0 | 12.3 |
| East Asia and Pacific | 213.4 | 165.0 | 0.0 | 2.8 | 381.2 |
| Eastern Europe and Central Asia | 499.0 | 40.9 | 0.0 | 0.0 | 540.0 |
| Latin America and Caribbean | 13.7 | 0.0 | 9.7 | 7.6 | 31.0 |
| Middle East and North Africa | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| South Asia | 21.0 | 5.7 | 3.1 | 0.2 | 30.0 |
| Total | 751.5 | 211.6 | 12.8 | 18.6 | 994.4 |

*Source:* Business Warehouse and portfolio review.

developing the project. Many existing building practices, such as the pricing of heat, billing, and metering, all worked against energy efficiency. In addition, several institutions involved in promoting better housing did not necessarily coordinate with one another. This included the heat supply industry, the organizations responsible for housing development, and the government. Finally, there was little knowledge of the best international practices in supplying heat to residential buildings. The project objective was to introduce new practices to improve the incentives for introducing building efficiency.

The China heating project involved three main components geared toward improving heating efficiency in the project areas. The first component aimed to demonstrate ways to improve building insulation, improve the heat supply system, and introduce incentives for consumers to reduce their energy consumption through proper pricing and metering of heating consumption. In addition to these practical operational measures, another component addressed the policy issues surrounding the reforms necessary to support the whole process. Finally, several provinces were identified to test out the impact of both the policies and the operational changes to see how the various measures could be adjusted for the implementation of a national program.

In Russia the Municipal Heating Project launched in 2002 aimed to improve heat supply and also to ease the financial burden associated with the supply of district heating on municipal governments. The breakdown of the Soviet economic system in late 1991 and the transition to a market economy proved particularly difficult for infrastructure services in Russia, and the heating sector was no exception. The old infrastructure for heating in Russia was designed without regard for energy efficiency, and municipal heating was considered a public service. This project was designed to address some of these difficulties by improving the operating efficiency of district heating systems through investments to save energy and reduce heat losses, improving cost recovery by introducing commercial practices, and by supporting government efforts to target subsidies better for low-income households. These actions aimed to improve standard of living in eight major cities by improving the quality and reliability of heat supply and by supporting the redirection of subsidies toward low-income households.

The project contributed to a favorable environment for heating reform in Russia. The Russian government considered housing and communal reform to be very important. In 2006–08 housing and communal reform was as one of the country's top development priorities. In the city Mytischi, which participated in

the project, the provision of high-quality heating and domestic hot water services was accompanied by a reduction in costs to produce and transport heat. In Mytischi District, the project resulted in both upgrading the heating systems and creating an efficient way to administer and finance district heating operations. The result was that both electricity and natural gas consumption decreased by about one-third. Finally, the project also resulted in more comfortable levels of heat for those in buildings included in the program.

The productive use of energy is extremely important for energy projects to promote development. The reason is that the provision of infrastructure, such as electricity, requires that people pay for the service. If electricity can be used in a way that generates income, it will be more affordable to households. Another benefit is that the service can be provided at a more reasonable cost because of economies of scale. A significant amount of sector work has been done in the World Bank on promoting the productive use of energy. However, the World Bank project investments in this type of activity are quite low at only US$30 million over a period of nine years. This can be explained by the fact that much of the support for productive uses involves technical assistance, which is not as expensive as capital goods. However, this is an area in which more attention can be focused on how to include productive uses of energy in project operations.

## Conclusion

Some developments in the energy access lending portfolio of projects or project components are quite promising. Assistance to Africa—a region with the lowest access rates in the world—is both high and growing both in terms of the size of investments and the breadth of the issues covered. Africa is the region with the lowest electricity access rates and the highest reliance on biomass energy and "traditional" fuels. At present, it is receiving about one-quarter of the total World Bank investments for energy access. By contrast, South Asia is a region with the next greatest need for energy access investments. It had much lower levels of financing for energy access than either Africa or East Asia and the Pacific. Although it is well understood that South Asia faces significant policy sector challenges concerning energy access, the investment amounts seem to be below what is required for a region with a very high poverty rate and significant populations dependent on traditional forms of biomass energy. However, many large power projects in the region would contribute to alleviating energy poverty; such contributions are discussed in the next section.

In conclusion, there has been significant progress in scaling up energy access in developing countries, but significant challenges remain. Of course, the World Bank is but one player in promoting energy access in developing countries, and it is clear that coordinated approaches between international donors and the countries themselves will be necessary to tackle the challenge of providing modern energy services to the world's poorest populations. Nevertheless, in the coming years a greater focus on problems of energy access and its role in development will be necessary.

4

# INFRASTRUCTURE AND DEVELOPMENT: OUTCOMES AND MEASURMENT ISSUES

Some practical difficulties exist in measuring all energy access investments and their impacts. The reason is that increasing energy access though large distribution systems generally requires a simultaneous expansion of generation and transmission. Attributing all costs involved in large-scale generation and transmission of energy would be misleading because much of that energy will go to industry, commercial establishments, and governments. For instance, most cost-benefit work on rural electrification requires an estimate of the marginal electricity costs, which are the incremental costs to provide electricity service, including generation and transmission, to new consumers. Thus, leaving out the cost of generation and transmission for providing improved energy access would also be somewhat misleading. Likewise, including all costs of such investments would be a very distorting. For community or smaller renewable energy systems, this is not an issue because generation and distribution are all contained within household or village systems. It is mainly an issue with large network projects.

In this chapter, the study evaluates how to apportion investments in large infrastructure projects to energy access and also how projects have fared in estimating the development impacts. This was not done as part of the previous chapter because these figures are very imprecise. However, the examination of both issues is important for assessing energy access investments in developing countries.

## Energy Access and Large Infrastructure Projects: Measurement Issues

Most of this study deals with the direct financing of energy access infrastructure, along with policies and technical assistance to support such activities. However, some energy projects can have an indirect impact on energy access. For instance, adding rural consumers to rural electrification grid systems requires some upstream investments in generation and transmission. Therefore, it is quite likely that some of the World Bank investments in transmission and generation support energy for poor people as well. Estimating the portion of such a large infrastructure investment flowing to poor people requires assumptions about the rate of rural electrification, a country's poverty level, and average consumption levels of electricity by the poor. The beneficiaries of such financing would be poor people with an electricity connection and those

new households that can be connected to electricity service because of the investments. The benefits of this part of such investments would be the economic opportunities and livelihood improvements resulting from a new secure and affordable energy supply.

A large share of total World Bank lending over the last three fiscal years involves energy sector, structural adjustment, and emergency loans. There is considerable controversy about the impact of these lending instruments on the poor (Lampietti, Banerjee, and Branczik 2007; Victor 2006; Eberhard and others 2005; Bacon 2002; Besant-Jones 2006). The general conclusion from the literature is that sector reforms should take into consideration the impacts of rising prices on the poor and develop policies to mitigate such adverse impacts and to make sure reform encourages rather than discourages providing services to the poor. This is an indication of the equity issues involved in service delivery changes, and a reminder that how these issues are treated is important for the success of reform.

Since it is virtually impossible to know the indirect impact of economic growth on poverty without sophisticated econometric modeling, we relied on simple assumptions about poverty and energy access in order to impute the portion of investments flowing to the poor from some typical large energy projects. One approach for calculating upstream infrastructure development investments for energy access is to assess the share of electricity going to poor households for a country or area covered by an investment project. This share is calculated by multiplying the number of poor or rural households with access to electricity by the average electricity consumed by these households, and comparing those figures with electricity consumption across all sectors. Stated simply, this is the share of electricity flowing through the infrastructure investment that reaches the poor.

Using this estimation approach, we find important but modest amounts of investment flowing from large-scale generation and transmission projects to the poor. The main reason for this is that poor households use very modest amounts of electricity. In most household energy studies, the estimate of electricity use in poor households ranges from 30 to 50 kilowatt-hours of electricity per month. In addition, for most developing countries, it is mainly the poorest households that have no access to electricity or other modern energy services, either because of affordability issues or lack of physical access.

In addition, a general rule of thumb is that residential electricity consumption in most countries is around 30 percent of total electricity use (see Africa in Table 4.1). The implication is that two-thirds of generation and transmission investments are for purposes other than residential electricity. As indicated, these investments may go to productive enterprises with trickle-down impacts on the poor, but they are very difficult to measure. In addition, much of the residential electricity is used primarily by higher-income urban households. Finally, for many poor countries, a high percentage of their populations do not have access to electricity at all, and therefore do not consume any at all. The implication is not that these investments should not be made, since they are necessary for the development of the electricity sector and therefore are important for the country. However, there is a need to ensure that a strong access program is in place in these countries, so that the benefits of these projects ultimately reach the poor.

To illustrate the extent of the indirect impact of upstream investments on alleviating energy access and poverty for this study, we have chosen to review a list of typical large energy loans (Table 4.1). From this list, we examine the implications of the Southern Africa Power Market II Project for energy access and the India Power Grid II Project, both of which deal with high-voltage transmission of electricity. The Africa Power Market Project involves the implementation of the Malawi-Mozambique electricity interconnection to increase access to diversified, reliable, and affordable supplies of energy and to expand Malawi and Mozambique's opportunities to benefit from bilateral and regional

**TABLE 4.1: Typical Medium and Large Energy Infrastructure Projects**

| Country | FY | Project name | Total bank financing | Bank energy financing | Direct energy access | % residential electricity consumption | % poverty rate (< 1.25 per capita per day 2005 | % access to electricity 2005 |
|---|---|---|---|---|---|---|---|---|
| Africa | 04 | Southern Africa Power Market | 178.5 | 178.5 | 0.0 | 30 | 51 | 37 |
| China Rural/ Urban | 03 | Yixing Pumped Storage Project | 145.0 | 145.0 | 0 | 28/12 | 26/2 | 99 |
| India | 02 | Power Grid II | 450.0 | 450,0 | 0 | 20 | | 65 |
| Indonesia | 03 | Java-Bali Power Sector | 141.0 | 141.0 | 0.0 | | 24/18 | 80 |
| Ethiopia | 03 | Energy Access SIL | 132.7 | 132.7 | 130.0 | 38 | 39 | 15 |
| Ukraine | 05 | Hydropower Rehabilitation | 106.0 | 106.0 | 0.0 | 21 | 3 | 100 |
| Turkey | 04 | Renewable Energy | 202.0 | 101.0 | 0.0 | 24 | 3 | 100 |
| Poland | 04 | Hard Coal Social Mitigation | 200.0 | 100.0 | 0.0 | 25 | 0.1 | 100 |

*Source:* Portfolio review and Business Warehouse; poverty data from World Bank PovcalNet for 2005. The poverty line is defined as US$1.25 per capita per day or US$38 per capita per month.

power trading in the South African Power Pool. This is a crucial project for improving regional trade and encouraging better efficiency of electricity distribution in the region. It also makes it possible to expand energy access in the region.

For estimating the share of the investment that might reach poor households, we take the case of Malawi. Malawi is fairly typical of many countries in Sub-Saharan Africa. Only 26 percent of households in Sub-Saharan Africa have electricity, and most of them live in urban areas. In addition, the new households getting an electricity connection in the region are quite poor and will use what are considered subsistence levels of electricity. For Malawi, a Living Standards Measurement Study was completed in 2005, so it is possible to estimate the electricity going to poor households at the time of the project (Table 4.2). The majority of electricity being consumed in Malawi is in the urban areas. According to the 2005 study, only about two-thirds of urban households in the country have electricity, and less than 3 percent of rural households have it. As a consequence, most of the residential electricity in Malawi is consumed by the highest two-fifths of the population. It is interesting that for those that have electricity, the monthly kilowatt-hour monthly usage of electricity is quite high compared to other African countries. Electricity is very inexpensive in Malawi, so it is very common to use it for cooking in urban areas. As of 2005, more than 87 percent of residential electricity was being used by the highest income quintile. Because of the low amount of electricity being used by the lower income groups, even if there is a dramatic expansion of electricity, the combination of low prices and heavy use by high-income groups means that most of the investments will not reach the poorest households. The poorest 60 percent of the populations consume only about 5 percent of the total residential electricity use in the country. Because residential electricity use is only 30 percent of total regional electricity use, this would mean only about 1 percent of the electricity investments are going to the poorest households in Malawi. This is mainly because of the low levels of electricity access in the country.

A similar analysis for India demonstrates the importance of electricity access levels for assessing

**TABLE 4.2: Residential Electricity Use in Malawi, 2005: Estimates from Living Standards Measurement Study**

| | Low | Low middle | Middle | High middle | High | Average |
|---|---|---|---|---|---|---|
| Lilongwe households | | | | | | |
| Households in income class | 28,282 | 28,282 | 28,282 | 28,282 | 28,282 | 141,408 |
| Lilongwe urban electricity users | 0 | 0 | 1,768 | 7070 | 24157 | 32995 |
| % with electricity | 2.1 | 4.2 | 12.5 | 38.5 | 91.7 | 29.8 |
| Electricity use of users (kWh/mo) | n.a. | n.a. | 374 | 210 | 861 | 695 |
| Electricity expenses of users US$/mo | n.a. | n.a. | 12.19 | 6.17 | 26.54 | 21.41 |
| Other urban households | | | | | | |
| Households in income class | 36,270 | 35,931 | 36,193 | 36357 | 35970 | 180720 |
| Other urban electricity users | 2,036 | 3,064 | 7,937 | 15706 | 30030 | 58773 |
| % with electricity | 7 | 9 | 26 | 47 | 86 | 35 |
| Electricity use of users (kWh/mo) | 68 | 65 | 121 | 164 | 448 | 295 |
| Electricity expenses of users US$/mo | 2.14 | 2.09 | 3.74 | 4.90 | 13.11 | 8.69 |
| Rural households | | | | | | |
| Households in income class | 473,393 | 474,152 | 473,541 | 473,970 | 473,475 | 2,371,416 |
| Rural areas electricity users | 262 | 0 | 910 | 3867 | 32586 | 37624 |
| % with electricity | 0.13 | 0.07 | 0.19 | 0.90 | 7.62 | 1.78 |
| Electricity use of users (kWh/mo) | 144 | n.a. | 126 | 137 | 324 | 299 |
| Electricity expenses of users (US$/mo) | 1.33 | n.a. | 1.17 | 1.27 | 3.00 | 2.77 |
| Total households | | | | | | |
| Electric use (kWh/month (000)) | 175 | 198 | 1,734 | 4,589 | 44,807 | 51,504 |
| % kWh used in income group | 0.3 | 0.4 | 3.4 | 8.9 | 87.0 | 100.0 |

*Source:* O'Sullivan and Fitzgerald 2007.
*Note:* Income class is roughly in quintiles for the country; n.a. stands for not applicable because too few households are in the income class.

the benefits going to poor households. With so little access to electricity in Africa, it is not unexpected that investments for improving generation and transmission are necessary, although in the short term they do not reach the poorest households. For India, there was a recent national survey that provides electricity use by income class (Table 4.3). Instead of examining regional patterns, we will assume that generation and transmission projects have benefits for the whole country. The figures in the table represent the total electricity consumed by all households in various income deciles for urban and rural areas. Because of the large rural electrification distribution program, the distribution of investments for generation and transmission reach far more households than in Malawi. Residential electricity use in India is about 21 percent of total electricity use in the country, and the lowest four income classes for both urban and rural areas use about 6 percent of total electricity consumed in India. For a US$450 million transmission project such as Power Grid II, the investments that should be classified as electricity access would be about US$26 million.

Another way to approach this problem is through examining the marginal cost of generation and transmission that is involved in investing in energy

**TABLE 4.3: Residential Electricity Use in India, 2005: Estimates from the India Human Development Survey**

| Income decile | Monthly rupees expenditures in class | Monthly residential kWh in class | % class of total residential kWh | % residential class of total national kWh | Cumulative % class of total national kWh |
|---|---|---|---|---|---|
| Urban | | | | | |
| Lowest | 687,118 | 271,575 | 3.0 | 0.6 | 1 |
| 2 | 773,305 | 302,624 | 3.3 | 0.7 | 1 |
| 3 | 845,642 | 324,748 | 3.6 | 0.7 | 2 |
| 4 | 1,013,784 | 387,994 | 4.2 | 0.9 | 3 |
| 5 | 1,143,479 | 425,834 | 4.7 | 1.0 | 4 |
| 6 | 1,104,347 | 406,594 | 4.4 | 0.9 | 5 |
| 7 | 1,350,049 | 486,685 | 5.3 | 1.1 | 6 |
| 8 | 1,540,920 | 551,349 | 6.0 | 1.3 | 7 |
| 9 | 1,658,888 | 587,280 | 6.4 | 1.3 | 9 |
| Highest | 2,185,761 | 746,256 | 8.2 | 1.7 | 10 |
| Rural | | | | | |
| Lowest | 667,611 | 313,773 | 3.4 | 0.7 | 1 |
| 2 | 581,084 | 278,211 | 3.0 | 0.6 | 1 |
| 3 | 663,502 | 317,210 | 3.5 | 0.7 | 2 |
| 4 | 729,344 | 344,059 | 3.8 | 0.8 | 3 |
| 5 | 852,516 | 396,198 | 4.3 | 0.9 | 4 |
| 6 | 898,480 | 422,452 | 4.6 | 1.0 | 5 |
| 7 | 1,038,660 | 485,408 | 5.3 | 1.1 | 6 |
| 8 | 1,250,463 | 565,820 | 6.2 | 1.3 | 7 |
| 9 | 1,588,974 | 702,178 | 7.7 | 1.6 | 9 |
| Highest | 1,932,941 | 821,689 | 9.0 | 1.9 | 11 |
| Grand total | 22,506,867 | 9,137,935 | 100 | 21 | 21 |

*Source:* Desai and others 2005

access. Many studies have been completed on the marginal costs of generation and transmission as a component of rural electrification projects. The findings vary, but generally electricity generation and high-voltage transmission are estimated to be around 10–20 percent of total marginal investment costs in rural electrification. This simply means that for every new electricity connection in a country with no spare generation and transmission capacity, new marginal investments must be in generation and transmission. Thus, if the average cost of connecting a new household to the grid is US$500, it would require an equivalent investment of about US$50–100 in new generation and transmission. The implication of these figures is that the investments necessary to support energy access are quite large.

The indirect flow of access-related benefits from large infrastructure investment is hard to measure, but likely to be modest in scale. As indicated in

**TABLE 4.4: Energy Access Investments with Estimated Access Related Generation and Transmission, FY2000–08**
(*US$ millions*)

| Fiscal year | Total energy investments | Total generation and transmission investments* | Total energy access investments | Total energy access plus 5% of generation and transmission | Total energy access plus 7.5% of generation and transmission | Total energy access plus 10% of generation and transmission |
|---|---|---|---|---|---|---|
| 2000 | 1,765 | 432 | 448 | 470 | 480 | 491 |
| 2001 | 1,817 | 839 | 246 | 288 | 309 | 330 |
| 2002 | 2,166 | 536 | 520 | 547 | 560 | 574 |
| 2003 | 1,249 | 24 | 169 | 170 | 171 | 171 |
| 2004 | 1,054 | 149 | 254 | 261 | 265 | 269 |
| 2005 | 1,992 | 708 | 326 | 361 | 379 | 397 |
| 2006 | 3,176 | 1,897 | 476 | 571 | 618 | 666 |
| 2007 | 2,031 | 1,050 | 359 | 412 | 438 | 464 |
| 2008 | 4,963 | 2,071 | 1,151 | 1,255 | 1,306 | 1,358 |
| Total | 20,213 | 7,707 | 3,949 | 4,334 | 4,527 | 4,720 |
| % of total | 100 | 38 | 20 | 21 | 22 | 23 |

*Source:* Portfolio review.
* The generation and transmission investments include transmission, thermal generation, large hydropower generation, and renewable energy generation.

Table 4.4, allowing 10 percent of generation and transmission investments to be included as energy access only improves the overall estimates from 20 percent to 23 percent of total World Bank investment lending. In fact, other categories of benefits from such projects are much more important and tangible, such as economic efficiency and economic growth. Without the expansion of generation and transmission, the expansion of the electricity grid and therefore access to electricity is difficult. In fact, it would be very hard to justify the expansion of electricity service in countries where there are significant shortages of electricity supply. However, the more salient point is that it is better to make sure that expansion of electricity access is not slighted or ignored in countries with large generation and transmission needs. This will result in projects in which the investment benefits can be spread more equitably to people in both poor urban and rural areas.

## Indicators of Energy Access Project Impacts

This study has compiled a list of all the project output indicators, including new households reached by the projects and the number of existing households that can take advantage of improved service (Table 4.5). It should be cautioned that the reporting for output indicators for the projects is highly inconsistent. Many projects should have reported households affected by the project, but no information was given in the project appraisal documents. Thus, we present these indicators with the caveat that they are probably a minimum rather than a comprehensive list of indicators. According to this review, close to 8 million households received new access to energy, and more than 2 million took advantage of improved energy services as a result of the projects from 2000 to 2008 (Table 4.4).

There are several reasons for reporting these figures, one of which admittedly is likely to be low estimates

**TABLE 4.5: Energy Access Output Indicators Underreported Reported in World Bank Projects, FY2000–08**

| | New households affected | Existing households affected | Cooking stoves and CFLS disseminated | Hectares of forest affected |
|---|---|---|---|---|
| Cooking and biomass energy | 306,000 | 0 | 1,058,500 | 1,657,000 |
| Efficiency cookstoves and lightbulbs | 6,000 | 0 | 808,500 | 1,116,000 |
| Improved forestry production | 0 | 0 | 250,000 | 541,000 |
| Interfuel substitution | 300,000 | 0 | 0 | 0 |
| Household electricity | 7,535,440 | 2,289,200 | 570,000 | 1,000,000 |
| Grid periurban | 113,150 | 400,000 | 0 | 0 |
| Grid rural electrification | 5,289,854 | 1,881,200 | 570,000 | 1,000,000 |
| Off-grid electrification | 2,112,436 | 0 | 0 | 0 |
| Public sector capacity | 20,000 | 8,000 | 0 | 0 |
| Productive use and efficiency | 109,400 | 106,100 | 0 | 0 |
| Building energy efficiency | 15,400 | 106,100 | 0 | 0 |
| Efficient cookstoves and lightbulbs | 94,000 | 0 | 0 | 0 |
| Grand total | 7,950,840 | 2,395,300 | 1,628,500 | 2,657,000 |

*Source:* Portfolio review and Business Warehouse.

of project impacts. The first is that it is a good accomplishment to reach so many households, but it should be kept in mind that the necessary investment requirements are still quite large. Approximately 320 million households worldwide are still without electricity service. The second is that it gives an indication of where most of the World Bank investments in energy access have had an impact; rural grid electrification and off-grid electrification are clearly the main areas of the investment portfolio. Finally, this does illustrate that the projects in general need to do a better job of developing proper output indicators for projects that do not involve direct investments in household infrastructure, and developing better systems for monitoring and evaluating the impacts of projects.

## Conclusion

Large infrastructure investments are necessary conditions for energy access. Many of the costs and benefits involved in large infrastructure investments are shared among a variety of sectors, and accurately measuring their impacts is often imprecise and judgmental. However, without investments in projects, such as generation and transmission, there would not be enough electricity to expand energy access. Complicating matters further, the project documents of large infrastructure investments are hazy when specifying the project development outcomes and indicators of development impact. Two conclusions emerge from the project review. In energy access, which is the subject of this review, better methodologies need to be applied to the actual impacts of such projects on development. The current investments in upstream projects are necessary conditions for improving energy access, but there should be a more explicit commitment to ensure that this expansion actually takes place. The reason is that without such complementary investments, most benefits will not reach the poor except indirectly through the very hard-to-measure impacts on economic growth and consequent growth in economic opportunities for poor households.

5

# MODERNIZING ENERGY SERVICES FOR THE POOR

The present and future need to make modern energy services available to the rural and urban poor presents a unique challenge in which the World Bank can play a significant role. Addressing the complex problems of these populations requires the strengths of diverse institutions, groups, and individuals. This would include international lending agencies, NGOs, local communities, and private entrepreneurs. Two main issues have emerged from this review. There is a need to take advantage of innovative and successful emerging approaches for promoting energy access and development in conjunction with addressing the inherent complexity of energy access issues. There is also a need for improved ways to track energy access investments in the World Bank's lending portfolio and their impacts. This is necessary to understand both the strengths and weaknesses of present approaches, and also to establish a baseline for measuring future progress.

This review develops a comprehensive approach to analyzing energy access investments in the World Bank project portfolio. This is a significant step toward developing a monitoring system for evaluating both individual investments and the overall developmental impact of the World Bank's energy access projects. It should be kept in mind that this review does not cover sector work. Rather, it is strictly a review of project investments that are listed in the World Bank's Business Warehouse. The approach developed is not perfect, but a component-by-component review of all World Bank energy investments represents a method that is quite stringent.

The work on energy access is of increasing importance for the World Bank, which reflects the linkage between energy access and achieving the MDGs. This is reflected in several ways. First, there has been an acceleration of direct investment in both grid and off-grid electricity access. These investments now comprise close to half the total energy access portfolio. Grid electricity investments include the actual investments in wires, poles, and transformers to provide electricity to both rural and periurban households. The off-grid systems include both electricity generation from small sources (for example, PV, wind, local hydropower, and diesel generators), as well as the local distribution system. These and other off-grid investments were supported by direct investments, the development of rural energy funds, and supporting policies and technical assistance.

Historically, the World Bank has been involved in rural grid electrification systems. It is only in the last 10 years that the level of investment for off-grid electricity solutions has been comparable to

the direct investment in traditional grid extension. This trend reflects the mainstreaming of early rural electrification sector work (World Bank 1996) and the advent of the GEF, the Carbon Funds, and the regional programs, such as ASTAE, for the promotion of renewable energy in off-grid applications. More recently, the possibility of an investment fund promoting energy services for the poor has arisen.

## General Trends in Energy Access Investments

The general findings of the review are quite positive. As indicated, investments in electricity access—both grid and off-grid—are increasing, along with other energy investments by the World Bank. In fact, this review has examined some extremely successful programs in which the World Bank has been involved with rural electrification programs for decades. The impact that such programs can have on development is quite substantial, with rates of return that are very high, as documented by a recent review by the World Bank IEG (2008). In general, the design of rural electrification programs is very country-specific, and they require a significant amount of project preparation in the initial stages. Later repeat projects can lessen the cost, but the cost required for the development of initial projects that must face poor pricing regimes, conservative utilities, weak institutions, and adverse regulatory regimes should not be underestimated.

As indicated, the investments going to household electricity comprise about half of all investments in the energy access portfolio. Within household electricity, grid electricity investments comprise close to 70 percent of this financing, and off-grid electricity is close to 20 percent. It is encouraging that Africa, which has the lowest electricity access rates of any region in the world, also has an active program to assist countries in promoting access to electricity services, which is true for both grid and off-grid electricity projects. Off-grid projects in South Asia have been significant, including in such countries as Bangladesh, Nepal, and Sri Lanka. In East Asia, projects in China and the Philippines are attempting to reach their most remote populations without electricity through off-grid and mainly renewable energy projects. Thus, the promotion of rural electricity in World Bank projects has traditionally been through grid electricity, but increasingly innovative projects have been developed to serve people in areas that will not receive grid electricity for many years to come. These innovative programs are generally run through either private sector organizations, such as equipment retail companies, as is the case in China, or through the support of NGOs and microfinance organizations.

One surprising finding is that about one-quarter of the World Bank's investments in energy access—about US$1 billion between 2000 and 2008—involves policy development and institutional building. Under these types of investments, the main categories of funding were for rural electrification master plans, policy frameworks, energy strategies, and heating sector reform. Although there were some regional differences, much of this investment went to support the development of public sector capability to administer such projects.

Investments in energy efficiency and the promotion of productive uses of energy also comprises about one-quarter of World Bank lending for energy access. These are projects that have direct or indirect support for households, and that include investments in building efficiency, installation of efficient equipment, and the enhancement of the energy delivery network, so the majority of these investments are in energy efficiency. As expected, the main regions with these types of investments are Eastern Europe and Central Asia and East Asia and Pacific. The main reason for this is that these regions already have extensive energy networks, and improving the efficiency of these existing investments to serve household and community populations better has been a priority.

One somewhat surprising finding is that so few investments have been made in promoting the energy transition to higher-quality cooking fuels. In this regard, a concerted effort is needed to improve

the lives of the 3 billion people in the world that use solid fuels for cooking in very inefficient ways, since this could have significant benefits for both health and the environment. Electricity is only rarely used in developing countries for cooking, so most of the electricity investments have a substantial impact on quality of life, but really do not improve household cooking. Only about 1 percent of the total lending was dedicated to the promotion of the transition to more modern cooking fuels. It must be realized that projects, such as improved cooking stoves, local forest management, and development of gas and LPG networks, have faced challenges in the past, whether local institutional issues or political realities. The regional patterns of investment suggest that Africa has been more involved in improved cookstoves and improved forest management, in Latin America the focus has been on improved stoves, and in North Africa and the Middle East, the goal has been to support the transition to modern fuels, such as LPG and gas. However, this is an area that should receive more attention, since improving the cooking environment has significant impacts on household welfare in the form of improved health and alleviation of hours of drudgery that could be better used for more productive activities.

Potential exists to expand work in the area of periurban energy, which today is just considered part of urban infrastructure. The use of higher-quality cooking fuels and the promotion of electricity in poor urban areas or slums generally are not addressed in the lending program. Serving poor households in urban slums usually takes a different approach than the usual methods used for expanding grid electricity service, which may be a new area of concentration for the World Bank's lending program.

To conclude, quite a bit of progress has been made in promoting energy access in developing countries. It should be kept in mind that the World Bank is not the only development agency involved in energy access. In order to truly promote the poor's access to modern energy services that are necessary for achieving the MDGs, the cooperation of a wide variety of development agencies will be required.

## Financial Instruments and Energy Access

The main financial instrument utilized for energy access investments is World Bank–IDA funds. This is because energy access projects are mostly directed toward poor households. However, IDA is a general poverty alleviation fund, and allocations are made based on country size, population, and level of poverty. For larger countries, this is not such an issue, but for scaling up energy access in small countries, it has significant limitations. In small countries, IDA funds generally are dedicated toward one sector per year, and energy has to wait its turn for available resources. As a result, obtaining these funds for rural energy projects in small countries can sometimes be difficult.

Energy access projects also have very high rate of using grant funds. Most grant funds available for energy access projects involve a specialized review procedure. Examples are the Public-Private Infrastructure Advisory Facility, the GEF, and the Carbon Funds. Obtaining such grants requires an inordinate amount of time preparing proposals and satisfying multiple financing windows. Mobilizing the extra preparation financing and undertaking the range of tasks needed to prepare an energy access project makes for a protracted and complicated project preparation process. Energy access project development would benefit greatly from introducing more streamlined or simplified procedures.

As evidenced by the high level of grant funds in the World Bank's energy access investments, these various grant funds to support energy access have been very important for promoting energy access. However, it would be much easier if there were dedicated grant funds for addressing the development of energy access for the poor in developing countries. Applying for such grant funds to support energy access would more directly address the issue of alleviating energy poverty without the trappings of environmental, global warming, or privatization issues. This is not to say that the other issues are not important, but it would make the application process for grants more

streamlined and more directly related to an issue that is of high importance to the World Bank, and that is to alleviate poverty.

## Lessons Learned from Portfolio Review and Successful Projects

Several lessons can be drawn from both this portfolio review and the successful projects that have emerged from this review. The first is that at the beginning of many energy access projects, there is a period of high levels of technical assistance in which the Bank assists governments in developing custom strategies to deal with providing energy to their poorest populations. The second is that both public support and private investments are important in many projects, but they take a different form depending on the country and its political realities. The third is that many projects have low levels of monitoring and evaluation, so it is difficult to judge the development effectiveness of the projects and whether they support the MDGs.

### *High Levels of Technical Assistance*

For new countries that are politically committed to developing better access for their poorest populations, an initial period of analysis and strategy development is necessary. For instance, there is often a need to develop new institutions to implement a rural energy or electricity access program, which is true whether the main program is going to be for grid or off-grid electricity. As an example, in the early Bangladesh rural electrification program, the Rural Electrification Board was developed to handle the entire rural electrification grid expansion program. This meant that the government had to be committed to both financial and institutional support for the program, and it was a novel way of doing business for the country, which in the past had relied almost exclusively on state-run utilities for electricity provision. When it came time in that last loan to support off-grid electrification, the task was given to an entirely different agency that would dedicate staff to developing and supporting mostly renewable energy options. The business models of these two enterprises are quite different, so different public support mechanisms were necessary.

The Bangladesh model is but one option in a wide variety of institutional, legal, and regulatory approaches to providing energy access to poor populations. Most countries must develop an approach that coincides with their social-political realities. This is the case whether the projects are grid or off-grid expansion of electricity, promotion of energy efficiency, or development of ways to encourage better cooking fuels. At the beginning of this process, laws must be changed, sometimes institutions have to be created or altered, and techniques to develop well-targeted subsidies that do not destroy business incentives have to be studied and implemented. These are not easy tasks, and they require a significant commitment by governments to undertake strategies and projects to help their poorest populations gain access to high-quality energy services.

The good news is that, after this initial high level of technical assistance to prepare the political, institutional and financial landscape for energy access, much of the World Bank's investments in repeat projects are much easier to implement and are highly cost effective. In fact, it was somewhat surprising that World Bank investments in energy access are somewhat concentrated in countries with repeat projects. Vietnam is a very good example of this. The first loan in 2000 spawned a series of investments over the decade to take the country to an over 90 percent electrification rate today. The interesting feature of these series of loans is that they are not repeat projects in the sense that they are the same. Rather, they keep defining and solving implementation problems and issues that come up as the program evolves. The lesson is that there are significant levels of technical assistance to set up the framework for energy access investments that should not be underestimated in countries that want to embark on energy access programs, although this can be followed by a stream of projects that are easier to implement over subsequent years.

### *Public and Private Investments in Energy Access*

The rural access agenda is often thought to be a public agenda, but this is only partially true. The review of World Bank projects actually challenges this idea and there seems to be a need for public-private partnerships in many projects. To be sure, some purely public-rural electrification projects are in the portfolio, but there also is a large amount of investment in what might liberally be called the private sector. Taking the case of three large projects in the portfolio, the Bangladesh rural electrification program is based on publicly supported electricity distribution businesses that are called cooperatives. For the off-grid program, microcredit organizations are selling PV SHSs and making three-year loans to recover the costs of the systems with competitive interest rates. In Vietnam, the latest project involves support for local electricity companies that collect revenue and maintain local system lines. The goal is to develop incentive frameworks to make these small private and sometimes semipublic businesses work more effectively. In Peru, the investments are actually going mostly to private distribution companies to promote electricity expansion in a way that is more financially viable for the involved companies. Even investments in purely public electricity companies often end up in the hands of private sector companies that produce electricity equipment or construct and maintain the electricity lines.

### *Monitoring and Evaluation Needs Improvement*

Monitoring and evaluation of energy access project impacts is also still at a very basic level in most energy access projects. Projects often do not quantify the physical targets to be met, unless they are expansion projects with specific goals. Besides the usual physical measures, few projects measure the social or economic impact in a comprehensive way. One significant exception to this is the Vietnam rural electrification project, which has a comprehensive monitoring and evaluation instrument associated with it; it was actually financed through independent trust funds outside the project. Given the current climate and interest in energy access issues, a better job needs to be done in tracking both the impact of the projects themselves and the yearly progress in meeting the energy access goals.

## Conclusion

This review of World Bank energy access investments reveals both strengths and weaknesses in approaching the goal of alleviating energy poverty and achieving the MDGs in developing countries. Progress has been made for World Bank financing for both energy and energy access during the last decade. Significant commitments have been made for addressing energy access issues in Africa, where the need is probably the greatest. There are many highly diverse, innovative, and significant advances in project design, including innovative subsidy models and private-public partnerships. The increasing amount of investments going to off-grid electrification compared to a decade ago is clearly a step in the right direction. Likewise, problems have arisen as well. Cooking energy issues are widely discussed within the World Bank and at international forums, but more needs to be done to promote World Bank lending in the areas of biomass energy and interfuel substitution. Also, project monitoring and evaluation has been modest at best, hence a real need to improve the assessment of project impacts on the poor. Energy sector reform projects still address energy access issues in a modest way, and the links between the benefits of reform and energy poverty need to be more clearly delineated in the project documents.

Much progress has been made both through investments by international development agencies and the countries themselves. The number of people with electricity increases every year, and this number is staying ahead of population growth. Some notable progress is even being made in the development of a new generation of improve biomass stoves. However, the rapid expansion of populations in developing countries and patterns of increasing urbanization in the form of slums means the task of dealing with energy poverty will be a challenge for many years to come.

# Annex 1

# ACCESS INVESTMENT COMPARISONS WITH CLEAN ENERGY INVESTMENT FRAMEWORK (CEIF) REPORT UPDATES

The figures compiled for energy access under the Clean Energy Investment Framework (CEIF update reports) are based on a different definition than those analyzed in this study. The term *energy access* for this report relates to the physical proximity of people to infrastructure and to the policies and supporting technical activities that are geared toward encouraging people to move to cleaner, more efficient, and in general more modern fuels. This definition frames energy access as supporting the transition from low-quality or inefficient use of energy sources to higher and more efficient uses. The CEIF has the dual purpose of tracking clean energy and energy access investments, with the focus on how to support investments in developing countries that reduce risks from climate change and achieve low-carbon growth. These two quite different focuses actually lead to different ways of classifying energy access in the Bank's lending portfolio.

## Differences in Classifications

Differences in the calculations of energy access are based on the underlining purposes of these two reports. This goal of this energy access review is to classify the various components that make up or lead to energy access, including rural electrification, biomass energy, heating reforms and building efficiency, and the promotion of modern fuels, such as LPG, for cooking. Accordingly, a thorough review of World Bank projects at the component level has been undertaken to determine energy access. The purpose of the CEIF report is to broadly classify projects or large project components into categories, such as low carbon, transmission and distribution, oil, gas, coal, thermal generation, and other types of energy investments. As a result, the CEIF report undertakes classification on a broader level according to its interest in carbon production and climate change (Table A2.1).

The significant differences make it very difficult to reconcile the energy access figures between the two reports. The major difference is to the result of the treatment of generation and transmission as energy access in the CEIF updates and their qualified exclusion in this study. Another noteworthy difference is that IFC investments are included in the CEIF updates, but because they are not

**TABLE A2.1: Example of Differences in Project Classifications: Energy Access Review versus the Clean Energy Investment Framework**

| Project type | CEIF | Energy access review |
|---|---|---|
| Thermal generation | 100% access in IDA only | 0% access, but qualified in Chapter 4 |
| Transmission | 100% access | 0% access, but qualified in Chapter 4 |
| Rural electrification (distribution) | 100% access | 100% access |
| Urban electrification (distribution) | 100% access | 100% access |
| Building heating efficiency | 100% low carbon | 100% access |
| Cooking and biomass energy | Not classified | 100% access |
| Policy and reform lending | 0% access | Included % that is related to access definition |
| Non-energy project policy and reform with energy components | 0% access | Included % that is related to access definition |
| Mining projects | Not classified | Included % that is related to access definition |
| Renewable energy | 100% low carbon or low carbon access | Included % that is related to access definition |
| IFC investments and MIGA | Examined in report because it is part of the World Bank Group | Not Examined in report because it is not in World Bank annual report energy figures. |
| Low carbon | Classified | Not classified |

*Source:* Portfolio review and Clean Energy Investment data base.

in the World Bank annual report (World Bank, various years), they have not been included in this study. The issues involved in estimating generation and transmission are detailed in Chapter 4 of this report. Certainly much electricity goes to commercial businesses and industry, but households consume much electricity as well.

A comparison of the figures from both reports reveals that the investment figures are fairly far apart (Table A2.2). This is mainly to the result of the inclusion of generation and transmission and other investments in the CEIF report that are not considered in this review. An effort was made to reconcile the figures by reconstituting some of the categories in Table A2.1, and the results were encouraging. By adding generation and transmission to the energy access figures in this report, the numbers are fairly close. However, overall there are too many differences in the project classifications, as well as in the definition of energy access to reconcile the figures. As indicated, both reports have different purposes, and they are both valid, given their respective definitions of energy access.

## Implications

The differences between the two approaches to energy access may actually reflect on the lack of research on energy poverty as it relates to climate change. The goal of alleviating poverty is central to the international efforts to promote development. In fact, linking macro issues, such as climate change, to micro issues, such as energy poverty, is difficult beyond the stage of saying that economic growth and reduced climate change are good for everyone. Little information is available on the energy poor and how their energy use pattern relates to climate change. For instance, what would be gained from substituting electric modern fuels or modern ways of cooking for traditional use of fuels in low-income developing countries? What would happen with massive adoption of improved stoves in developing

**TABLE A2.2: Comparison of Energy Access Review and Clean Energy Investment Framework Figures, 2003–08**
*(US$ millions per year)*

| Year | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 |
|---|---|---|---|---|---|---|
| CEIF access (IFC and MIGA excluded) | 618 | 441 | 586 | 664 | 476 | 956 |
| Blended low carbon and access | 176 | 79 | 396 | 265 | 479 | 903 |
| Total CIEF access | 794 | 521 | 983 | 929 | 955 | 1,858 |
| % Access in CIEF classification | 0.68 | 0.57 | 0.53 | 0.29 | 0.47 | 0.41 |
| Access in this review | 169 | 254 | 326 | 476 | 359 | 1151 |
| % Access in investment review | 0.14 | 0.24 | 0.16 | 0.15 | 0.18 | 0.23 |

*Source:* Portfolio review and Clean Energy Investment data base.

countries? With more efficient heating technologies, how would this impact climate change? Quite a few ways are available for households to move up the energy ladder to more modern forms of using energy. In order to understand the relationship between energy poverty and climate change, it would be necessary to develop better information on energy use by the poor as it relates to climate change.

Annex 2

# THE WORLD BANK ENERGY ACCESS INVESTMENT PORTFOLIO: FISCAL 2000–08

| Fiscal year | Region | Country | Project name | Product line | Bank total commit. | Energy commit. | Access commit. | Policy intervention | Electricity extension intervention | Non-electri. HH interv. | Efficiency and productive uses |
|---|---|---|---|---|---|---|---|---|---|---|---|
| FY00 | EAP | China | CN-BEIJING ENVIRONMENT II | IBRD/IDA | 374.0 | 199.5 | 173.5 | Yes | No | Yes | No |
| FY00 | EAP | Vietnam | VN-RURAL ENERGY | IBRD/IDA | 150.0 | 150.0 | 150.0 | Yes | Yes | No | No |
| FY00 | LCR | Brazil | BR Energy Efficiency (ELETROBRAS) | IBRD/IDA | 58.4 | 58.4 | 36.8 | Yes | No | Yes | Yes |
| FY00 | SAR | India | UP POWER SECTOR RESTRUCTURING PROJECT | IBRD/IDA | 150.0 | 150.0 | 35.6 | Yes | Yes | No | No |
| FY00 | SAR | India | REN EGY II | IBRD/IDA | 130.0 | 130.0 | 20.0 | Yes | Yes | No | Yes |
| FY00 | ECA | Ukraine | KIEV PB ENERGY EFFIC | IBRD/IDA | 18.3 | 18.3 | 18.3 | Yes | No | No | Yes |
| FY00 | LCR | Mexico | GEF MX ALTERNATIVE ENERGY | GEF | 8.9 | 8.9 | 8.9 | Yes | Yes | No | Yes |
| FY00 | SAR | India | ENERGY EFFICIENCY | GEF | 5.0 | 5.0 | 5.0 | No | No | Yes | No |
| FY01 | ECA | Russian Federation | MUN HEATING | IBRD/IDA | 82.5 | 82.5 | 82.5 | Yes | No | No | Yes |
| FY01 | ECA | Latvia | RIGA DIST HEAT | IBRD/IDA | 36.2 | 36.2 | 36.2 | Yes | No | No | Yes |
| FY01 | ECA | Ukraine | SEVASTOPOL HEAT SUPPLY IMPROVEMENT | IBRD/IDA | 28.2 | 28.2 | 28.2 | Yes | No | No | Yes |
| FY01 | EAP | Vietnam | VN-COMMUNITY BASED RURAL INFRA. | IBRD/IDA | 102.8 | 23.6 | 23.6 | Yes | Yes | No | No |
| FY01 | ECA | Belarus | SOC INF RETROFIT | IBRD/IDA | 22.6 | 22.6 | 22.6 | Yes | No | No | Yes |
| FY01 | SAR | India | MP DPIP | IBRD/IDA | 110.1 | 16.5 | 16.5 | Yes | No | No | No |
| FY01 | ECA | Poland | KRAKOW ENRGY EFF | IBRD/IDA | 15.0 | 15.0 | 15.0 | Yes | No | No | Yes |
| FY01 | AFR | Lesotho | LS-Utilities Sec Reform SIL (FY01) | IBRD/IDA | 28.6 | 20.6 | 13.6 | Yes | Yes | No | No |
| FY01 | LCR | Brazil | BR Bahia Rural Poverty Reduction Project | IBRD/IDA | 54.4 | 5.4 | 5.4 | Yes | Yes | No | No |
| FY01 | SAR | India | Rajasthan Power I | IBRD/IDA | 178.2 | 178.2 | 5.2 | Yes | Yes | No | No |
| FY01 | LCR | Brazil | BR Pernambuco Rural Poverty Reduction | IBRD/IDA | 30.1 | 3.0 | 2.9 | Yes | Yes | No | No |
| FY01 | AFR | Nigeria | NG-Privatization Supt SIL (FY01) | IBRD/IDA | 114.3 | 27.8 | 1.6 | Yes | Yes | No | No |
| FY01 | ECA | Kosovo | ENERGY SECTOR TA (KOSOVO TF) | Special Finc. | 2.5 | 2.5 | 0.8 | Yes | No | Yes | Yes |
| FY01 | EAP | Mongolia | MN-GEF-Urban Stove Improvement | GEF | 0.6 | 0.6 | 0.6 | Yes | No | Yes | No |

(continued on next page)

| Fiscal year | Region | Country | Project name | Product line | Bank total commit. | Energy commit. | Access commit. | Policy intervention | Electricity extension intervention | Non-electri. HH interv. | Efficiency and productive uses |
|---|---|---|---|---|---|---|---|---|---|---|---|
| FY01 | LCR | Uruguay | UY PUBLIC SERVICES MODERNIZATION TA | IBRD/IDA | 6.0 | 2.0 | 0.5 | Yes | No | No | No |
| FY02 | SAR | Bangladesh | Rural Elect. Renewable Energy Dev. | IBRD/IDA | 199.2 | 199.2 | 199.2 | Yes | Yes | No | No |
| FY02 | LCR | Brazil | Energy Sector Reform Loan | IBRD/IDA | 431.8 | 431.8 | 108.0 | Yes | Yes | No | No |
| FY02 | SAR | Sri Lanka | Renewable Energy for Rural Economic Dev. | IBRD/IDA | 83.0 | 83.0 | 83.0 | Yes | Yes | No | Yes |
| FY02 | AFR | Uganda | UG-Energy for Rural Transform (FY02) | IBRD/IDA | 52.4 | 52.4 | 47.9 | Yes | Yes | No | Yes |
| FY02 | EAP | Vietnam | VN-SYSTEM ENERGY, EQUITIZATION & RENEWAB | IBRD/IDA | 216.0 | 216.0 | 18.8 | Yes | Yes | No | Yes |
| FY02 | ECA | Lithuania | EDUC IMPRVMT | IBRD/IDA | 25.4 | 16.8 | 13.8 | No | No | No | Yes |
| FY02 | AFR | Tanzania | TZ-Songo Gas Dev & Power Gen (FY02) | IBRD/IDA | 183.0 | 183.0 | 11.8 | Yes | Yes | No | No |
| FY02 | ECA | Lithuania | VILNIUS DIST HEAT | IBRD/IDA | 17.1 | 17.1 | 10.1 | Yes | No | No | Yes |
| FY02 | LCR | Ecuador | EC Power & Comm.Sect Moderniz. & Rural Servi | IBRD/IDA | 25.8 | 11.6 | 7.3 | Yes | Yes | No | No |
| FY02 | ECA | Serbia | SAC (SERBIA) | IBRD/IDA | 70.0 | 14.0 | 7.0 | No | No | No | Yes |
| FY02 | LCR | Brazil | BR Sergipe Rural Poverty Reduction | IBRD/IDA | 20.8 | 4.4 | 4.4 | Yes | Yes | No | No |
| FY02 | ECA | Serbia | EMG ELEC POWER RECN | Special Finc. | 6.0 | 6.0 | 3.1 | Yes | No | No | Yes |
| FY03 | AFR | Ethiopia | ET-Energy Access SIL | IBRD/IDA | 132.7 | 112.8 | 130 | Yes | Yes | Yes | No |
| FY03 | LCR | Nicaragua | NI Off-Grid Rural Electrification (PERZA)* | IBRD/IDA | 16 | 11.8 | 14.5 | 8 | Yes | No | Yes |
| FY03 | LCR | Bolivia | BO Decent Infras for Rur Transformation | IBRD/IDA | 20 | 13.4 | 7.5 | Yes | Yes | No | Yes |
| FY03 | AFR | Guinea | GN Decentralized Rural Electrification* | IBRD/IDA | 7 | 4.9 | 7 | Yes | Yes | No | No |
| FY03 | SAR | Nepal | POWER DEVELOPMENT PROJECT | IBRD/IDA | 75.6 | 69.6 | 5.5 | Yes | Yes | No | No |
| FY03 | LCR | Brazil | BR-Energy Sector TA Project | IBRD/IDA | 12.1 | 12.1 | 2.4 | Yes | No | No | No |
| FY03 | AFR | Chad | TD CRITICAL ELEC & WATER Services | IBRD/IDA | 54.8 | 36.7 | 1.8 | No | Yes | No | No |

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| Fiscal year | Region | Country | Project name | Product line | Bank total commit. | Energy commit. | Access commit. | Policy intervention | Electricity extension intervention | Non-electri. HH interv. | Efficiency and productive uses |
|---|---|---|---|---|---|---|---|---|---|---|---|
| FY04 | SAR | Afghanistan | Emergency Power Rehabilitation Project | IBRD/IDA | 105 | 99.8 | 78 | Yes | Yes | No | No |
| FY04 | AFR | Mali | ML Household Energy & Universal Access* | IBRD/IDA | 39.2 | 39.2 | 37.5 | Yes | Yes | Yes | Yes |
| FY04 | AFR | Mozambique | MZ Energy Reform and Access Project* | IBRD/IDA | 40.3 | 33.4 | 33.6 | Yes | Yes | No | Yes |
| FY04 | EAP | Cambodia | KH-Rural Electrif. & Transmn* | IBRD/IDA | 45.8 | 40.2 | 25.6 | Yes | Yes | No | Yes |
| FY04 | ECA | Serbia and Montenegro | ENERGY EFF | IBRD/IDA | 21 | 20.4 | 20.5 | No | No | No | Yes |
| FY04 | SAR | Afghanistan | Emergency National Solidarity Project | IBRD/IDA | 95 | 19 | 19 | No | Yes | No | No |
| FY04 | EAP | Philippines | PH-Rural Power Project* | IBRD/IDA | 19 | 19 | 18.9 | Yes | Yes | No | Yes |
| FY04 | EAP | Philippines | PH-GEF-Electric Cooprtv System Loss Redu | GEF | 12 | 12 | 12 | Yes | Yes | No | No |
| FY04 | ECA | Czech Republic | PCF UMBRELLA | CO | 7 | 7 | 4.2 | No | No | No | Yes |
| FY04 | LCR | Uruguay | UY Energy Efficiency Project | GEF | 6.9 | 6.5 | 1.5 | No | Yes | Yes | No |
| FY04 | ECA | Moldova | REN ENER FROM AG WASTE BIOMASS (GEF MSP) | GEF | 1 | 0.7 | 1 | Yes | No | No | Yes |
| FY04 | LCR | Dominican Republic | DO Power Sector TA Project | IBRD/IDA | 7.3 | 0.2 | 0.9 | Yes | No | No | No |
| FY04 | AFR | Madagascar | MG-Environment Program 3 | IBRD/IDA | 40 | 4 | 0.8 | No | No | Yes | No |
| FY04 | SAR | Pakistan | NWFP Community Infrastructure II (CIP2) | IBRD/IDA | 37.1 | 0.7 | 0.7 | No | No | No | Yes |
| FY04 | SAR | Bangladesh | Power Sector Development TA | IBRD/IDA | 15.5 | 11.3 | 0.3 | Yes | No | No | No |
| FY05 | EAP | Vietnam | VN-2nd Rural Energy* | IBRD/IDA | 225.3 | 225.3 | 225.3 | Yes | Yes | No | No |
| FY05 | AFR | Senegal | SN-Rural Electric Service Prj* | IBRD/IDA | 34.9 | 21.3 | 22 | Yes | Yes | Yes | Yes |
| FY05 | EAP | China | CN-GEF-Heat Reform & Bldg Egy Eff. | GEF | 18 | 5.8 | 18 | Yes | No | No | Yes |

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| Fiscal year | Region | Country | Project name | Product line | Bank total commit. | Energy commit. | Access commit. | Policy intervention | Electricity extension intervention | Non-electri. HH interv. | Efficiency and productive uses |
|---|---|---|---|---|---|---|---|---|---|---|---|
| FY05 | AFR | Eritrea | ER-Power Distribution SIL | IBRD/IDA | 50 | 45 | 14.5 | Yes | Yes | No | No |
| FY05 | ECA | Russian Federation | KAZAN MUNICIPAL DEVT | INF | 125 | 12.5 | 12.5 | Yes | No | No | No |
| FY05 | AFR | Kenya | KE-Energy Sector Recovery Prj | IBRD/IDA | 80 | 77.6 | 12.1 | Yes | Yes | No | No |
| FY05 | AFR | Benin | BJ-Energy Service Delivery APL | IBRD/IDA | 45 | 28.8 | 7.2 | Yes | No | Yes | No |
| FY05 | SAR | Afghanistan | Emerg National Solidarity – Supplemental | IBRD/IDA | 28 | 5.6 | 5.6 | No | Yes | No | No |
| FY05 | LCR | Chile | CL-Infrastructure for Territorial Dvlpmt | IBRD/IDA | 50.3 | 4.5 | 4.5 | No | Yes | No | Yes |
| FY05 | AFR | Rwanda | RW-Urgent Electricity Rehab SIL | IBRD/IDA | 25 | 23.8 | 2.7 | Yes | No | Yes | No |
| FY05 | LCR | Peru | PE Santa Rosa Hydro Carbon Finance | CO | 1.5 | 1.5 | 1.5 | No | Yes | No | No |
| FY05 | EAP | Timor-Leste | TP-POWER SECTOR PRIORITY INVESTMENTS | Special Finc. | 1.4 | 1.4 | 0.1 | No | No | Yes | No |
| FY06 | AFR | Ethiopia | ET-Electricity Access (Rural) Expansion | IDA | 133.4 | 133.4 | 133.4 | Yes | Yes | Yes | Yes |
| FY06 | LCR | Peru | PE Rural Electrification | IBRD | 59.5 | 59.5 | 59.5 | Yes | Yes | Yes | Yes |
| FY06 | ECA | Belarus | POST-CHERNOBYL RECOVERY | IDA | 50.0 | 50.0 | 50.0 | Yes | No | Yes | Yes |
| FY06 | LCR | Mexico | MX Competitiveness DPL | IBRD | 300.8 | 60.2 | 30.1 | Yes | Yes | Yes | Yes |
| FY06 | ECA | Croatia | District Heating Project | IBRD | 29.8 | 29.8 | 29.8 | Yes | No | No | Yes |
| FY06 | LCR | Mexico | MX ENVDPL II | IBRD | 200.5 | 40.1 | 20.1 | Yes | No | Yes | No |
| FY06 | LCR | Honduras | HN (CRL1) Rural Infrastructure Project | IDA | 49.4 | 19.7 | 19.7 | Yes | Yes | No | No |
| FY06 | EAP | China | CN-Renewable Energy II (CRESP II) | IBRD | 86.3 | 86.3 | 19.0 | No | Yes | No | No |
| FY06 | ECA | Armenia | URBAN HEAT | IDA | 15.0 | 15.0 | 15.0 | Yes | No | No | No |
| FY06 | EAP | Philippines | PH-SUPPORT FOR STRATEGIC LOCAL DEV & INV | IBRD | 100.0 | 13.0 | 13.0 | Yes | Yes | No | No |
| FY06 | AFR | Nigeria | NG-Natl Energy Dev SIL (FY06) | IDA | 172.0 | 172.0 | 11.1 | Yes | Yes | No | No |
| FY06 | EAP | Lao PDR | LA-Rural Electrification Phase I | IDA | 10.0 | 10.0 | 10.0 | Yes | Yes | No | Yes |

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| Fiscal year | Region | Country | Project name | Product line | Bank total commit. | Energy commit. | Access commit. | Policy intervention | Electricity extension intervention | Non-electri. HH interv. | Efficiency and productive uses |
|---|---|---|---|---|---|---|---|---|---|---|---|
| FY06 | SAR | Bangladesh | Bangladesh Development Support Cr. III | IDA | 200.0 | 30.0 | 10.0 | Yes | No | No | No |
| FY06 | LCR | Brazil | BR-MG Rural Poverty Reduction | IBRD | 35.0 | 8.8 | 8.8 | Yes | Yes | No | No |
| FY06 | SAR | Afghanistan | Emerg NSP (II supplemental) | IBRD/IDA | 40.0 | 8.0 | 8.0 | Yes | Yes | Yes | No |
| FY06 | AFR | Rwanda | RW-PRSC 2 DPL (FY06) | IDA | 55.0 | 8.3 | 5.5 | Yes | Yes | Yes | Yes |
| FY06 | AFR | Malawi | MW-Infrastr Srvcs SIM | IDA | 40.0 | 5.2 | 5.2 | Yes | Yes | No | No |
| FY06 | AFR | Congo, Democratic Republic of | DRC-Transitional Support Credit (DPL) | IBRD/IDA | 90.0 | 13.5 | 4.5 | No | No | Yes | No |
| FY06 | EAP | Lao PDR | LA-GEF Rural Electrification Phase I | GEF | 3.8 | 3.8 | 3.8 | Yes | Yes | No | Yes |
| FY06 | SAR | Nepal | Nepal – Biogas Program | Carbon Offset | 4.5 | 3.4 | 3.4 | No | No | Yes | No |
| FY06 | AFR | Ethiopia | ET-GEF Energy Access Prj (FY06) | GEF | 4.9 | 4.9 | 3.3 | Yes | Yes | No | No |
| FY06 | ECA | Georgia | PRSO | IDA | 20.0 | 3.4 | 2.9 | Yes | No | No | No |
| FY06 | ECA | Serbia | PPFDPC1(SERBIA) | IBRD | 55.0 | 5.5 | 2.8 | Yes | No | No | No |
| FY06 | AFR | Guinea-Bissau | GW-MS Infrastructure Rehab SIM (FY06) | IDA | 15.0 | 8.0 | 2.4 | Yes | Yes | No | No |
| FY06 | MNA | Djibouti | DJ-POWER ACCESS AND DIVERSIFICATION | IDA | 7.0 | 7.0 | 1.6 | Yes | Yes | No | No |
| FY06 | ECA | Moldova | BIOMASS HEAT IN RUR COMM (CDCF) | Carbon Offset | 1.5 | 1.5 | 1.5 | Yes | No | Yes | No |
| FY06 |  | Papua New Guinea | PG-GEF-Teacher's Solar Lighting Project | GEF Med Size | 1.0 | 1.0 | 1.0 | Yes | Yes | Yes | No |
| FY06 | EAP | Lao PDR | Lao PDR PRSO2 | IDA | 8.0 | 0.8 | 0.8 | Yes | Yes | No | No |
| FY06 | EAP | Timor-Leste | TP Consolidation Support Program (CSP) 1 | IDA | 0.5 | 0.1 | 0.0 | Yes | No | No | Yes |
| FY07 | AFR | Uganda | UG-Power Sector Dev. Project (FY07) | IDA | 300.0 | 300.0 | 150.0 | Yes | No | No | No |
| FY07 | AFR | Congo/Africa | 3A-Reg&Domestic Pwr Mkt Dev. (FY07) | IDA | 296.7 | 296.7 | 50.0 | Yes | Yes | No | Yes |
| FY07 | SAR | Sri Lanka | CL-TAL Min of Public Works | IDA | 40.0 | 40.0 | 40.0 | Yes | Yes | No | Yes |

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| Fiscal year | Region | Country | Project name | Product line | Bank total commit. | Energy commit. | Access commit. | Policy intervention | Electricity extension intervention | Non-electri. HH interv. | Efficiency and productive uses |
|---|---|---|---|---|---|---|---|---|---|---|---|
| FY07 | ECA | Serbia | ENERGY EFF ADDITIONAL FINANCING | IBRD | 28.0 | 28.0 | 28.0 | Yes | No | No | Yes |
| FY07 | SAR | Afghanistan | NSP II | IDA | 120.0 | 16.8 | 16.8 | Yes | Yes | No | No |
| FY07 | SAR | India | India AP DPL III | IBRD | 225.0 | 22.5 | 11.3 | Yes | No | No | Yes |
| FY07 | AFR | Central African Republic | CF-Development Policy Operation DPO FY07 | IBRD/IDA | 82.0 | 20.5 | 10.3 | Yes | No | No | No |
| FY07 | MNA | Morocco | MA-Energy Sector DPL | IBRD/IDA | 100.0 | 100.0 | 10.0 | Yes | Yes | No | No |
| FY07 | EAP | Pacific Islands | 4P-GEF Sustainable Energy Finance | GEF | 9.5 | 9.5 | 9.5 | Yes | Yes | Yes | Yes |
| FY07 | EAP | Mongolia | MN-Renewable Energy for Rural Access | IBRD/IDA | 7.0 | 7.0 | 7.0 | Yes | Yes | No | No |
| FY07 | LCR | Argentina | AR Prov Ag Devt I Add'l Financ Ln7425-AR | IBRD | 37.0 | 5.6 | 5.6 | No | No | Yes | No |
| FY07 | AFR | Rwanda | RW-PRSG III DPL (FY07) | IDA | 50.0 | 12.5 | 5.0 | Yes | Yes | Yes | No |
| FY07 | LCR | Brazil | BR Pernambuco Rural Pov. Add'l Financing | IBRD | 30.0 | 4.5 | 4.5 | Yes | Yes | No | No |
| FY07 | ECA | Macedonia, former Yugoslav Republic of | SUSTAINABLE ENERGY (GEF) | GEF | 5.5 | 5.5 | 3.1 | Yes | No | No | No |
| FY07 | SAR | Nepal | Nepal – Village Micro Hydro | Carbon Offset | 1.9 | 1.9 | 1.9 | No | Yes | No | No |
| FY07 | ECA | Kyrgyz Republic | VIP 2 | IDA | 15.0 | 1.2 | 1.2 | Yes | Yes | Yes | No |
| FY07 | EAP | Lao PDR | LA - PRSO III | IDA | 10.0 | 1.2 | 1.2 | Yes | Yes | No | No |
| FY07 | AFR | Ghana | GH-PRSC 5 DPL (FY07) | IDA | 110.0 | 15.4 | 1.1 | No | No | Yes | No |
| FY07 | ECA | Tajikistan | TJ Prg. Development Policy Grant | IDA | 10.0 | 1.0 | 1.0 | Yes | No | No | Yes |
| FY07 | ECA | Kosovo | LIGNITE POWER TECHNICAL ASSISTANCE | IDA | 8.5 | 8.5 | 1.0 | Yes | Yes | Yes | Yes |
| FY07 | EAP | Timor-Leste | TP Energy Services Delivery Project | IDA | 2.5 | 2.5 | 0.6 | Yes | No | Yes | No |
| FY08 | EAP | China | CN-Liaoning Med. Cities (LMC) III | SDN | 191.0 | 191.0 | 186.9 | Yes | No | No | Yes |

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| Fiscal year | Region | Country | Project name | Product line | Bank total commit. | Energy commit. | Access commit. | Policy intervention | Electricity extension intervention | Non-electri. HH interv. | Efficiency and productive uses |
|---|---|---|---|---|---|---|---|---|---|---|---|
| FY08 | EAP | Vietnam | VN-Rural Distribution Project | SDN | 150.0 | 150.0 | 150.0 | Yes | Yes | No | No |
| FY08 | AFR | Ethiopia | ET-Elect. Access Rural II SIL (FY07) | SDN | 130.0 | 130.0 | 130.0 | No | Yes | No | No |
| FY08 | ECA | Russian Federation | HOUSING & COMMUNAL SERVICES | SDN | 200.0 | 104.0 | 104.0 | Yes | No | No | Yes |
| FY08 | ECA | Ukraine | URBAN INFRASTRUCTURE | SDN | 140.0 | 70.9 | 70.9 | Yes | No | No | Yes |
| FY08 | MNA | Egypt, Arab Republic of | EG-NATURAL GAS CONNECTIONS | SDN | 75.0 | 75.0 | 68.3 | No | No | Yes | No |
| FY08 | AFR | Cameroon | CM-Energy Sector Development SIL (FY08) | SDN | 65.0 | 65.0 | 65.0 | Yes | Yes | No | No |
| FY08 | SAR | Bangladesh | Power Sector DPL | SDN | 120.0 | 120.0 | 60.0 | Yes | No | No | No |
| FY08 | AFR | Ghana | GH-Energy Dev & Access SIL (FY08) | SDN | 94.5 | 94.5 | 47.2 | Yes | Yes | No | No |
| FY08 | AFR | Burkina Faso | BF-Energy Access SIL | SDN | 38.8 | 38.8 | 38.8 | Yes | Yes | Yes | No |
| FY08 | LCR | Mexico | MX (CRL2) Integrated Energy Services | SDN | 30.0 | 30.0 | 30.0 | Yes | Yes | No | Yes |
| FY08 | SAR | Bangladesh | BD DSC IV-Supplemental Financing II | PREM | 100.0 | 25.0 | 25.0 | Yes | No | No | No |
| FY08 | AFR | Zambia | ZM-Incr.Eff.&Access to Elec SIL (FY08) (including GEF) | SDN | 36.0 | 36.0 | 22.0 | Yes | Yes | No | No |
| FY08 | SAR | Bangladesh | Bangladesh DSC IV-Supplemental Financing | PREM | 75.0 | 19.5 | 19.5 | Yes | No | No | No |
| FY08 | SAR | Pakistan | Electricity Distribution and Transmission | SDN | 256.7 | 256.7 | 16.4 | Yes | No | Yes | No |
| FY08 | AFR | Senegal | SN-En. Sec. Recov. Dev Policy Financing | SDN | 80.0 | 80.0 | 16.0 | Yes | No | No | No |
| FY08 | AFR | Tanzania | TZ-Energy Development & Access Expansion | SDN | 105.0 | 105.0 | 16.0 | Yes | Yes | No | No |
| FY08 | LCR | Argentina | AR Energy Efficiency Project | SDN | 15.2 | 15.2 | 15.2 | Yes | No | Yes | Yes |
| FY08 | ECA | Belarus | SOC. INF RETROFIT - ADDL FINANCING | SDN | 14.1 | 14.1 | 14.1 | Yes | No | No | Yes |

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| Fiscal year | Region | Country | Project name | Product line | Bank total commit. | Energy commit. | Access commit. | Policy intervention | Electricity extension intervention | Non-electri. HH interv. | Efficiency and productive uses |
|---|---|---|---|---|---|---|---|---|---|---|---|
| FY08 | MNA | West Bank and Gaza | WBG PRDP Support | PREM | 40.0 | 40.0 | 10.0 | Yes | No | No | No |
| FY08 | SAR | Bangladesh | Grameen Shakti Solar Homes | SDN | 9.0 | 9.0 | 9.0 | Yes | No | No | No |
| FY08 | MNA | Morocco | MA-ONE Support Project | SDN | 150.0 | 150.0 | 8.9 | No | No | No | Yes |
| FY08 | ECA | Tajikistan | ENERGY EMERGENCY | SDN | 5.7 | 5.7 | 5.7 | No | No | No | Yes |
| FY08 | AFR | Tanzania | TZ-GEF Energy Dvpt and Access Expansion | SDN | 4.5 | 4.5 | 4.5 | No | Yes | No | No |
| FY08 | AFR | Guinea | GN-Electricity Sec Eff Improv GEF (FY07) | SDN | 4.5 | 4.5 | 2.3 | Yes | No | Yes | No |
| FY08 | MNA | West Bank and Gaza | GZ-ELECTRIC UTILITY MANAGEMENT | SDN | 12.0 | 12.0 | 1.6 | Yes | No | No | No |
| FY08 | ECA | Azerbaijan | RURAL INVESTMENT (AZRIP) ADDL. FINANCING | SDN | 15.0 | 1.4 | 1.4 | Yes | Yes | No | No |
| FY08 | AFR | Burundi | BI-Multisectoral Water & Electricity Inf | SDN | 50.0 | 33.0 | 1.0 | No | No | Yes | No |

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