RENEWABLE ENERGY FOR DEVELOPMENT

The Role of the World Bank Group

CONTENTS

FOREWORD

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Energy poverty in developing countries poses a persistent impediment to economic development. It is a serious equity issue as well. At the same time, the environmental impacts of conventional energy and traditional fuels are unsustainable at both the local and global levels.

The Millennium Development Goals (MDGs)—in poverty reduction, health, education, and other indicators to increase equity and ensure environmental sustainability—represent critical development targets we aim to meet by 2015. However, the MDGs do not in themselves illuminate the role of energy. For those in the developing world, access to energy—adequate, affordable, and sustainable sources of energy, linked in a meaningful way to people's economic and social potential—is a key ingredient to development that will buttress almost all of the MDGs. Our efforts must go beyond simply improving energy supplies: energy investments need to be integrated into the fabric of development. In meeting these energy needs, however, there are several realities we must face.

Fostering renewable energy and energy efficiency is a global challenge for our times.

First, the demographics of energy demand pose an enormous challenge and require enormous investments. The business-as-usual scenario is that in 25 years, even with US$8 trillion in energy investments in developing countries, 1.4 billion people will still lack access to

modern lighting and power—a reduction of only 200 million people relative to today. More than 2.6 billion people in developing countries will continue to rely on traditional biomass for cooking and heating in 2030, even more than today. Despite ongoing efforts at substitution, biomass will continue to be a primary source to meet the basic cooking and heating needs for many in the developing world. To avoid major environmental and health damage, biomass use needs to be more sustainable, efficient, and clean.

Second, climate change concerns will increasingly be a compelling driver for sustainable energy. In a more volatile climate—with increased droughts, floods, and other impacts—it is the developing world that stands to be disproportionately harmed, and this threatens to unravel many of the development gains made thus far. This is simply unacceptable. Sustainable energy—renewable sources, such as wind, solar, biomass, geothermal, and hydropower—and energy efficiency are not virtuous just for their own sake. Although currently only at 2 percent of world electricity supply (excluding hydropower), they are a necessity for both developing and industrial countries. Developing countries offer unique opportunities for cultivating sustainable energy in large part because the bulk of their energy demands and investments still lie before them. Sustainable energy broadens their choices, as well as providing a path toward increased energy independence. The role of industrial countries is to provide technology and finance to make this path equitable and attractive to maximize the role of sustainable energy.

Through our project-based work, and increasingly with carbon finance, we are able to give sustainable energy an important seat at the development table and bring the virtues of sustainable energy to the marketplace. We are working closely with our client countries to link infrastructure investments with economic and social development to reduce poverty and improve the human condition. We have learned a great deal over the past 15 years with more than US$6 billion in resources from the World Bank Group and Global Environment Facility (GEF) committed to our renewable energy and energy efficiency investments. The World Bank Group is ready to scale up and work with partners worldwide to be a constructive force for sustainable energy. The World Bank Group is committed to nothing less than a revolution in the rate and scale with which sustainable clean energy services are expanded to those who lack them, and the new dimension in global partnerships that is needed to bridge the modern energy divide.

OVERVIEW

This report provides an overview of renewable energy and energy efficiency projects and programs on which the World Bank Group has worked since 1990. Although the primary focus of the report is on renewable energy, it discusses energy efficiency, which forms an essential complement to renewable energy development in delivering sustainable energy services. Given the energy requirements in the developing world—as reflected in the lack of access to modern energy services—the World Bank Group's energy programs support the development of all forms of energy (except for nuclear energy) where they can best meet the needs. Renewable energy and energy efficiency increase the menu of available energy options if they are used at the right place and time. Renewable energy and energy efficiency, termed "sustainable energy," are a small but growing part of the energy portfolio of the World Bank Group.

Renewable energy technologies as discussed in this report comprise run-of-river and small hydropower, solar energy for heat and power, wind energy for mechanical and electrical power generation, and geothermal and biomass energy for power generation and heat.

Energy efficiency refers to support for energy-efficient equipment and processes, the development of energy efficiency businesses and financing mechanisms, and investments to reduce the energy used in district heating.

In this report, "sustainable energy" refers to the combination of renewable energy and energy efficiency, although they are not the only energy options through which sustainable development can be achieved.

The first part of this report introduces the work of the World Bank Group in renewable energy and energy efficiency. It sets out the linkage between the issues of energy and development, the World Bank Group's strategic response to these challenges, who within the World Bank Group is engaged in addressing sustainable energy issues, and what has been done since 1990. A map on page 40 illustrates the location and type of sustainable energy projects that have been undertaken. The annex lists all projects.

The second part of this report discusses how sustainable energy can enhance development. This is illustrated with examples from the World Bank Group's own portfolio. The third part discusses Bank Group experience with sustainable energy projects. Important elements in the cycle of every project are the establishment of an analytical basis and the capacity for projects to be implemented. A major impediment to sustainable energy projects is their financing, and both traditional and new financing avenues are discussed. The World Bank Group experience with sustainable energy projects highlights the importance of working across sectors and of program approaches. This part also discusses the lessons learned. The last part concludes the report by suggesting a way forward.

RENEWABLE ENERGY AND ENERGY EFFICIENCY AT THE WORLD BANK GROUP

ENERGY FOR DEVELOPMENT

Bringing modern energy services to the 1.6 billion people who lack access to electricity and the 2.4 billion who rely on traditional biomass for cooking and heating is a major challenge. As of 2004 the richest 20 percent of the world's population consume 58 percent of total energy, whereas the poorest 20 percent consume less than 4 percent. The majority of those underserved are the poor in Sub-Saharan Africa and South Asia. Although the share of people lacking access to electricity and modern fuels is expected to decline, population growth—barring any major policy shifts—will mean that 1.4 billion people will still lack electricity in 2030 under a business-as-usual scenario. Similarly, 2.6 billion people will continue to rely on traditional biomass in 2030.

You grow in an environment full of diseases, violence, and drugs…You don't have the right to education, work, or leisure, and you are forced to "eat in the hands of the government" …so you are an easy prey for the rules. You have to accept whatever they give you.

A YOUNG WOMAN, PADRE JORDANO, BRAZIL

Energy services are an essential part of economic development and human development, extending beyond the direct uses of energy services—heating, cooking, and lighting—to indirect effects through economic development, employment, and strengthening communities. These modern services can reduce the millions of premature deaths from indoor air pollution. Modern lighting for schools and homes allows students to read beyond daylight hours or where natural lighting is limited. Households with modern energy services, including efficient cookstoves, can spend less time collecting wood and other biomass for these needs—a task that can consume hours of time for women and children. Relieved of this burden, children are afforded more time for attending school, and women can devote time to agriculture and other productive activities—which can in turn provide income to cover the cost of the energy services.

Now we are part of the world.

A WOMAN IN INDONESIA COMMENTING ON HER SOLAR HOME SYSTEM

Improving energy access for the poor requires significant changes in the energy service delivery systems. Energy interventions for sustainable livelihoods must target the roots of poverty by promoting livelihoods that can handle stress or shock, and create economic development opportunities that extend beyond immediate consumption needs. Although it must be recognized that solutions to the supply of energy services will in most cases remain fossil fuel–based, renewable energy and energy efficiency can help provide the basis of stable and secure livelihoods. In the light of the immense gap between needs and realistic projections of supply of services, affordability of supply should remain an important factor in deciding which options are best suited for specific circumstances.

Renewable energy and energy efficiency can contribute effectively to sound development. First, they can directly affect the livelihood of people by giving them access to modern energy services. Second, they can help countries grow in an environmentally sustainable way. Pollution from properly used renewable energy sources is negligible, and energy efficiency reduces the amount of energy needed. Third, they can help contribute to energy security by broadening the portfolio of options for energy resources, reducing dependence on fuels with significant price volatility, and availability concerns arising from international or local transportation barriers. Although not a Millennium Development Goal (MDG), sustainable energy access and use are a necessary condition of achieving the MDGs.

A STRATEGY FOR SUSTAINABLE ENERGY

Fostering sustainable energy may be undertaken in many different ways: promoting research and development, implementing quantitative or qualitative

Since their adoption in 2000, the **Millennium Development Goals** have become cornerstones for development. They reflect the commitment of the international community to an expanded vision of development, one that vigorously promotes human development as the key to sustaining social and economic progress in all countries, and one that recognizes the importance of creating a global partnership for development. The goals have been commonly accepted as a framework for measuring development progress:

1. Eradicate extreme poverty and hunger.
2. Achieve universal primary education.
3. Promote gender equality and empower women.
4. Reduce child mortality.
5. Improve maternal health.
6. Combat HIV/AIDS, malaria, and other diseases.
7. Ensure environmental sustainability.
8. Develop a global partnership for development.

The availability of modern energy services, including from renewable energy sources, can help meet all the above goals. Renewable energy and energy efficiency are particularly important in addressing the reduction of emissions—including greenhouse gases, which cause climate change—and pollution of air, soil and water.

In 2002 the **World Summit on Sustainable Development** gave new impetus to global action to fight poverty and protect the environment. The agenda for sustainable development was broadened and strengthened, emphasizing particularly the linkages among poverty, the environment, and the use of natural resources. Energy was central to the negotiations and outcomes, although in the end no energy targets were adopted. The following important commitments were made at the summit related to energy and the environment:

- **Access to Energy.** Improve access to reliable, affordable, economically viable, socially acceptable, and environmentally sound energy services and resources, sufficient to achieve the Millennium Development Goals, including the goal of halving the proportion of people in poverty by 2015.
- **Renewable Energy.** Diversify energy supply and substantially increase the global share of renewable energy sources in order to increase its contribution to total energy supply.
- **Energy Efficiency.** Establish domestic programs for energy efficiency with the support of the international community. Accelerate the development and dissemination of energy efficiency and energy conservation technologies, including the promotion of research and development.
- **Energy Markets.** Remove market distortions, including the restructuring of taxes and the phasing out of harmful subsidies. Support efforts to improve the functioning, transparency, and information about energy markets with respect to both supply and demand, with the aim of achieving greater stability and ensuring consumer access to energy services.

standards, creating access to finance, removing market barriers, and using policy instruments, such as taxes, green certificates, and subsidies. Supporting sustainable energy for the World Bank Group means assisting its partner countries in enabling them to access the most cost-effective, best-performing, and reliable sustainable energy technologies that they can afford and that best suit their needs. The World Bank Group's work therefore focuses on creating the enabling conditions necessary for people to gain access to the most modern and appropriate forms of energy available.

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The World Bank Group's energy sector strategy focuses on four principal business lines, which guide its lending products, analytical services, and technical assistance work. These business lines encompass the main areas of the Bank Group's energy strategy, addressing the challenges of achieving a sustainable energy future and reducing energy poverty:

1. **Helping the poor directly** by facilitating access to modern energy services, reducing the cost and improving the quality of energy supplied to low-income households, and supporting the provision of energy needed for social services and income-generating activities. Renewable energy resources can help provide modern energy services to households, enterprises, and social facilities, such as health, education, water, and telecommunications. Energy efficiency can help reduce the cost and the time involved in obtaining energy services.

2. **Improving macroeconomic and fiscal balances** includes rationalizing energy taxes, eliminating operating subsidies to state-owned enterprises, and improving procurement and marketing of imported and exported energy products. These help level the playing field so that renewable energy and energy efficiency can compete fairly in the energy marketplace.

3. **Promoting good governance and private sector development** through the creation of objective, transparent, and nondiscriminatory regulatory mechanisms; introducing and expanding competition; and strengthening the capacity to finance energy businesses. This allows investors and entrepreneurs in renewable energy and energy efficiency to increase their investments and make such supplies more available.

4. **Protecting the environment** includes removing market and regulatory barriers to renewable energy technologies, promoting fuel-switching, strengthening environmental management capacity in the energy sector, and facilitating access to the carbon market by client countries. Renewable energy resources and energy efficiency directly address environmental concerns at the local, regional, and global levels.

THE WORLD BANK GROUP: FIVE INSTITUTIONS WITH A COMMON MISSION

The World Bank Group consists of five closely associated institutions, all owned by member countries: the International Bank for Reconstruction and Development (IBRD), the International Development Association (IDA), the International Finance Corporation (IFC), the Multilateral Investment Guarantee Agency (MIGA), and the International Centre for Settlement of Investment Disputes (ICSID).

Each institution plays a distinct role in the mission to fight poverty and improve living standards for people in the developing world. The term "World Bank Group" encompasses all five institutions. "World Bank" refers specifically to the IBRD and IDA. All

these institutions, except ICSID, directly support activities related to sustainable energy.

The **IBRD** works to reduce poverty in middle-income and creditworthy poorer countries by promoting sustainable development, through loans, guarantees, and nonlending—including analytical and advisory—services. Renewable energy and energy efficiency are a significant and growing component of IBRD project support.

Donor contributions to **IDA** enable the World Bank to provide US$7 billion each year in concessional lending to the world's 81 poorest countries, home to 2.5 billion people. IDA helps provide access to better basic services—such as education, health care, energy, and clean water and sanitation—and supports reforms and investments aimed at productivity growth and employment creation. Renewable energy and energy efficiency applications are a component of a number of IDA-funded initiatives that focus on poverty alleviation and economic development.

The **IFC's** mandate is to further economic development through the private sector. Working with business partners, it invests in private enterprises in developing countries and provides long-term loans, guarantees, and risk management and advisory services to its clients. The IFC invests in projects in regions and sectors underserved by private investment and finds new ways, including innovative financial modalities and business models to develop promising opportunities in markets deemed too risky by commercial investors in the absence of IFC participation. The IFC has a growing portfolio of renewable energy and energy efficiency projects.

MIGA helps encourage foreign investment in developing countries by providing guarantees to foreign investors against losses caused by noncommercial risks, such as expropriation, currency inconvertibility and transfer restrictions, and war and civil disturbances. Furthermore, MIGA provides technical assistance to help countries disseminate information on investment opportunities. Risk guarantees by MIGA have made it possible for the private sector to undertake renewable energy projects that would otherwise not have proceeded.

READ MORE ON THE INTERNET:

http://www.developmentgoals.org
http://www.worldbank.org/ourdream

PARTNERSHIPS FOR SUSTAINABLE ENERGY

Partnering with client governments, public institutions, civil society, and the private sector is essential for ensuring the sustainability of energy investments. It allows the World Bank Group to leverage resources, build awareness, and share expertise with partners committed to tackling energy challenges. The grant and concessional finance that many of these partnerships bring have helped test innovative project ideas that span alternative forms of financing and the development of innovative energy technologies. Most partnerships are being cofinanced by a wide range of donor governments.

The **Global Environment Facility** (GEF), which is the largest partner in the area of renewable energy and energy efficiency, provides both project preparation services and investment funds. The GEF is the financing mechanism for a range of international environmental agreements, and it provides financing for projects that have a global environmental benefit. Since the establishment of the GEF in 1991, the World Bank Group institutions have worked closely together to implement the GEF's role as the financial mechanism for the United Nations Framework Convention on Climate Change.

Partnering with client governments, public institutions, civil society, and the private sector is essential for ensuring the sustainability of energy investments.

Another close partner in sustainable energy, the **United Nations Development Programme** (UNDP), along with a number of bilateral partners, has closely collaborated in the Energy Sector Management Assistance Programme (ESMAP) and in the Asia Alternative Energy Program (ASTAE). **ESMAP** was established as early as 1983. It is a global technical assistance program that supports analytical work and provides policy advice on sustainable energy development to governments of developing countries and economies in transition. Its activities range from policy work, capacity building, and knowledge dissemination to pilot projects. ESMAP is a critical source of funding for supporting project ideas and upstream development work. The **Asia Alternative Energy Program** was established in 1992 to mainstream renewable energy and energy efficiency investment in the World Bank Group's energy sector lending and technical assistance activities in Asia. Since its inception, the Asia Alternative Energy Program has supported a broad portfolio of renewable energy and energy efficiency projects and activities throughout Asia.

Another important partnership is the **Africa Poverty Targeted Energy Services Initiative** (APTESI), which was established early in 2004 and merged the activities of two earlier programs dating back to 1993 and 1998, respectively. The earlier programs are the **Regional Program for the Traditional Energy Sector** and the **Africa Rural and Renewable Energy Initiative.** The aim of the former programs, as well as the current one, is to scale up access to modern energy services and promote cross-sectoral activities to facilitate transformation of rural communities, businesses, and households, and to encourage greater use of renewable energy, including biomass.

At the 2002 World Summit on Sustainable Development, the World Bank Group, together with the UNDP and other partners, introduced the **Global Village Energy Partnership** (GVEP), which seeks to expand modern energy services to underserved communities and households by building a global network of organizations and groups. GVEP grew out of two international Village Power conferences at the World Bank Group in 1998 and 2000, and is serving a growing knowledge management need. To date, it includes more than 300 partners.

The World Bank Group's **Carbon Finance Business** (CFB) was initiated in 1999 with the Prototype Carbon Fund (PCF). It now includes additional targeted carbon funds and technical assistance facilities. The purpose of CFB activities is to catalyze investment in climate-friendly projects in developing and transition economies through the purchase of certified greenhouse gas emissions reductions largely from

projects in the energy sector. These certified emissions reductions can be credited against domestic emission reduction obligations.

SUSTAINABLE ENERGY AT THE WORLD BANK GROUP IN NUMBERS

Since the 1970s, the World Bank Group has supported increased access to modern energy services in the developing world. In the 1990s the World Bank Group embraced the idea that access to energy needed to be based not only on economic considerations, but also on environmentally sustainable grounds. Renewable energy and energy efficiency are fundamental to such solutions. By 2004, through its investments and technical support, the World Bank Group had leveraged about US$10 billion in additional financing from public, private, and bilateral sources for renewable energy and energy efficiency in developing countries. The table on the right summarizes all data in this section.

The World Bank Group's energy projects based on renewable energy resources are giving more than 1.2 million unelectrified households basic lighting and power services mainly by introducing solar photovoltaic units and adding several thousand megawatts of grid-connected renewable energy generation. They are displacing several thousand megawatts of fossil fuel capacity through energy efficiency measures. Sustainable forestry projects are increasing rural incomes and improving fuelwood management. Although World Bank Group investment support is important, a significant role played by the World Bank Group is helping to build the technical and institutional foundations, as well as the enabling environment for leveraging considerably more investments from others.

Since 1990, the **IBRD** and **IDA** (the World Bank) alone have approved US$3 billion in loans and credits for renewable energy and energy efficiency in 45 countries. Additional resources have come from

World Bank Group Renewable Energy and Energy Efficiency Commitments (millions of U.S. dollars)

		Amounts committed since 1990		
Sources		**Total**	**Renewable energy**	**Energy efficiency**
Direct investment				
World Bank (IBRD and IDA)[a]		3,054	1,320	1,734
IFC[b]		845	752	93
GEF[c]		1,057	694	363
Financing that leverages investments[d]				
IBRD Carbon Finance Business	*Funds approved or under management*	410	n.a.	n.a.
	Funds committed	295	234	61
IFC Carbon Finance Business	*Funds under management*	55	n.a.	n.a.
MIGA[e]		600	600	0

n.a. Not applicable.

a. Loan and credit Board approvals in 45 countries up to World Bank Group fiscal year 2004. World Bank figures include only hydropower of less than 10 MW.

b. Mainstream investment portfolio. The value of these investments is measured at gross original commitment levels (IFC equity and loans) and excludes the value of any associated financing within the transactions (that is, sponsor equity, other cofinancing, and GEF cofinancing or carbon finance).

c. GEF Council cofinancing commitments for 98 projects implemented, or to be implemented by the World Bank Group. This includes all climate change projects approved by the GEF Council for work program entry. For renewable energy, the following have been grouped together:

OP6—Promoting the Adoption of Renewable Energy by Removing Barriers and Reducing Implementation Costs;

OP7—Reducing the Long-Term Costs of Low Greenhouse Gas Emitting Energy Technologies; and

STRM (Short Term Response Measures).

For energy efficiency the following have been grouped together:

OP5—Removal of Barriers to Energy Efficiency and Energy Conservation; and

OP11—Promoting Environmentally Sustainable Transport.

d. CFB and MIGA financing leverages mainly private sector investments—they do not directly invest in a project. CFB typically leverages five to six times the value of the carbon emission reductions purchases in investments. Figures since CFB inception in 2000.

e. Figures state gross coverage for investments. Guarantees in support of US$2.3 billion of investments in renewable energy.

Source: World Bank Group, April 13, 2004.

associated financing from governments, private industry, civil society, consumer payments for services, and the Global Environment Facility (GEF). Typically more than 60 percent of renewable energy and energy efficiency project costs are covered by cofinancing, largely through the private sector. By 2004 the World Bank's cumulative renewable energy and energy efficiency commitments were about 14 percent of the World Bank's power sector commitments compared with just 4 percent in 1990. In early 2004, the World Bank's active portfolio in renewable energy and energy efficiency comprised more than US$1.7 billion in loans, credits, and grants in 72 projects spread across 36 countries. In addition to direct energy efficiency investments, the World Bank also supports energy efficiency investments through adjustment loans and power sector loans that promote reform of sector policies so that countries will be able to develop their energy sectors along a sustainable path. Investment loans for transmission and distribution infrastructure invariably include an objective to reduce system losses.

The **IFC** has committed US$752 million to renewable energy projects and US$93 million to energy efficiency projects since 1990. This covers 21 projects in 11 countries. Most of the projects are run-of-river hydropower with other investments in commercial geothermal, biomass cogeneration, energy service companies (ESCOs), and financial intermediation, including energy efficiency cofinancing facilities and private equity funds. The IFC's 2004 active mainstream investment portfolio for sustainable energy projects is US$227 million or nearly 20 percent of the IFC's outstanding power sector portfolio. The IFC is currently implementing 11 sustainable energy projects with US$123 million in support from the GEF, and with additional cofinancing of US$108 million, which includes a large portfolio of off-grid and grid-connected solar photovoltaic projects.

The **GEF** Council has approved more than US$1 billion for 98 operations in 47 different countries for World Bank Group implementation since 1992. These funds leverage more than US$5.5 billion of other private and public sector resources in addition to World Bank Group support. GEF funding for renewable energy of US$694 million supports a diversity of projects, including solar photovoltaics (PV), geothermal, biomass, wind, small hydropower, and solar thermal. GEF funding for energy efficiency is US$363 million. The funding for energy efficiency supports projects as diverse as end-use demand management, efficient lighting, system loss reduction, and efficient transport.

Targeted **donor support** for World Bank Group preinvestment activities, policy analysis, capacity building, and project preparation in sustainable energy has been important for jump-starting innovative project work. External support for renewable energy and energy efficiency in Asia included US$18.7 million to the Asia Alternative Energy Program from late 1992 to early 2004. Between 1997 and 2004, US$14 million in ESMAP funding supported 60 renewable energy or energy efficiency activities, such as studies, pilots, and policy advice. The Regional Program for the Traditional Energy Sector and the Africa Rural and Renewable Energy Initiative—the two predecessor programs to the Africa Poverty Targeted Energy Services Initiative dedicated to energy development in Africa—also received jointly about US$15 million since 1993.

Carbon Finance Business: Carbon finance operations are an important and expanding part of the World Bank Group's activities with the majority of such projects involving either renewable energy or energy efficiency. Carbon funds totalling US$465 million are managed by both the World Bank and the IFC. More than 90 percent of the pipeline is in renewable energy, energy efficiency, and waste-to-energy projects.

MIGA has provided US$600 million in gross coverage in support of US$2.3 billion of investment in renewable energy projects. These projects include seven hydropower projects totaling 2,500 MW, and five geothermal projects totaling 400 MW. MIGA has received a number of applications for similar projects, and is underwriting several more.

WHAT CAN RENEWABLE ENERGY DO?

ENHANCING THE QUALITY OF LIFE

Is there enough food to eat? Is there enough safe water to drink? Can children grow up in a healthy and safe environment? Can people read and write to make themselves heard? Do they have employment? Answers to these questions tell us about people's quality of life. Indeed, quality of life touches upon the most personal aspects of livelihood, namely, whether people have a standard of living adequate for their health and well-being. Alongside with fossil energy sources, renewable energy can make a significant contribution to helping people attain an adequate quality of life that empowers them, among other things, to reduce drudgery, extend their working day, participate in and contribute to a growing local economy, and take better advantage of community health and educational services. For example, renewable energy technologies can provide for the following energy services:

- **Drinking:** Water pumping, filtration, and disinfection facilities provide safe drinking water.
- **Eating:** Because 95 percent of staple foods need to be cooked to be digested, securing an affordable and reliable supply for energy for cooking is crucial.
- **Information:** Access to radio and television enhances information on local and national events.
- **Lighting:** Electric lighting helps people gain additional time for studying and reading in the evening, and enjoy greater security and more comfort. The quality of electric light is better when compared with candles or kerosene light—and less hazardous. Better lighting also leads to reduced cooking times and easier cleaning because of illuminated rooms.

SOLAR LIGHTING—MAKING A DIFFERENCE

Mrs. Samarawickrama from the remote village of Karuwalagaswena (Sri Lanka) reported to SEEDS—a Sri Lankan microcredit agency with a World Bank–financed dedicated credit line for off-grid renewable energy systems—how the solar home system had changed her life: previously, her daughter was studying at night using a kerosene lamp. She would sit up with her daughter every night, because she feared that the kerosene lamp could catch fire: one of her daughter's classmates had become disfigured because of such a fire. With the new solar home system, the mother could now sleep soundly every night, as her daughter studied with a safe light.

LIVELIHOOD AND ECONOMIC DEVELOPMENT

In rural communities, food-related activities (agriculture, livestock, fishing, fish farming), fiber production (forestry, crops for fiber), and post-harvest activities are the dominant economic activity or productive uses. Nonfarm enterprises are important supplements to food production–based incomes, and they help people move out of poverty and increase and diversify their incomes. They can also help women increase their economic and social power.

Shop operating with solar PV power in Sri Lanka financed by the Energy Services Delivery project.

Access to energy—including through renewable energy—helps improve the productivity of such activities. Energy resources can provide not only electricity to support livelihood and economic activities, but also motive power and heating energy. Renewable energy applications include mechanical wind-powered water pumping, biopower systems for supplying motive power, electricity, heat, and hydropower for motive power and electricity. In addition, renewable energy–powered communications can enhance the information available to businesses. Radio reporting on the weather, for example, can enhance farmers' and fishermen's ability to respond to sudden changes. Small amounts of power for cellular telephones and telephone networks can provide growers with information on market conditions and prices.

Access to modern energy by itself is not enough to facilitate economic and social development.

Access to modern energy by itself is not enough to facilitate economic and social development: it is necessary, but not sufficient. Co-investments in improved health and educational services and telecommunications are needed, as are investments in productive enterprises and infrastructure, to make access to energy a more potent element for development. The World Bank Group views modern energy services as an essential component of a group of infrastructure services required to support sustainable development. Many of the World Bank Group's poverty reduction and developmental projects reflect this in their design. Case 1 illustrates how a World Bank Group project in Senegal has led to significant income generation.

CASE ONE

SENEGAL

REDUCING POVERTY THROUGH INCREASED INCOMES AND FOREST PRESERVATION

The World Bank is supporting a US$20 million innovative project to help meet Senegal's rapidly growing urban demand for household fuels. The challenge is to do this without the loss of forest cover, while enhancing and diversifying local incomes and empowering rural women. More than 300,000 hectares of environmentally sustainable, community-managed forests have been established in the Tambacounda and Kolda regions in southeast Senegal, creating a protection zone around the Niokolo-Koba National Park, a biosphere reserve. By early 2004 the project had met or exceeded its goals, except for a lower rate of dissemination of improved charcoal stoves than was expected. In March 2004 the project produced more than 400,000 tons of sustainable fuelwood per year while reducing deforestation related to fuelwood in the area by almost 30,000 hectares per year, and reducing net carbon dioxide emissions by more than 1 million tons annually. Biodiversity is being preserved and enhanced by establishing sustainable forests and a protective buffer zone around the park.

Efficient stoves are also being promoted as part of the project.

The creation of jobs in the participating villages and the inclusion of women in the management and marketing of fuelwood and related income-generating activities has already enhanced the quality of life locally. The project is supporting the creation of real assets for local communities through crop diversification, animal husbandry, honey production, and value added products. It is also supporting the supply of clean drinking water. Through an educational program, local women are learning how to improve their health and the health of their families, while the children are learning about the importance of maintaining natural resources within the local schools curriculum. In March 2004 the project had generated additional annual income to rural communities from the sale of sustainable fuelwood and new agricultural and animal husbandry products estimated at more than US$9.5 million.

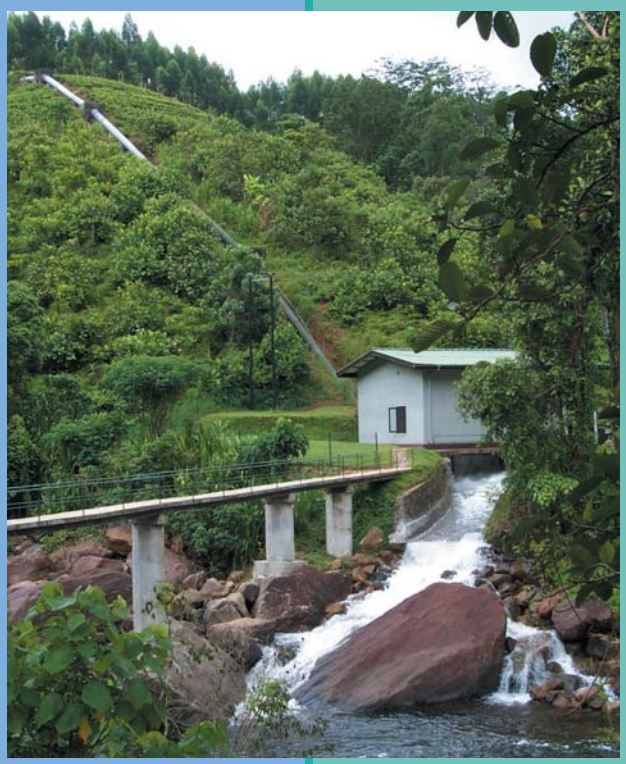
The World Bank is already replicating the Senegal model in other parts of Sub-Saharan Africa: the payoff is a potentially powerful model for sustainable management of forest resources, fuelwood production, and local economic and social development.

CASE TWO

SRI LANKA

RENEWABLE ENERGY, ENTERPRISE, AND BANKING FOR DEVELOPMENT

The Energy Services Delivery Project and its follow-on project, Renewable Energy for Rural Economic Development, are among the more successful, commercially oriented solar home systems, microhydro, and small village hydropower projects. Through this project, rural households get financing for solar home systems and microhydro from microfinance institutions, leasing companies, and commercial banks. These financing options are implemented by a competitive network of entrepreneurs. Together the projects target more than 100,000 rural consumers comprising about 5 percent of total electrified households in Sri Lanka. By early 2004, 40,000 systems had been installed, up from almost zero in the mid-1990s. The projects also finance 85 MW (8 percent of national generation capacity) of small hydropower projects, developed by the domestic private sector.



Small hydropower plant in Sri Lanka financed by the project.

This joint investment by the World Bank and GEF of US$113 million in these two projects is one of the largest investments that the World Bank Group has made in Sri Lanka. These projects have supported the emergence of a vibrant and quickly growing local private sector market, with well-established companies, including solar home system dealers and micro- and small hydropower developers. A number of commercial banks that have been prequalified to lend for solar PV and micro- and small hydropower projects, are active in developing new business. A new class of local entrepreneurs and NGOs has arisen that provides electricity services in addition to the power utility. Rural families and communities are enjoying the opportunities that new electricity services are providing—light for entertainment, studying, cooking, and socializing; light and telecommunications for small businesses; and power for small enterprises, schools, and health centers. This is a path-defining project in renewable energy for development.

SOCIAL AND COMMUNITY SERVICES

In rural areas, where social services are often very basic and delivered locally via remote, decentralized small social service centers, decentralized renewable energy solutions can be least-cost options to improve the delivery of such services. Improved health and better education are closely correlated with improved social and economic conditions. Thus "socially productive" uses of modern energy services include uses that support vital community services, such as better schools and learning, improved health centers, reliable and affordable supplies of clean water, communications, and public lighting. Together, such community services allow people to work more effectively and productively.

Renewable energy options can contribute to offering better **education services**. Improved rural quality of life helps attract and retain qualified teachers. Adult education and training programs are often highly desired and lighting makes evening study possible. Electricity allows rural schools to use modern communication tools and computers for distance learning, and teacher training. Investments in education need to go hand in hand with the development of suitable curricula and the training of teachers, in order for the electricity supply equipment and information and communication technology to add full value.

Solar water heating and solar photovoltaics, as well as wind and microhydro systems for off-grid electricity services, are examples where renewable energy systems can help primary **health care centers** to deal with night-time emergencies, refrigerate medicines and vaccines, operate laboratory equipment and lights, and use mass media—such as television and radio—to communicate public health messages.

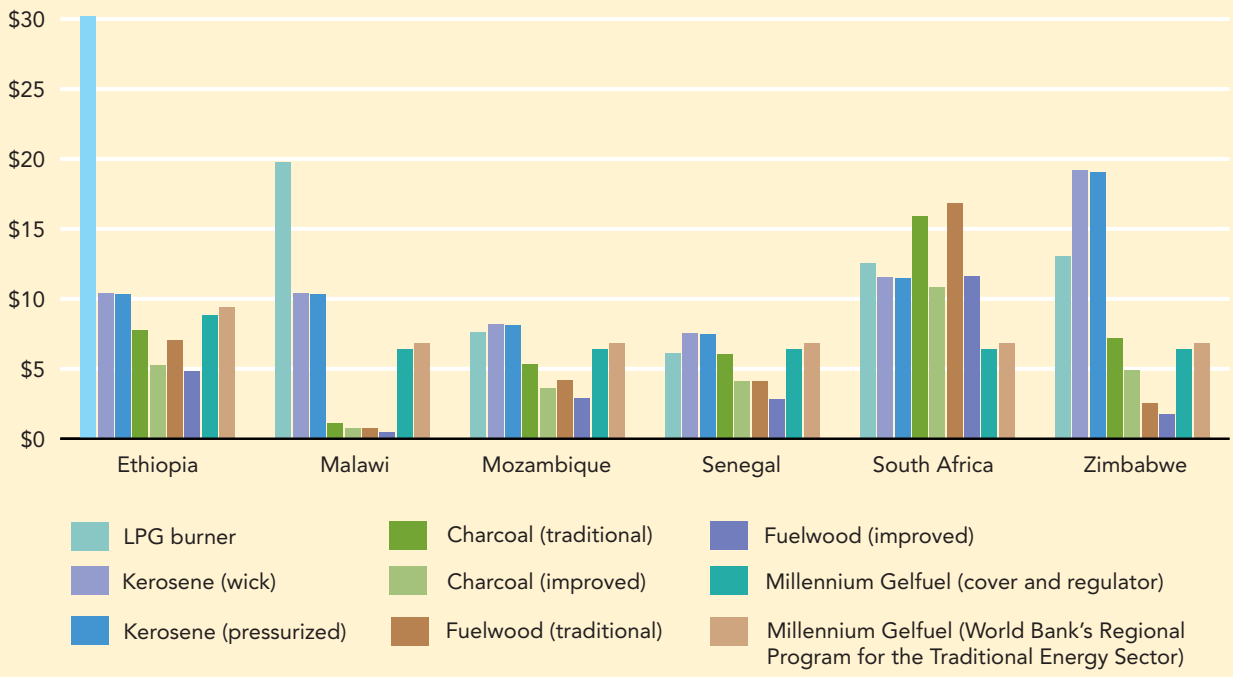
Sustainable energy solutions can help reduce the health and environmental impacts intrinsic to growth and development.

Public infrastructure provides for the framework in which **life in a community** takes place. Solar PV street lighting can allow both young and old to move safely in the evening. Rural women report a greatly enhanced sense of safety and security when there are public lights. Small shops can stay open in the evenings, and entrepreneurs can produce more goods or services than without adequate lighting. Case 2 gives the example of a large-scale renewable energy project in Sri Lanka that enhances financing in rural areas for solar home systems and micro hydropower.

HEALTH AND ENVIRONMENT

Sustainable energy solutions can help reduce the health and environmental impacts intrinsic to growth and development. Impacts of energy use occur at local, regional, and global levels. Local impacts are felt as closely as in people's homes. Inefficient indoor combustion of fuelwood and dung subjects mainly women and young children in the developing world to significant health hazards. Between 2.2 and 2.4 million people in the developing world die annually from indoor air pollution—more than the deaths attributed globally to tuberculosis or malaria.

FIGURE 1. THE COMPARATIVE COST OF HOUSEHOLD COOKING FUELS
(US$ PER MONTH PER HOUSEHOLD FOR 75 MEALS)



Note: 75 meals/month = 2.5 meals/day x 30 day/month.

These deaths are caused mostly by respiratory diseases contracted through open stove cooking and heating. Children in The Gambia carried on their mothers' backs as they cooked over smoky stoves were six times more likely to develop acute respiratory infections than unexposed children. Other ill effects on health are asthma, chronic bronchitis and other respiratory diseases, an increase in stillbirths, premature deaths, cancer, eye diseases, and blindness. Both improved cooking stoves and cleaner-burning substitute fuels can contribute to significantly reducing these hazards. Biogas or biomass-based liquid fuels, as examples, can virtually eliminate dangerous indoor air pollution. Case 3 discusses how the World Bank Group has supported "Gelfuel" as a cleaner and safer substitute for fuelwood in Africa.

Although land clearing for agriculture is the major cause of deforestation, unsustainable use of fuelwood also contributes to soil erosion, a drop in watersheds, and desertification at the village level. A policy based on sustainable biomass management, which combines end-use energy consumption, agroforestry, and the creation of revenue generating activities, can be a solution. Examples of World Bank Group projects with sustainable biomass for fuelwood component can be found in Benin, Bolivia, Burkina Faso, Chad, Ethiopia, Mali, and Senegal. The project in Senegal is discussed in case 1, page 13.

The energy sector contributes significantly to regional and global pollution through large-scale, fossil fuel–based power generation. Major concerns are acid rain and human-induced climate change. Acid rain is mainly generated by sulfur dioxide emissions from the combustion of coal. It is an increasing problem in Southeast Asia, but it can be remedied by the application of end-of-pipe control technologies.

CASE THREE

AFRICA

GELFUEL FOR SAFE, CLEAN, AFFORDABLE COOKING IN AFRICA

Two-thirds of African households—more than 350 million people—depend on fuelwood for cooking. Under prevailing land and forestry resource use patterns, this is unsustainable. In addition, burning fuelwood in poorly ventilated spaces poses a serious health hazard for women who prepare meals and for their children. With fuelwood supplies diminishing and petroleum fuel prices expected to increase over time, investment in the development of alternative low-cost and renewable household fuels for Africa is urgent.

Late in 2000 a small Zimbabwean company and a World Bank team launched a Development Marketplace 2000 project to develop an ethanol-based product, "Millennium Gelfuel," into a low-cost, renewable, clean, and safe household cooking fuel for Sub-Saharan Africa.

Gelfuel is based on biomass ethanol alcohol, and is produced from agricultural crops, such as sugarcane and sweet sorghum. It is a renewable organic product that can be locally produced in much of Africa without competing with land for food production purposes. Other potential benefits include generating economic growth in rural areas, increasing rural employment, creating opportunities for ecosystem rehabilitation, and reducing oil import expenditures.

Results of this effort to date include the development of five different low-cost, high-efficiency Gelfuel stoves and the retrofitting of more than 15 different traditional African stoves. One year after the initiative began, the cost to consumers was cut in half. Consumer tests and marketing assessments in Ethiopia, Malawi, Mali, Mozambique, Senegal, and Zimbabwe overwhelmingly affirmed the appeal and potential commercial viability of the Gelfuel. Figure 1 illustrates how the 2003 cost of Gelfuel compares with that of other cooking fuels in selected countries in Africa.

In 2003 the original Gelfuel burner was further modified to enable the safe use of straight ethanol at about two-thirds of the cost of the Gelfuel option. With three non-subsidized commercial plants currently in operation (Zimbabwe, South Africa, and Malawi) the viability of the Gelfuel and straight ethanol for cooking applications in Africa has been proven and the economic feasibility parameters established. The challenge now is to scale up ethanol production in Africa to the levels required by the market.

PV products shop and its owner in China supported under the Renewable Energy Development project.

Climate change is caused by the emission of greenhouse gases from the combustion of fossil fuels both in power plants and vehicles. Carbon dioxide emissions—the most important greenhouse gas contributor to climate change—from developing countries are about 38 percent of global emissions compared with 27 percent from the United States. Africa, by comparison, contributes only 3 percent. Countries that emit greenhouse gases can begin to address climate change through more widespread application of large, grid-connected renewable power projects, energy efficiency programs, and cleaner and more energy-efficient transport systems. Fuel-switching to less carbon-intensive fossil fuels is equally important. Among the large-scale renewable energy developments that the World Bank, IFC, and MIGA have contributed to in developing and transition economies are grid-connected biomass cogeneration, wind electric power, geothermal energy conversion, and run-of-river hydropower.

WORLD BANK GROUP EXPERIENCE WITH SUSTAINABLE ENERGY

PREPARING THE GROUND

The World Bank Group provides a wide variety of analytic and advisory services to help meet the development needs of individual countries and the international community. It includes products ranging from major reports that focus on key issues, to policy notes, workshops, and conferences. All are designed to provide information for policy discussions, support the development and implementation of country strategies, formulate effective lending programs, build institutional capacity, and communicate knowledge to the international community.

Increasingly, renewable energy development is being integrated into the important planning documents of client governments and the World Bank Group. For individual countries, a program of analytical work called "Economic and Sector Work" is set out in the World Bank Group's Country Assistance Strategies. The Country Assistance Strategies are the business plans agreed with the country that tailors the World Bank Group's assistance to each borrower's development needs. These programs are closely aligned with country priorities, and broad dissemination of the completed work is standard practice. The support to Vietnam for renewable energy development, as described under case 4, page 20, illustrates how such analytical work led to investment support for renewable energy development.

The World Bank Group's financial support is extending beyond investment and adjustment loans and credits.

MEETING THE FINANCIAL CHALLENGE

Investment in sustainable energy in the World Bank Group presents challenges at two levels: in selecting the type of initial financing at the project or program level, and in identifying the appropriate financial tools for administering them over the long term.

The World Bank Group's financial support is traditionally based on investment and adjustment loans and credits. The IBRD gives loans, and IDA gives credits. Investment loans and credits are long-term (5- to 10-year disbursements), and they finance goods, works, and services in support of economic and social development projects. Adjustment loans have a short-term focus (1- to 3-year disbursements), and provide quick external financing to support policy and institutional reforms. Repayment can take place over periods of up to 40 years. Loans and credits are made as part of the comprehensive lending program set out in the Country Assistance Strategy. Safeguard policies help to prevent unintended adverse consequences on third parties and the environment. In case 5 on page 23 examples of large renewable energy projects cofinanced by the IBRD and IDA are discussed.

Over the last decade, new instruments focused on mitigating project risk have been developed. Guarantees have emerged as a key tool in promoting and supporting private financing in borrowing

CASE FOUR

VIETNAM

RENEWABLE ENERGY ACTION PLAN

The World Bank Group's support to Vietnam in renewable energy planning illustrates its role in helping countries develop a strategy for benefiting from renewable resources. At the request of the Government of Vietnam, the World Bank/ESMAP supported efforts to develop a 10-year Renewable Energy Action Plan. The Action Plan will give priority to providing energy services in poorer isolated communities and villages. The plan is built on six strategic principles that can be applied in other countries:

1. Renewable electricity will be used when it is the economically least expensive option and economically viable.

2. Renewable electricity will be supplied on a commercial basis, by all types of businesses, including by a variety of private and public sector companies, cooperatives, and NGOs.

3. Communities, individual consumers, and investors will actively contribute to and participate in the program. All stakeholders will participate in program design and implementation and invest their own funds in the activities and installations.

4. The government will help create the enabling market environment by issuing policies and establishing the legislation and regulation to support commercial development.

5. Access to long-term credit will be increased to improve financial viability of businesses and affordability of services. The program facilitates access to credit for individual households to purchase systems or for communities or developers to finance larger-scale plants.

6. Limited grant assistance will be provided in recognition of the social and environmental benefits, but will be used carefully. Grant funding is needed to build the capacity for large-scale, renewable electricity development and to defray the costs of preinvestment activities. For off-grid facilities targeted at poorer communities, capital cost subsidies will be considered.

countries by covering risks that the private sector is not normally in a position to absorb or manage. For emerging renewable technologies or energy efficiency investments, guarantees can be critical in building investor or intermediary experience to solidify new markets and attract further investment. With its experience in developing countries and its long-standing relationships with governments, the World Bank Group is in a unique position to mitigate market entry risks by covering some of the sovereign, political and credit risks. Both the World Bank (IBRD and IDA) and MIGA guarantees may cover political risks. The IFC can also provide partial credit guarantees where appropriate. Case 6 on page 25 explains how MIGA has used a guarantee to enable the construction of a geo-thermal power plant in Kenya.

The activities of the IFC and MIGA are mainly focused on the provision of finance for project developments by private sector sponsors, including grid-connected renewable energy transactions. Such transactions typically require mobilization of both equity and debt financing in which the IFC can participate both as a minority shareholder and through senior loans and capital mobilization. The IFC is also active in local capital markets and has helped to capitalize banks, leasing companies and nonbank finance companies. The IFC maintains a network of project development facilities and partnership arrangements to support the small and medium-size enterprise (SME) sector. Specific attention has been given in recent years to support SMEs involved in sustainable energy businesses in part through GEF cofinancing. Examples of mainstream, renewable-energy IFC projects are described in case 7 on page 26.

An essential ingredient for sustainable energy projects, which often contain highly innovative components, is grant and concessional finance from the GEF and from bilateral donors. Without such counterpart resources, many of the World Bank Group projects that were undertaken in the past decade would not have been possible, because they would have imposed an undue risk on the World Bank Group's client countries.

NEW FINANCING AVENUES: THE GREENHOUSE GAS MARKET

Carbon finance is proving to be a powerful tool to improve the viability of clean technology investments. The World Bank Group's carbon finance operations have US$465 million either approved or under management from private companies and governments. This includes US$410 million in the World Bank's (IBRD) Carbon Finance Business (CFB) and US$55 million at the IFC.

Continued global warming is in nobody's interest, but the simple facts of the matter are that developing countries will suffer the most damage, and their poor will be at an even greater disadvantage. I see the Bank's role in climate change as providing every opportunity to developing countries to benefit from the huge investment OECD must make in reducing climate change.

JAMES D. WOLFENSOHN—UNGASS JUNE 1997

The mission of the CFB at the World Bank is to catalyze the market for project-based reductions in greenhouse gas emissions from projects in developing countries and in countries with economies in transition, as well as to disseminate the lessons learned. A large proportion of CFB projects are renewable energy, energy efficiency, and waste-to-energy projects, but fuel-switching from coal to gas, reduction of gas flaring, and coal-bed methane capture are also options for carbon financing.

The CFB buys emission reductions on behalf of its participants who use them to meet their emission reduction targets—including those under the Kyoto Protocol regime. In most cases carbon finance helps

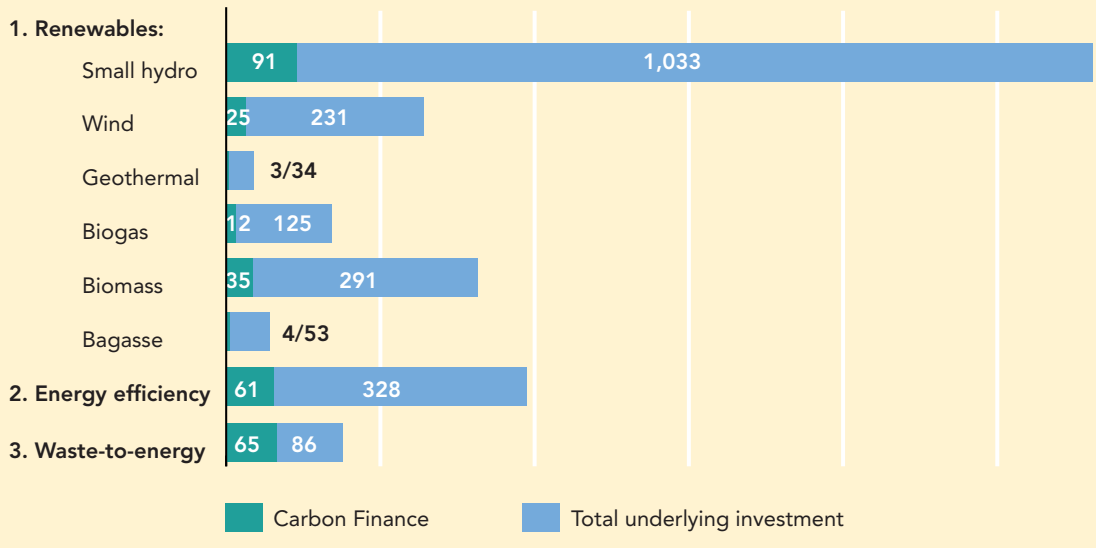
to mitigate risk and increase profitability for the projects concerned. Carbon finance operations are now an important part of the renewable energy and energy efficiency portfolios of several regional departments at the World Bank, and they continue to expand. The leverage of funding for carbon finance is considerable, as figure 2 illustrates.

The CFB comprises a family of six carbon funds. The first, the Prototype Carbon Fund (PCF)—a partnership of 17 companies and 6 governments—became operational in April 2000. The Community Development Carbon Fund gives a premium on the price of carbon to support sustainable development in local communities. The other funds include the Netherlands Clean Development Mechanism Facility, the Netherlands European Carbon Facility, the Italian Carbon Fund, and the BioCarbon Fund. The CFB also manages technical assistance in the area of carbon finance.

Of the US$410 million approved and/or under management, the CFB currently has US$325 in its project pipeline. Ninety percent of that is in renewable energy, energy efficiency, and waste-to-energy projects—about US$295 million. These carbon purchases are expected to leverage some US$2.2 billion of new and additional financing for sustainable energy. Some examples of projects from the PCF for which emission reductions purchase agreements have been signed include the following:

- **Chile:** Chacabuquito Small Hydro run-of-river project to displace coal or gas generation.
- **Colombia:** Jepirachi 19.5 MW Wind project to provide clean power and community services to indigenous people in remote areas.
- **Hungary:** Pannongreen Pécs Heat and Power Project for conversion of Pécs coal-fired boilers to biomass.
- **Indonesia:** Indocement Sustainable Cement Production to support energy efficiency measures and the use of alternative fuels.
- **Uganda:** West Nile Electrification for small hydro plants to replace diesel generators.

FIGURE 2. THE MULTIPLIER EFFECT OF CARBON FINANCE ON TOTAL INVESTMENTS IN SUSTAINABLE ENERGY
(MILLIONS OF U.S. DOLLARS)



CASE FIVE

WORLD BANK

EXAMPLES FROM ARGENTINA, LAO PDR, AND MEXICO

In **Argentina**, the Renewable Energy for Rural Markets Project is a model for an innovative way to address the challenge of rural access. The project provides for rural off-grid concessions lasting 15 years. Area concessions are bid out on the basis of minimum subsidies in eight Argentine provinces. The project aims to electrify up to 35,000 rural households and at least 1,100 public facilities, mainly by using decentralized renewable energy technologies, with a total investment of about US$120 million. The technologies include solar home systems, wind home systems, and various village minigrids.

Wind power mini-grid serving a village in Argentina.

The electrification level in **Lao PDR** grew steadily from about 10 percent in 1990 to over 35 percent by the end of 2003. The government has an electrification target of 90 percent by 2020. Off-grid supplies (predominantly hydro and solar power) will play an increasing role in reaching this goal. The World Bank has supported electrification of more than 40,000 households through the Southern Provinces Electrification and Provincial Grid Integration project. Some 50,000–70,000 households are still to be electrified, with an off-grid component of about 18,000 households.

Mexico has significant renewable energy resources in wind, small hydropower, and biomass. Solar resources are plentiful and of very high quality. The World Bank and GEF will support the development of sustainable renewable energy investments for the direct sale of electricity generated from renewable energy to the Comisión Federal de Electricidad (the country's electric utility) and for private projects serving municipalities and industries under self-generation markets. An export market for renewable electricity to the United States is available, because green certificates available in the United States augment the price for electricity from renewable energy sources.

Solar PV powered library in rural Argentina.

Case 8 on page 28 shows how carbon credits generated in Nepal can improve people's quality of life.

In addition to the World Bank's CFB, the IFC has its own carbon finance business, and in 2004 US$55 million was under management in the IFC-Netherlands Carbon Facility (INCaF) primarily to support renewable energy and energy efficiency. The IFC is also designing and delivering financial products for this new market. These value added products will leverage the IFC's ability to take long-term credit risk in emerging markets and will help unlock the latent investment capital embodied in carbon purchase agreements.

JUMP-STARTING THE PRIVATE SECTOR

Most renewable energy and energy efficiency projects have used a variety of financing tools, which either target the energy resource developer, the project developer or sponsor, financial intermediaries, the service provider, the entrepreneur, or the energy end user. The types of financial instruments that have been extended to the private sector include debt and equity financing, working capital credits, corporate loans, grants, and partial guarantees. Financial instruments targeted at the end user have focused on consumer credit, lease payments, or fee-for-service approaches.

The administration of financial instruments targeted at entrepreneurs is managed by credit institutions or intermediaries in client countries. In Sri Lanka, for example, the credit facility Sarvodaya Economic Enterprises Development Services (SEEDS) has successfully extended loans for solar home systems.

Another approach is dedicated regional or international funds. The IFC established the GEF-funded Photovoltaic Market Transformation Initiative (PVMTI), which targets larger solar PV entrepreneurs in India, Kenya, and Morocco. The World Bank Group, GEF, and several other private and public funding agencies have supported the Solar Development Group, which between 2000 and 2004 approved about US$5 million for 47 small and medium-size solar enterprises in 22 countries in Africa, Asia, and Latin America for a wide range of business ventures—from the promotion of solar home system businesses to the R&D of solar-powered chicken incubators. A particularly innovative new fund is the proposed GEF-supported regional

CASE SIX

MIGA

RISK MITIGATION FOR GEOTHERMAL POWER

In Kenya, MIGA is providing a 15-year investor guarantee for a US$40 million 13 MW geothermal power plant that will diversify the country's power generation system and decrease reliance on hydroelectric power. The Olkaria III project is the first private geothermal power plant in Kenya. The Power Purchase Agreement was awarded by Kenya Power and Lighting Company (KPLC) under a World Bank–supervised international tender for the field and plant development of up to 100 MW. The first phase included the drilling of five appraisal wells and the construction of this 12 MW plant, which is owned and fully financed by ORMAT, with MIGA providing political risk insurance. This is the first stage of a 48 MW project awarded to ORMAT through an international bid issued by KPLC under World Bank supervision.

The Olkaria III geothermal project in Kenya.

CASE SEVEN

IFC

RENEWABLES ARE MAINSTREAM INVESTMENTS AT THE IFC

For the IFC, renewable energy investments have become part of their mainstream energy investment portfolio, as the examples below illustrate.

Inside powerhouse of the El Canada hydropower plant.

1. El Canada Hydro project, Guatemala. The IFC's Infrastructure Department recently completed an investment in the 43 MW El Canada run-of-river hydropower project on the Samala River located immediately downstream of an existing 15.5 MW hydropower project. The project sponsor is Enel Latin America, the renewable energy subsidiary of Enel of Italy. In addition to its use of a renewable resource, the project is the first investment made by the IFC in which carbon finance was used in addition to the IFC's regular financing. The carbon financing was provided by the World Bank's PCF. The project will offset 144,000 tons of greenhouse gas emissions annually during its life.

2. Pamir Hydropower project, Tajikistan. This is a unique financing arrangement for the expansion and rehabilitation of the Pamir hydropower project located in the remote and poverty-ridden Gorno Badakshan Autonomous Oblast. With support from the Aga Khan Foundation's Fund for Economic Development and the Swiss government, IFC's Infrastructure Department is proactively helping structure a financing package to expand a partially completed 14 MW hydroelectric plant to 28 MW and to construct a river regulating structure at the upstream lake to ensure year-round water flows. The IFC also mobilized concessional financing from IDA to help make the project costs and tariffs more affordable, and worked with the government to establish a lifeline tariff for the poorest consumers. This is the first use of IDA funding in a mainstream IFC investment project.

3. Balrampur Chini Mills Limited (BCML), Biomass Power project, Uttar Pradesh State in India. The IFC's Agribusiness Department has committed US$15 million in corporate financing for BCML, which will help finance approximately 40 MW of biomass-based cogeneration at two separate sugar mills. The loan will support establishment of a 20 MW biomass-fired cogeneration plant associated with an investment in a greenfield sugar mill project in Haidergarh. The power plant will use bagasse, a waste produced after sugarcane is crushed, as the biomass feedstock to produce electricity and process steam for use by the sugar mill. A surplus of nearly 16 MW of electricity will be dispatched into the grid. A similarly sized, bagasse-fired cogeneration plant is being financed at the company's existing Balrampur plant along with a 60-kiloliter per day ethanol distillery (producing a more environmentally friendly blendstock for gasoline). The distillery also generates saleable fertilizer as a byproduct. The regular IFC financing is being supplemented with the sale of carbon credits to an IFC-managed carbon finance facility provided by the Government of the Netherlands.

GeoFund for the development of geothermal power in Europe and Central Asia (described in case 9 on page 31 and figure 3 on page 30).

In the domain of energy efficiency, private sector financial institutions are rarely willing to give loans to support investments in energy efficiency measures in the absence of targeted incentives. To address this barrier, dedicated energy efficiency funds have been included in the project design. These funds either provide direct finance for energy efficiency measures or provide other financial intermediaries with guarantees for energy efficiency loans.

Another concept that has become widespread is the energy service company (ESCO). ESCOs are now an integral part of about half the energy efficiency projects that have been approved. An ESCO is an entity that "sells" energy efficiency services to companies and takes payment from the energy efficiency savings that are returned from the investment. Specific financing tools include partial loan guarantees, loan loss reserve funds, corporate loans, dedicated energy efficiency funds, private equity funds, and investment grants.

Between late 1991 and early 2004, the World Bank Group approved 32 energy efficiency projects, and the IFC an additional 10 projects. About 10 percent of the funding from energy efficiency has been provided by the GEF. Most of the projects are in Central Asia, East Asia, and Eastern Europe. Case 10 on page 32 discusses the IFC's and the World Bank's efforts to commercialize energy efficiency investments.

INNOVATION AND IDEAS

Ideas are the genesis of innovation. The World Bank Group, however, recognizes that the challenges of introducing and cultivating sustainable energy solutions are significant and easily overwhelmed by well-established conventional energy sources. To help new ideas emerge and reach implementation so that their merits can be compared, the World Bank Group has launched the Development Marketplace—a program that promotes innovative

Bioenergy powered rural enterprise in the Philippines (Development Marketplace winner 2002).

DO YOU HAVE AN IDEA FOR SUSTAINABLE ENERGY?

The Development Marketplace competition is open to all, including NGOs and other civil society organizations, multilateral and bilateral development agencies (including the World Bank Group), private foundations, universities and schools, private sector groups, individuals, and local and municipal governments.

All proposals must be submitted through the Development Marketplace website at http://www.developmentmarketplace.org. Details on how to apply are on the website. If you are unable to access the Internet, contact the Development Marketplace team by fax at (202) 522-2042. If you are unable to access the website, send an E-mail to dminfo@worldbank.org.

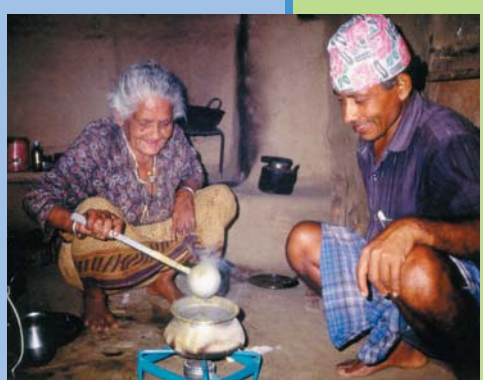
CASE EIGHT

NEPAL

A BIOGAS PROJECT IN NEPAL REAPS CARBON CREDITS

Nepal is a small land-locked country with a population of 25 million, more than 90 percent of whom live in rural areas and rely on agriculture for their livelihoods. Nepal is one of the world's lowest-income countries: per capita income reached US$236 in 2003. Only 10 percent of households are connected to the power grid, and per capita energy consumption is very low. Most of the energy used, in particular for cooking, comes from traditional fuel, such as fuelwood and animal dung. The dependence on fuelwood has contributed greatly to deforestation.

With the help of the World Bank's Community Development Carbon Fund, the Netherlands Development Agency, the Kreditanstalt für Wiederaufbau of Germany, and the Nepali Government's Alternative Energy Promotion Center, the project aims to disseminate and install high-quality biogas plants at a reasonable price, and to bring fuel for cooking and lighting directly into each rural household. Under the coordination of the Biogas Support Program, about 60,000 of these plants will be installed over 21 years. They will reach more remote and poor areas of the hills, the Terai, and the mountains of Nepal.



Cooking with biogas, Biogas Support Program.

The project will generate a total of 1.8 million tons of carbon dioxide equivalent during the first crediting period of 7 years, with delivery starting in 2004. The sources of emission reduction are from manure treatment and the displacement of the use of chemical fertilizer and fossil fuel. The Community Development Carbon Fund expects to purchase a minimum of 1.43 million tons of carbon dioxide equivalent for a 10-year crediting period.

The community will benefit from the project in many ways. And because the technology is indigenous, it is locally available. A major benefit to households is the reduction in the workload for women and children who will no longer have to collect firewood for cooking. A village woman near Kathmandu pointed to a hill nearby and said, "Life with the biogas plant has become so much easier…no more climbing to that hill to collect wood." Potential employment will add more than 150,000 person-years for skilled people in the construction, maintenance, and marketing of biogas. The use of biogas means negligible smoke, hence improved indoor air quality and better family health. Moreover, the residual biological slurry from the biogas plants can be used as superior organic fertilizer to enhance agricultural yields.

development ideas by providing seed capital to people at the grassroots level. With no bureaucracy, preconditions, or preconceptions, it solicits a basket of project and program ideas, so that they can be considered for further development.

The initiative's success has attracted financing partners, including the GEF—which contributed nearly US$1 million to the 2003 award pool—and UNAIDS, Microsoft, and the U.S. Agency for International Development (USAID). Several units within the Bank Group also provide support, including the World Bank Information for Development Program (*info*Dev), the HIV/AIDS program, and the IFC. An example of a project that won a prize at the Development Marketplace is Gelfuel for Africa as discussed under case 3 on page 17. Another innovative example, this time done by IFC, is summarized in case 11 on page 35.

LEARNING AND ACCESSING KNOWLEDGE

Two critical elements in meeting the MDGs are to increase access to knowledge and expertise about development and to equip people to adapt and apply it to their local circumstances. The World Bank Institute (WBI) takes the lead in this role for the World Bank Group in cooperation with other departments, as well as with external partners. The World Bank Group supports the Global Development Learning Network (GDLN)—a worldwide partnership of distance learning centers and other public, private, and nongovernmental organizations (NGOs) committed to development learning and development dialogue for lasting poverty reduction. Energy thematic groups share knowledge within the World Bank Group.

The World Bank Group helps build local capacity through training and learning programs, policy services, knowledge-sharing activities, and knowledge networks targeted to meet the needs of an audience that ranges from government officials to local community leaders. In renewable energy development, the Energy Sector Management Assistance Programme (ESMAP) and the Asia Alternative Energy Program take a lead role along with external partners, the Global Village Energy Partnership (GVEP), the Regional Program for the Traditional Energy Sector, the Africa Rural and Renewable Energy Initiative, and the Photovoltaic Global Approval Program, among others. Examples of learning and knowledge products include practitioner and stakeholder workshops in Africa, Asia, and Latin America; reports on modern energy service technologies; guidance on best practice and quality assurance; cross-country studies; and impacts on gender and health.

USEFUL WEBLINKS ON LEARNING AND ACCESSING KNOWLEDGE:

http://www.worldbank.org/wbi
http://www.esmap.org
http://www.worldbank.org/astae
http://www.gvep.org
http://www.gdln.org/dlc.html

WORKING ACROSS SECTORS

Combining sustainable energy services with investments in nonenergy sectors can be highly beneficial. Including an agroforestry component can enhance the sustainability of improved biomass supplies. Energy services can improve on the ability to use educational facilities and health centers. The availability of electricity is key to using contemporary communication equipment, including landline and cellular telephones. The World Bank Group, together with its partners and client country agencies, is increasingly supporting cross-cutting sustainable energy applications that specifically address local development needs and objectives. A few examples are found in projects in Bolivia, China, and Uganda.

A project in **Bolivia** will spend about US$60 million in three phases over 10 years to increase rural access to electrification and communications technology,

using decentralized private-public business models and focusing on productive uses and training of suppliers and users. Output-based subsidies for innovative medium-term service contracts aimed at local market development will be competitively awarded. Extending cellular telephone coverage, television, and radio to the same rural areas is expected to significantly increase the demand for and benefits from electricity.

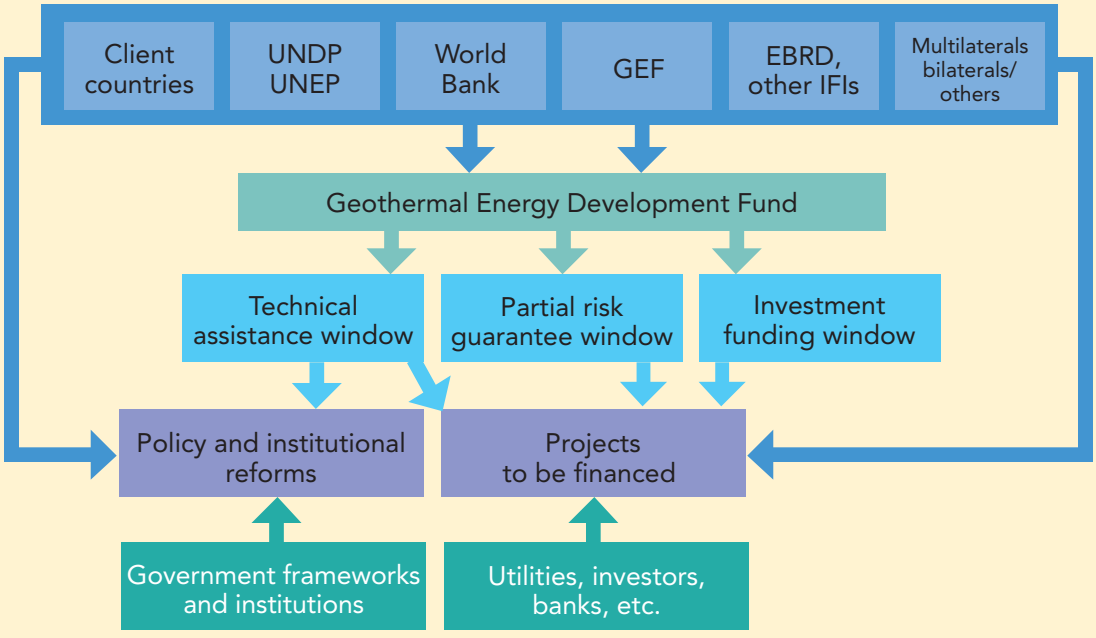
In **China**, the World Bank is implementing a GEF-funded project to introduce passive solar health clinics in Northwestern China. The project has introduced new building designs, provided training for design institutes, and helped cover the incrementally higher cost of the new buildings. The results are promising. The replacement of indoor coal stoves has eliminated indoor carbon monoxide emissions and reduced carbon dioxide emissions. The indoor air temperature is more comfortable now and offers a healthier environment conducive to healing.

In **Uganda**, the World Bank and GEF are supporting the country's rural energy and information-communication technologies sectors to bring about rural transformation. One specific project takes a cross-sectoral approach and involves productive use applications, actively engaging the private sector and building local capacity to extend the grid, setting up minigrids and also selling, installing, and servicing solar home systems. World Bank and GEF commitments for Phase I of the three-phase (10-year) loan are approximately US$72 million. Ten-year targets include connection of 400,000 new customers, grid or off-grid electrification of all health clinics, and installation of 80 MW of renewable energy-based generation capacity.

MOVING FROM PROJECTS TO PROGRAMS

To make a measurable impact in scaling up sustainable energy, more and larger alternative energy

FIGURE 3: THE INSTITUTIONAL STRUCTURE OF THE GEOTHERMAL ENERGY DEVELOPMENT FUND



CASE NINE

EUROPE AND CENTRAL ASIA

THE GEOFUND—NOT JUST HOT WATER

The Europe and Central Asia region possesses almost 20 percent of the world's geothermal resources. Yet with the exception of Iceland, Italy, Russia, and Turkey, there is virtually no geothermal-based power generation in the region. There are, however, applications of geothermal energy for district heating and other thermal end uses in most countries of the region, and there is good potential for expansion in some of these. Other applications include geothermal heating of greenhouses and heat for spas. The famous spas of ancient Rome and Central Asia were often heated by geothermal energy, and geothermal heating is an important market today in countries such as Iceland and Turkey.

Aging district heating infrastructures often provide good opportunities for retrofitting them to use geothermal heat sources and to replace fossil fuels. With re-injection of geothermal fluids into geothermal wells, geothermal energy for low-grade thermal applications is an environmentally attractive energy option. Although such applications are often economically viable, focused technical and financial assistance is needed to develop financially viable markets for these applications in Europe and Central Asia.

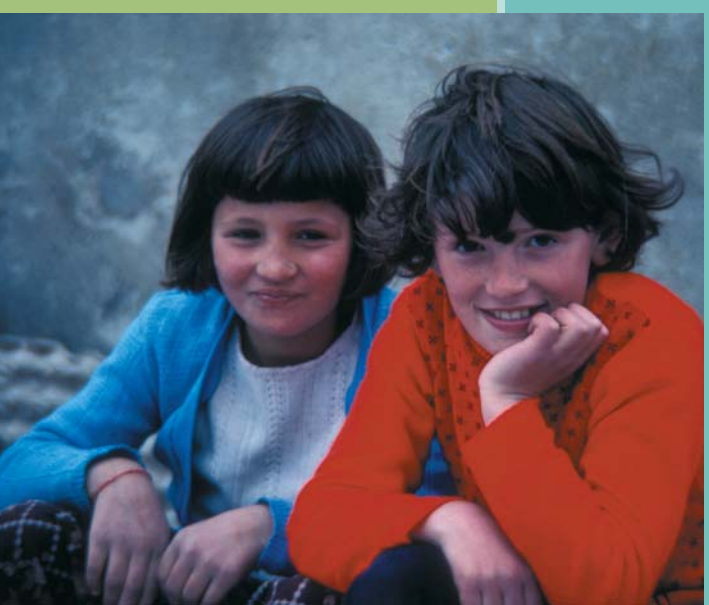
The World Bank Group and GEF have established a US$200 million fund (GeoFund) to promote geothermal energy development in Europe and Central Asia. The fund is expected to be operational in fall 2004 and will help support the development and financing of commercial geothermal projects for both power generation and purely thermal uses, such as district heating applications. The fund will provide technical assistance, partial risk guarantees, and investment funding. The investment funding will include contingent grants, low-cost financing and, in special cases, pure grant financing.

The fund is part of the larger World Bank Group–GEF Geothermal Energy Development Project in Europe and Central Asia, and is open to all countries in the region that have ratified the United Nations Framework Convention on Climate Change. Partners in geothermal development in Europe and Central Asia include the client countries, GEF, UNDP, UNEP, IFC, multilateral and bilateral donors, and others, including carbon finance institutions. Figure 3 to the left illustrates the fund's institutional structure.

CASE TEN

CENTRAL EUROPE

COMMERCIALIZING ENERGY EFFICIENCY FINANCE



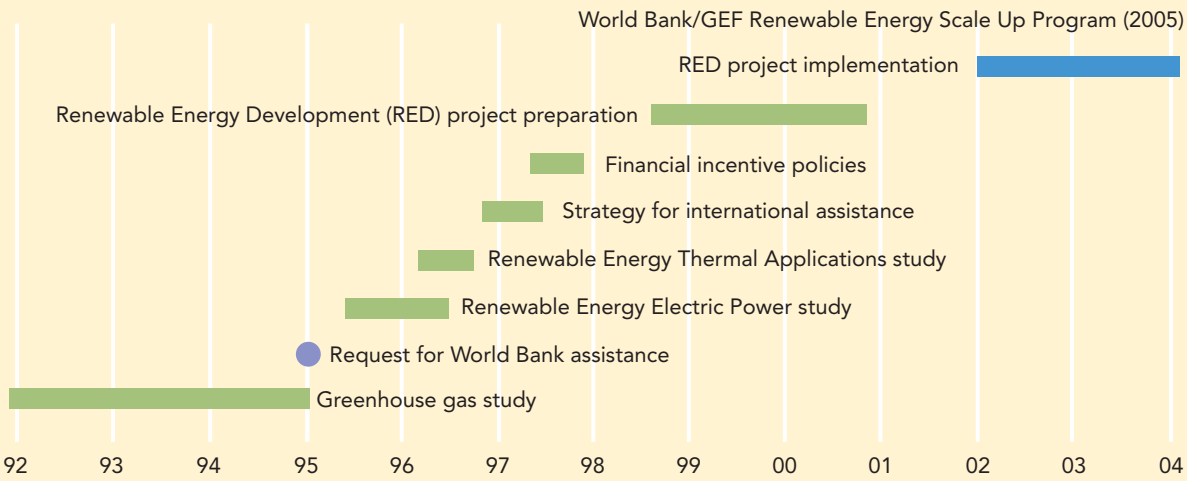
Central European countries remain three to five times more inefficient in energy use than their Western European neighbors. This inefficiency impairs economic competitiveness, creates social pressures and causes air pollution. The demand for new, energy-efficient technologies is strong, but little capital is available—especially in commercially accessible local currencies. Local financial institutions typically consider energy efficiency projects high risk because of their novelty and the difficulty in structuring collateral.

To promote such projects, the IFC, in partnership with the GEF, has established a US$90 million guarantee facility, including up to US$75 million invested by the IFC. The facility provides a partial guarantee for loans made by local financial intermediaries when they lend for energy-efficiency projects. This innovative structure enables the IFC to directly leverage more than US$225 million in private capital investments, while building a self-sustaining local lending market for sustainable energy investment.

The IFC implemented a pilot project in Hungary in 1997 and expanded the initiative to the Czech Republic, Estonia, Latvia, Lithuania, and Slovakia in 2003. The goal is to build a sustainable market for financing energy efficiency. The initiative uses a combination of technical assistance and credit enhancement instruments to enable local financial institutions to develop a profitable business in lending for energy efficiency. With GEF support the World Bank Group is implementing similar projects in Bulgaria, Croatia, FYR Macedonia, Poland, Romania and Serbia.

This effort will have significant economic, environmental, and social benefits. Examples of impacts of the program in Hungary include investments in projects to upgrade street lighting in small towns in the poorest parts of the country and replacement of outdated, unreliable heating technologies in hospitals.

FIGURE 4: THE WORLD BANK'S PROGRAMMATIC ENGAGEMENT WITH CHINA FOR RENEWABLE ENERGY DEVELOPMENT



Note: As of early 2004, CRESP is the World Bank Group's most ambitious renewable energy program, supporting the addition of up to 20,000 MW of renewable electricity in 10 years. This illustrates the often lengthy process that precedes the large-scale installation of renewable energy systems. The ongoing World Bank Group/GEF–assisted Renewable Energy Development Project supports the development of a sustainable market for PV for off-grid electrification and demonstration of the commercial viability of wind electric power in coastal areas. Other assistance for sustainable energy in China includes the development of a green electricity market in Shanghai and a wind farm performance improvement program, and support for passive solar health clinics in the northeastern provinces.

projects are required—and they have to be developed faster, with lower transaction costs—and the capacity for implementation must be in the country.

Essential to large-scale renewable energy development is establishing an institutional, policy, financial and regulatory framework that helps attract capital from international financial institutions, foreign direct investment and, most importantly, the domestic capital markets. The World Bank Group is well placed to assist in developing this capability, although this will require a paradigm shift from working on individual projects to working strategically on a multiproject program basis. Within a program, projects will serve as vehicles to build capacity and provide the momentum for policy and institutional change and to create an enabling environment to support the development of sustainable energy.

This approach can be adopted in selected countries that have significant potential. This programmatic approach requires both a longer time horizon and the flexibility needed to respond to specific market conditions as the renewable energy infrastructure matures. A logical consequence of the programmatic approach is that the funding requirement will be larger, which will also provide increased incentives for client countries to adopt appropriate policy and regulatory frameworks to support sustainable energy. Examples of such projects are in Bolivia, China, the Philippines, and Uganda.

Essential to large-scale renewable energy development is establishing an institutional, policy, financial and regulatory framework that helps attract capital.

Figure 4 shows the evolution of a programmatic approach in China, where World Bank Group engagement began in 1992, in a series of sector studies leading to the China Renewable Energy Development Project and to the proposed 10-year China Renewable Energy Scale-Up Program (CRESP). The CRESP supports China's renewable energy program with the objective of reducing environmental emissions from coal-fired power generation by developing sustainable commercial markets for electricity

from renewable energy. CRESP will assist in implementing a policy to create a mandated large-scale market and programs aiming to reduce costs for mature technologies, such as wind farms, small hydropower, and biomass. China expects CRESP to support a program that could eventually lead to adding about 14,000 MW of renewable energy in the next decade.

THE LESSONS OF EXPERIENCE

During the past 15 years the World Bank Group has encountered barriers to the development and operation of both grid-connected and off-grid renewable energy projects. In addressing these barriers and tracking the progress of these projects, much has been learned about what works, what does not, and why. Recent projects have incorporated these lessons:

Accessible and affordable financing for energy enterprises, energy investments, and consumer financing is essential for success.

Identifying opportunities: Renewable energy does not present solutions for all problems, but it increases the menu of possible options. It is important to note that renewable energy technologies should not be force-fitted on developing countries that are least able to pay for them. In order to render projects sustainable, greater attention must be given to engage governments and other stakeholders in taking ownership when identifying and assessing sustainable energy options. This is essential if sustainable energy is to become an integral part of key planning documents, such as Poverty Reduction Strategy Papers and Country Assistance Strategies.

Creating the enabling conditions: Sustainable energy projects have been implemented by the private sector, community organizations, and civil society, as well as by governments. The World Bank Group has found that success generally reflects the presence of effective market-enabling conditions. The enabling conditions include a supportive commercial environment, favorable markets with affordable services that are accessible to a wide range of customers, a supportive policy and regulatory environment, a functioning infrastructure, and attractive returns to private investors. For example, private developers and other sponsors of potential investments in grid-connected power plants and their financiers need to receive adequate price signals from governments or from other creditworthy buyers of electricity. A regulatory framework that allows private developers to make an adequate return on investment commensurate with the risk is essential for private capital mobilization. In its absence, few high-quality renewable energy projects will be available with attractive potential returns and active sponsors.

Increasing financing: Accessible and affordable financing for energy enterprises, energy investments, and consumer financing is essential for success. Availability of financing is necessary to buy down high upfront costs of grid-connected renewable energy or minigrid investments. Consumer credit on reasonable terms is necessary, for example, for household solar PV to be affordable. Investment and working capital are also required for many small and medium-size companies seeking to develop distribution chains for renewable energy products and services. Some renewable energy resources, such as geothermal, require significant exploration and development investments that involve higher risks. Along with ensuring the adequacy of financial resources, appropriate financial instruments are needed (for example, long-term debt, equity, risk mitigation, or preinvestment financing). Training of financial intermediaries and banks in developing renewable energy and energy efficiency portfolios is imperative. World Bank Group cofinancing, preinvestment support, the use of risk mitigation instruments, and financial sector capacity building have helped in building such capabilities to increase the availability of financing.

Strengthening governance: Good governance is necessary to ensure that rules and regulations are adhered to and that electricity customers pay, without which sustainable energy development will be

CASE ELEVEN

IFC

INNOVATION: DEMONSTRATING THE JOINT USE OF SMALL HYDRO AND SOLAR PHOTOVOLTAIC POWER

Cagayan Electric Power and Light Company (CEPALCO) is the third largest electric distribution utility in the Philippines. It was considering increasing its fossil generation to meet increasing demand. Instead, using a US$4 million grant from the GEF, and with the IFC acting as the executing agency for the GEF, CEPALCO has helped structure a ground-breaking solar photovoltaic (PV) project that will enhance the capacity of an existing privately financed 7 MW run-of-river small hydropower facility that is dispatched to CEPALCO.

The project has many "firsts" to its credit:

- At 1 MW, the plant is one of the largest grid-connected solar PV installation in the developing world as of 2004.
- The project demonstrates the joint use of hydropower and solar PV resources for the first time anywhere in the world, effectively increasing the capacity of the hydropower unit and converting the solar PV plant's power output to firm dispatchable power rather than an intermittent resource.
- The project financing is innovatively structured as a loan that converts to a grant if all the conditions are fulfilled.

severely constrained. More transparency is required on the implementation of business licensing and regulatory frameworks to encourage the formation of such businesses. Publicly and privately owned businesses need to be treated equally with respect to the ability to enter the market and obtain project approvals and access to financing.

Subsidies: Well-designed and applied subsidies are beneficial in making economically sound investments, financially viable. Inappropriate subsidies, such as give-away programs or equipment dumping have seriously damaged nascent renewable energy markets in several countries by discouraging entrepreneurs and raising expectations among consumers that cannot be met. They can result in unsustainable projects, as beneficiaries have little ownership. These projects can fail because they cannot establish or support facilities for the maintenance and repair of installed equipment over the long term. Rural electricity or liquid fuel subsidies that are intended to help the poor may not reach them. They can be counterproductive and erode the ability to serve consumers using lower-cost sustainable energy alternatives. At the same time, a general concern of technology-specific subsidies remains how to ensure that they reach the poor and not just middle-income groups. Subsidy schemes that are economically rational, performance-based, and time-bound have been found to be quite effective. Buying down initial costs is preferable to subsidizing operational costs, because the long-term availability of subsidy funds for paying for operating costs can be inherently uncertain.

Supporting innovation: The costs of preparing sustainable energy projects have declined through experience, but they often require additional up-front analytical and policy studies. As such, preparation costs remain relatively high and time-intensive for "first-off" projects in a country. Consequently, many World Bank Group projects with renewable energy and energy efficiency components have required trust funds and GEF assistance to cover project preparation expenses. The World Bank Group views these additional investments as critical in developing and maintaining a broad menu of energy alternatives for its clients. Because these costs are outside its normal business operations, the Bank Group continues to seek partnering with donors to facilitate this work.

Building infrastructure: The capacity and market infrastructure that is needed to facilitate sustainable energy scale-up must be supported. However, this work needs to be done in close coordination with, and in direct support of, investments or else the capacity that is built will dissipate.

Improving the quality and availability of information: More complete, timely, and accurate information is needed at all levels about the technologies, their costs, and effectiveness for the potential investors in grid-connected plants, communities and households, financiers, and governments. Better analytical approaches that can value distributed power supply, intermittent energy sources such as wind, externality benefits and costs, and energy portfolio risk, for example, are also needed. Good renewable resource information or energy efficiency potential and market data are always needed, but too often are not readily available.

Scaling up from pilot projects: Pilot projects are often financed with a mix of grant aid, donated equipment, and low-cost financing, in order to "try out" a particular approach. If such projects are locally successful, scaling them up can trigger regulatory oversight and other requirements associated with much larger investments and cash flows. If a pilot project is needed to convince government agencies and regulators that a particular approach is sound, and is needed as a prelude to regulatory and policy change, the pilot project design needs to include support to policy and regulatory change and an understanding that follow-up financing will be available.

TOWARD SUSTAINABLE DEVELOPMENT

Energy has become a key ingredient underlying all our day-to-day activities: all the production and trade, innovation, and social communication that we now define as part of being human. Energy, along with activity related to energy, now represents one of humanity's largest interactions with its environment. Against the backdrop of an ever-growing world population and the threat of climate change, humanity faces an unprecedented challenge in managing the global commons to protect the natural systems it relies on. Within this challenge, developing countries—representing more than three-quarters of humanity—need access to energy to allow them to participate in the global economy. Both the rate at which they achieve this access and the sustainability of the choices have tremendous ramifications for the entire human condition.

But how can the supply of sustainable energy be increased? The World Bank Group's first large-scale renewable energy project may serve as an inspiration. This US$280 million project, which was approved in 1994, contributed to India becoming one of the world's largest suppliers of energy from wind, small hydropower, and photovoltaic systems. By the time the project ended in 2001, India was getting 3.5 percent of electricity from new renewable energy resources, compared with 0.4 percent in 1995. India's role in global renewable energy markets is also significant because it is the fifth largest wind market in the world with more than 2,117 MW installed. Most of this progress was achieved with financing from the domestic private sector.

Several factors are now converging that provide broad opportunities to promote sustainable energy on such a scale and expand it further. First, technology costs have come down significantly in the past 10 years for a range of renewable technologies. Second, policy support by host governments has increased, and the program and market experience required to integrate sustainable energy choices has expanded with the help of the World Bank Group and its development partners, and with the commitment of its client governments.

Energy has become a key ingredient underlying all our day-to-day activities: all the production and trade, innovation, and social communication that we now define as part of being human.

These factors are mutually supportive. If an adequate regulatory environment is present, run-of-river hydropower projects, geothermal power projects, and a number of biomass applications can already fully compete with conventional power generation

Wind farm in Costa Rica financed by IFC, GEF and others.

technologies. The cost for wind power is dramatically reduced when compared with the price only a decade ago and, despite still facing some regulatory and financial barriers, it is now price-competitive with fossil fuel alternatives in some developing country settings. Energy efficiency today already generates savings, but the lessons learned from projects need to be consolidated and replicated to further demonstrate them as a consumer and investment opportunity.

The challenges of implementing sustainable energy projects in the World Bank Group's client countries remain high.

Concurrently, both the developed and developing worlds recognize the value of the additional development and sustainability benefits. In addition to providing direct energy services, the use of renewable energy and energy efficiency can reduce a country's dependence on imported fossil fuels, help improve balance of payments accounts, and can also generate more employment. The use of indigenous renewable sources can provide increased energy security and diversification while improving macroeconomic trade imbalance. As a result, sustainable energy technologies have begun to play an increasingly important role in the World Bank Group's client countries.

Taking full advantage of this convergence requires additional effort and commitment. Although valuable lessons have been learned on what has worked and what has not, the challenges of implementing sustainable energy projects in the World Bank Group's client countries remain high. The challenges include perceived financial and political risks, insufficient institutional capacity to implement projects, weak or inadequate regulatory frameworks, and limited understanding of what is feasible on the ground. Increasing the scale of sustainable energy—on the ground, where energy services are delivered—is also fundamental. In this context, "scale" means more effectively reaching out to the multitude of smaller-scale customers that may be overlooked by large, traditional infrastructural solutions, as well as aggregating large numbers of customers to market scale.

The developed world increasingly recognizes the critical need for sustainable energy and the role it must play in bringing it forward. The growing availability of carbon finance is one indication of this recognition, which provides a significant opportunity for the developing world to contribute to efforts to protect the global environment while growing their own economies. In moving forward, the World Bank

Group is helping shape this opportunity for the developing world and donor participation in the following ways:

- The World Bank Group will help build a wider constituency for sustainable energy by helping to address linkages of energy, poverty reduction, and environmental sustainability as they are reflected in the Millennium Development Goals (MDGs). Pillars of the debate will be energy poverty, the environment, and energy security.

- The World Bank Group will support enhanced international cooperation with the aim of establishing a common approach and acting cooperatively rather than in competition in scale-up of sustainable energy. Renewable energy development will require consultation and cooperation with bilateral and other multilateral development partners, public and private sector agencies and institutions, and civil society.

- The World Bank Group will help advance knowledge and learning to scale up sustainable energy. Improved knowledge and analytical techniques are especially important in technology choice decisions and in reducing the transaction costs associated with implementing sustainable energy projects. During the past decade, a base of experiential knowledge of sustainable energy development and good practice has emerged. The World Bank Group is committed to making this knowledge easily accessible and widely available to the development community.

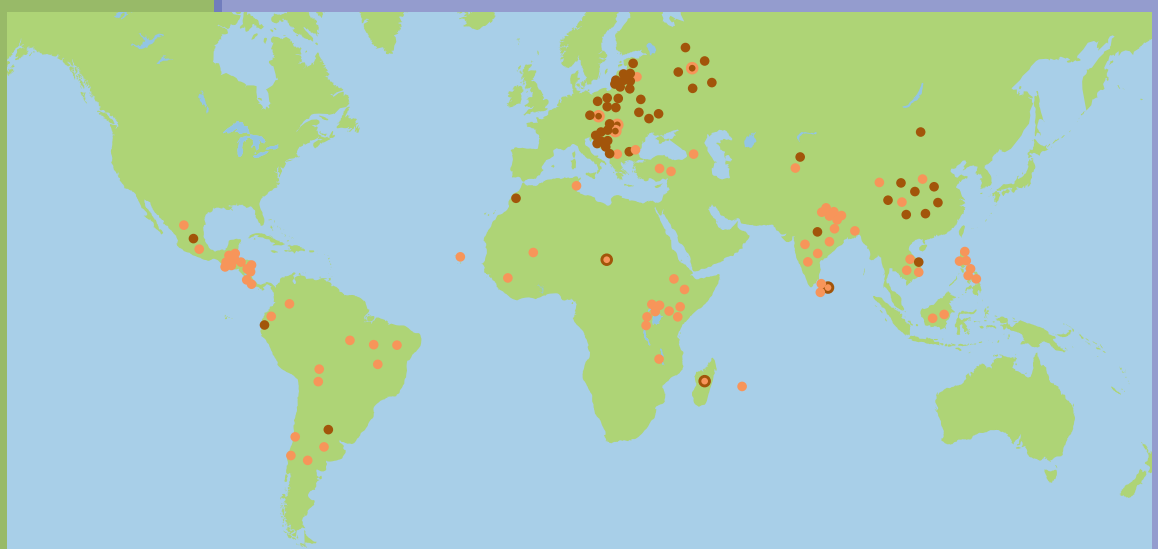
- The World Bank Group will develop and promote new commercial financing instruments that are better suited to the needs of sustainable energy investments, including leveraging financing from local capital markets, adopting risk-mitigation and credit-enhancement products, and offering capacity building support to promote private sector investment in sustainable energy.

- The World Bank Group will use the complementary expertise of the World Bank in policy and sector reform and finance, the IFC in private sector engagement and financing, and MIGA in risk mitigation to support increased investments in renewable energy and energy efficiency. Developing a renewed partnership with the GEF, as well as with other development partners for scaling up sustainable energy investments, will be critically important.

The World Bank Group expects to maximize the potential for sustainable energy solutions as an important ingredient in development.

By mobilizing its experience and financing and working cooperatively with a wide range of donors, private sector players, and investors, and by responding directly to the energy needs and opportunities in all its client countries, the World Bank Group expects to maximize the potential for sustainable energy solutions as an important ingredient in development.

WHERE ARE THE WORLD BANK GROUP PROJECTS?



The NASA satellite image of the world at night illustrates through its light patterns where electricity is available. Large parts of Africa, Asia, and Latin America remain in darkness. The map underneath indicates where World Bank Group projects in renewable energy (orange dots) and energy efficiency (brown dots) have been located since 1990. A large number of the renewable energy projects — many with lighting components — were located in the parts that appear dark on the NASA map.

ANNEX

WORLD BANK GROUP RENEWABLE ENERGY AND ENERGY EFFICIENCY PROJECTS SINCE 1990

Country	Approved in fiscal year	Financing	Project name	Energy type
SOUTH ASIA REGION				
Bangladesh	2002	IDA/GEF	Rural Electrification Renewable Energy Development	Solar PV
India	1993	IBRD/IDA/GEF	Renewable Resources Development	Wind, Solar PV, Hydro
India	1998	IFC	Asian Electronics (ESCO)	Efficiency
India	2000	IBRD/IDA/GEF	Renewable Energy II	Hydro, Efficiency
India	2001	IBRD/GEF	Rajasthan Power I	Solar Thermal, Efficiency
India	2002	IDA	Uttar Pradesh Water Sector Restructuring	Hydro
India	2003	IFC	Balrampur Chini Mills	Biomass/Biogas
Nepal	1993	IDA	Sunsari Morang Headworks	Hydro
Nepal	1996	IFC	Khimti Khola	Hydro
Nepal	1996	MIGA	Himal Power Limited	Hydro
Nepal	1998	IFC	Bhote Koshi	Hydro
Nepal	1998	IDA	Irrigation Sector Development	Hydro
Nepal	2003	IDA	Power Development	Hydro
Sri Lanka	1992	IDA	Power Distribution	Hydro
Sri Lanka	1997	IDA/GEF	Energy Services Delivery	Wind, Solar PV, Hydro, Efficiency
Sri Lanka	2002	IDA/GEF	Renewable Energy for Rural Economic Development	Wind, Solar PV, Biomass/Biogas, Hydro, Efficiency
MIDDLE EAST AND NORTH AFRICA REGION				
Morocco	1995	WB/GEF	Repowering Existing Power Plant	Efficiency
Tunisia	1995	WB/GEF	Solar Water Heating	Solar thermal
LATIN AMERICA AND CARIBBEAN REGION				
Argentina	1996	MIGA	New World Power	Hydro
Argentina	1999	IBRD/GEF	Renewable Energy in Renewable Markets	Solar PV
Argentina	1999	IFC/GEF	Argentina Efficient Street Lighting Program	Efficiency
Belize	1993	IFC	Becol	Hydro
Bolivia	1998	MIGA	Cobee	Hydro
Bolivia	2003	IDA	Decentralized Infrastructure for Rural Transformation	Solar PV
Brazil	1997	MIGA	Rio Light	Hydro
Brazil	1997	MIGA	Serra De Mesa	Hydro
Brazil	1998	IFC	Guilman Amorim	Hydro
Brazil	2003	CFB	PCF Minas Gerais Plantar	Biomass/Biogas
Chile	1992	IFC	Aconcagua	Hydro
Chile	1994	IFC	Panque	Hydro
Colombia	2003	CFB	Jepirachi Carbon Off Set	Wind
Costa Rica	1994	IFC	Hidrozarcas	Hydro
Costa Rica	1998	MIGA	Dona Julia	Hydro
Ecuador	2001	MIGA	San Francisco	Hydro
Ecuador	2002	IBRD/IDA/GEF	Power and Communications Sectors Modernization and Rural Services (PROMEC)	Efficiency

Country	Approved in fiscal year	Financing	Project name	Energy type
Guatemala	1992	IFC	Orzunil	Geothermal
Guatemala	1995	IFC	Fabrigas	Hydro
Guatemala	1997	IFC	Pantaleon	Biomass/Biogas
Guatemala	1999	MIGA	Orzunil I de Electricidad Limitada	Geothermal
Guatemala	2003	IFC	El Canada	Hydro
Honduras	1993	IDA	Morazan Dam Emergency	Hydro
Mexico	1994	WB/GEF	High Efficiency Lighting	Efficiency
Mexico	2000	WB/GEF	Renewable Energy for Agriculture	Wind, Solar PV
Mexico	2001	WB/GEF	Methane Gas Capture and Use at a Landfill	Biomass/Biogas
Nicaragua	2000	MIGA	Ormat Momotombo Power Company	Geothermal
Nicaragua	2001	WB/GEF	Renewable Energy and Forest Conservation	Solar thermal
Nicaragua	2003	IDA/GEF	Offgrid Rural Electrification	Solar PV, Hydro
EUROPE AND CENTRAL ASIA REGION				
Belarus	2001	IBRD/IDA	Social Infrastructure Retrofitting	Efficiency
Bosnia and Herzegovina	1996	Special financing	Emergency District Heating Rehabilitation	Efficiency
Bosnia and Herzegovina	1998	IBRD/IDA	Emergency Natural Gas System Reconstruction	Efficiency
Bosnia and Herzegovina	1999	IBRD/IDA	Local Development Pilot	Efficiency
Bulgaria	2003	IBRD	District Heating	Efficiency
Bulgaria	2004	CFB	Wood Residue to Energy	Biomass/Biogas
Croatia	2004	IBRD/GEF	Energy Efficiency	Efficiency
Czech Republic	1999	WB/GEF	Kyjov Waste Heat Utilization	Efficiency
Czech Republic	2004	CFB	PCF Umbrella	Wind, Biomass/Biogas, Hydro, Efficiency
Estonia	1994	IBRD	District Heat Rehabilitation	Efficiency
Georgia	1995	IDA	Municipal Infrastructure Rehabilitation	Efficiency
Hungary	1994	IBRD	Energy Environment	Efficiency
Hungary	1997	IFC/GEF	Hungary Energy Efficiency Co-Financing (HEECP & HEECP2)	Efficiency
Hungary	2002	IFC	Hungary Energy Efficiency Co-Financing (HEECP2)	Efficiency
Hungary	2003	WB/GEF	Small Hydro	Hydro, Efficiency
Hungary	2004	CFB	Pannonpower Biomass	Biomass/Biogas, Efficiency
Kyrgyz Republic	1996	IDA	Power and District Heating Rehabilitation	Efficiency
Kyrgyz Republic	1998	IDA	Power and District Heating Supplemental	Efficiency
Latvia	1995	IBRD	Jelgava District Heating Rehabilitation	Efficiency
Latvia	1998	IBRD/GEF	Solid Waste Management	Biomass/Biogas
Latvia	2001	IBRD	Riga District Heating	Efficiency
Lithuania	1996	IBRD/GEF	Klaipeda Geothermal	Efficiency
Lithuania	1997	IBRD	Energy Efficiency/Housing Pilot	Efficiency
Lithuania	1999	IBRD	Municipal Development	Efficiency
Lithuania	2002	IBRD	Vilnius District Heating	Efficiency
Lithuania	2002	IBRD	Education Improvement	Efficiency
Lithuania	2003	WB/GEF	Vilnius Heat Demand Management	Efficiency
Macedonia, FYR	2000	WB/GEF	Mini-Hydropower	Hydro
Poland	1991	IBRD	Heat Supply Restructuring & Conservation	Efficiency
Poland	1995	IFC/GEF	Poland Efficient Lighting (PELP)*	Efficiency

Country	Approved in fiscal year	Financing	Project name	Energy type
Poland	1995	IBRD/GEF	Coal to Gas Conversion	Efficiency
Poland	1998	IBRD	Flood Emergency	Efficiency
Poland	2000	IBRD/GEF	Podhale Geothermal District Heating and Environment	Efficiency
Poland	2001	IBRD	Krakow Energy Efficiency	Efficiency
Russian Federation	1995	IBRD	Energy Efficiency	Efficiency
Russian Federation	1996	IBRD	Enterprise Housing Divestiture	Efficiency
Russian Federation	1997	IBRD	St. Petersburg Center City Rehabilitation	Efficiency
Russian Federation	2001	IBRD	Municipal Heating	Efficiency
Russian Federation	2004	IFC/GEF	Financing Energy Efficiency	Efficiency
Russian Federation	2004	IFC/GEF	Developing the Legal and the Regulatory Framework for Wind Power	Wind, Efficiency
Serbia and Montenegro	2004	IDA	Energy Efficiency	Efficiency
Slovenia	1996	IBRD	Environment	Efficiency
Tajikistan	FY 03	IFC	Pamir	Hydro
Turkey	FY 91	IFC	Kepez Electrik	Hydro
Turkey	2004	IBRD	Renewable Energy	Hydro
Ukraine	1998	IBRD	Kiev District Heating Improvement	Efficiency
Ukraine	2000	IBRD	Kiev Public Buildings Energy Efficiency	Efficiency
Ukraine	2001	IBRD	Sevastapol Heat Supply Improvement	Efficiency

EAST ASIA AND THE PACIFIC REGION

Cambodia	2004	IDA/GEF	Renewable Energy Development	Solar, Hydro
China	1992	IBRD/IDA	Beijing Environmental	Efficiency
China	1995	IBRD/IDA	Yangtze Basin Water Resources	Hydro
China	1995	IBRD	Liaoning Environment	Efficiency
China	1997	WB/GEF	Efficient Industrial Boilers	Efficiency
China	1998	IBRD/GEF	Energy Conservation	Efficiency
China	1998	IBRD	Shandong Environment	Efficiency
China	1999	IBRD/GEF	Renewable Energy Development	Wind, Solar PV
China	2000	IBRD/GEF	Beijing Environment II	Efficiency
China	2003	WB/GEF	Energy Conservation, Phase II	Efficiency
China	2004	IBRD	Fourth Inland Waterways	Hydro
Indonesia	1997	IBRD/GEF	Renewable Energy Small Power	Biomass/Biogas, Hydro
Indonesia	1997	IBRD/GEF	Solar Home Systems	Solar PV
Lao PDR	1998	IDA	Southern Provinces Rural Electrification	Solar PV
Mongolia	2001	WB/GEF	Stove Improvement	Efficiency
Philippines	FY90	IBRD	Energy Sector Loan	Geothermal
Philippines	1994	IBRD/GEF	Leyte Luzon Geothermal - PNOC - NPC	Geothermal
Philippines	1994	IBRD	Leyte Cebu Geothermal- PNOC - NPC	Geothermal
Philippines	1995	MIGA	Magma Leyte	Geothermal
Philippines	2003	IFC/GEF	CEPALCO Solar Photovoltaic Demonstration	Solar PV
Philippines	2004	IBRD/GEF	PH-Rural Power Project	Solar PV, Hydro
Vietnam	2002	IDA/GEF	System Efficiency Improvement, Equitization & Renewables	Hydro
Vietnam	2003	WB/GEF	Demand-Side Management & Energy Efficiency	Efficiency

Country	Approved in fiscal year	Financing	Project name	Energy type
AFRICA REGION				
Burkina Faso	1998	Activity Implemented Jointly	Sustainable Energy Management	Biomass, Solar PV
Burundi	1991	IDA	Energy Sector Rehabilitation	Biomass/Biogas, Hydro
Cape Verde	1999	IDA/GEF	Energy/Water Sector Reform	Wind, Solar PV
Chad	1998	IDA	Household Energy	Biomass/Biogas, Efficiency
Ethiopia	1998	IDA	Energy II	Biomass/Biogas, Hydro
Ethiopia	2003	IDA	Energy Access	Solar PV, Biomass/Biogas
Guinea	2003	IDA/GEF	Decentralized Rural Electrification	Solar PV, Hydro
Kenya	1997	IDA	Energy Sector Reform	Geothermal
Kenya	2000	MIGA	Olkaria III Phase 1	Geothermal
Kenya	2002	MIGA	Olkaria III Phase 2	Geothermal
Madagascar	1996	IDA	Energy Sector Development	Biomass/Biogas, Hydro, Efficiency
Malawi	1992	IDA	Power V	Hydro
Mali	2004	IDA/GEF	Household Energy	Wind, Solar PV, Biomass/Biogas, Hydro
Mauritius	1992	IBRD/GEF	Susgar Energy Development	Biomass/Biogas, Hydro
Mozambique	2004	IDA/GEF	Energy Reform and Access	Solar PV, Hydro
Rwanda	1993	IDA	Rwanda Energy Sector Rehabilitation	Solar thermal, Hydro
Senegal	1997	IDA/GEF	Sustainable Energy Management	Biomass
Uganda	1991	IDA	Power III	Hydro
Uganda	2000	IDA	Power III Supplemental	Hydro
Uganda	2002	IDA/GEF	Energy/Rural Transformation	Solar PV
GLOBAL/REGIONAL PROJECTS				
Global	1996	IFC/GEF	Small and Medium Scale Enterprise Program (SME1)	Solar PV
Global	1997	IFC/GEF	Renewable Energy & Energy Efficiency Fund (REEF) Part 1	Biomass/Biogas
Global	1997	IFC/GEF	Small and Medium Scale Enterprise Program Replenishment (SME2)	Solar PV
Global	1998	IFC/GEF	Renewable Energy and Energy Efficiency Fund (REEF) Part 2	Geothermal, Wind, Solar PV, Biomass/Biogas, Hydro, Efficiency
Global	1998	IFC/GEF	Photovoltaic Market Transformation Initiative (PVMTI)	Solar PV
Global	1999	IFC/GEF	Efficient Lighting Initiative (ELI) - Tranche I	Efficiency
Global	2001	IFC	Solar Development Group (SDG)/Solar Development Capital (SDC)	Solar PV
Global	2001	IFC/GEF	Efficient Lighting Initiative (ELI) - Tranche II	Efficiency
Global	2001	IFC/GEF	Solar Development Group (SDG)	Solar PV
Global	2003	IFC/GEF	Fuel Cell Financing for Distributed Generation Application - Phase 1 & Phase 2	
ECA	2003	IFC/GEF	Commercializing Energy Efficiency Finance (CEEF)	Efficiency
ECA	2000	IFC	Honeywell ESCO	Efficiency
LAC	1999	IFC	Energia Global International Ltd. (EGI)	Geothermal, Wind, Hydro
LAC	2002	WB/GEF	Environmental Protection and Sustainable Development of the Guarani Aquifer System	Geothermal

Note: WB/GEF refers to stand-alone, GEF-funded projects, executed by the World Bank. Additional IFC investments have supported renewable energy utilization by agribusiness and forest product firms. However, specific data on the renewable energy components of these investments are not available at this time. The listed energy efficiency investments do not include many other types of IFC investments that produce energy efficiency benefits (that is, supply-side efficiency, fossil fuel–based cogeneration, railroad and mass transit projects, and energy efficiency equipment manufacture). Projects always include cofinancing from national and international sources.

ACRONYMS AND ABBREVIATIONS

APTESI	Africa Poverty Targeted Energy Services Initiative
ASTAE	Asia Alternative Energy Program (www.worldbank.org/astae)
CEPALCO	Cagayan Electric Power and Light Company (Philippines) (www.cepalco.com.ph)
CFB	Carbon Finance Business (http://carbonfinance.org/)
EBRD	European Bank for Reconstruction and Development (www.ebrd.org)
ESCO	Energy service company
ESMAP	Energy Sector Management Assistance Programme (UNDP/World Bank) (www.esmap.org)
GEF	Global Environment Facility (www.gefweb.org)
GVEP	Global Village Energy Partnership (www.gvep.org)
IBRD	International Bank for Reconstruction and Development (www.ibrd.org)
ICSID	International Centre for Settlement of Investment Disputes (www.worldbank.org/icsid/)
IDA	International Development Association (www.worldbank.org/ida)
IFC	International Finance Corporation (www.ifc.org)
INCaF	IFC-Netherlands Carbon Facility (http://ifcln1.ifc.org/ifcext/enviro.nsf/Content/INCAF)
***info*Dev**	World Bank Information for Development Program (www.infodev.org)
MDGs	Millennium Development Goals (www.developmentgoals.org)
MIGA	Multilateral Investment Guarantee Agency (www.miga.org)
MW	Megawatt
NGO	Nongovernmental organization
OECD	Organisation for Economic Co-operation and Development (www.oecd.org)
PCF	Prototype Carbon Fund (of the World Bank) (www.prototypecarbonfund.org)
PV	Photovoltaics
PVMTI	Photovoltaic Market Transformation Initiative (IFC) (www.pvmti.com)
SEEDS	Sarvodaya Economic Enterprises Development Services (a Sri Lankan microcredit agency) (www.sarvodaya.org)
SME	Small and medium-size enterprise
TWh	Terawatt-hour
UNDP	United Nations Development Programme (www.undp.org)
UNEP	United Nations Environment Programme (www.unep.org)
UNGASS	United Nations General Assembly (www.in.org/ga/58/)
USAID	U.S. Agency for International Development (www.usaid.gov)
WBI	World Bank Institute (www.wbi.org)

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