Improving Lives:

World Bank Group Progress on Renewable Energy & Energy Efficiency in Fiscal Year 2006

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Acronyms & Abbreviations

AAAs	analytical and advisory activities
AFR	Africa Region
APL	Adaptable Program Loan
ASTAE	Asia Sustainable and Alternative Energy Program
BHP	Bumbuna Hydropower Project (Sierra Leone)
CAS	Country Assistance Strategy
CER	certified emission reduction
CFL	compact fluorescent lamp
CFU	Carbon Finance Unit
CIS	Commonwealth of Independent States
CO_2	carbon dioxide
CRESP	China Renewable Energy Scale-Up Program
EAP	East Asia and Pacific Region
ECA	Europe and Central Asia Region
EDTL	Electricidade de Timor-Leste
EE	energy efficiency
EOF	Environmental Opportunities Facility
ESMAP	Energy Sector Management Assistance Program
ESW	economic and sector work
FAO	Food and Agriculture Organization
FY	fiscal year (July 1 to June 30)
GDP	gross domestic product
GEF	Global Environment Facility
GHG	greenhouse gas
GPOBA	Global Partnership on Output-Based Aid
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit (German Agency for Technical Cooperation)
IBRD	International Bank for Reconstruction and Development
ICSID	International Centre for Settlement of Investment Disputes
IDA	International Development Association
IDCOL	Infrastructure Development Country Limited
IEA	International Energy Agency
ISPs	Improved Stove Programs
KFW	Kreditanstalt für Wiederaufbau (Reconstruction Credit Institute)
KVA	kilo Volt Ampere
LAC	Latin America and the Caribbean Region
Lao PDR	Lao People's Democratic Republic
LEDs	light-emitting diodes
LPG	liquefied petroleum gas
MDGs	Millennium Development Goals
MEM	Ministry of Energy and Mines (Lao PDR)
MGI	Millennium Gelfuel Initiative
MIGA	Multilateral Investment Guarantee Agency
MNA	Middle East and North Africa
MW	megawatt
NGO	nongovernmental organization
OBA	output-based aid
OECD	Organisation for Economic Co-operation and Development
OTP	Hungary Sub Sovereign Schools Project
PELP	Poland Efficient Lighting Project
PROGEDE	Senegal Sustainable and Participatory Energy Management Project
PRSP	Poverty Reduction Strategy Paper
PSPIP	Power Sector Priority Investments Project
PV	photovoltaic
RE	renewable energy
RETs	renewable energy technologies
SAR	South Asia Region
SCDI	Upper Seli Community Development Initiative
SHS	solar home system
SICAJU	Sociedade Industrial de Caju
SPRE	Southern Provinces Rural Electrification Project (Lao PDR)
TA	technical assistance
Tk	Taka
WBG	World Bank Group
WHO	World Health Organization

Foreword

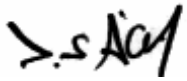
The potential role of renewable energy and energy efficiency in transforming people's lives in the developing world is enormous. Alongside fossil energy sources, renewable energy and energy efficiency can make a significant contribution to help people attain a quality of life that empowers them, among 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 education services.

To foster such potential transformation, the World Bank Group (WBG) has committed more than US$10 billion to renewable energy and energy efficiency in developing countries since 1990. We are building on this experience to support the implementation of the WBG's Renewable Energy and Energy Efficiency Action Plan—including the target of a 20 percent average annual growth in renewable energy and energy efficiency commitments—and the Clean Energy and Development Investment Framework.

Previous reports provided an account of the WBG's achievements toward the renewable energy and energy efficiency target and described the role played by WBG institutions and departments. In this report, we also illustrate how our projects have contributed to transforming people's lives. We discuss how renewable energy and energy efficiency can render people more secure and safe. We demonstrate how we can contribute to improving the standard of living to a level adequate for people's health and well-being. We asked a number of beneficiaries in our partner countries to speak for themselves, and these testimonies are recorded in this report.

This report acknowledges with thanks the dedication and hard work of our partner countries, the development partners of the WBG, and WBG staff who have contributed to scaling up the use of renewable energy and energy efficiency.

Jamal Saghir,
Director



Energy and Water
Chair, Energy and Mining Sector Board
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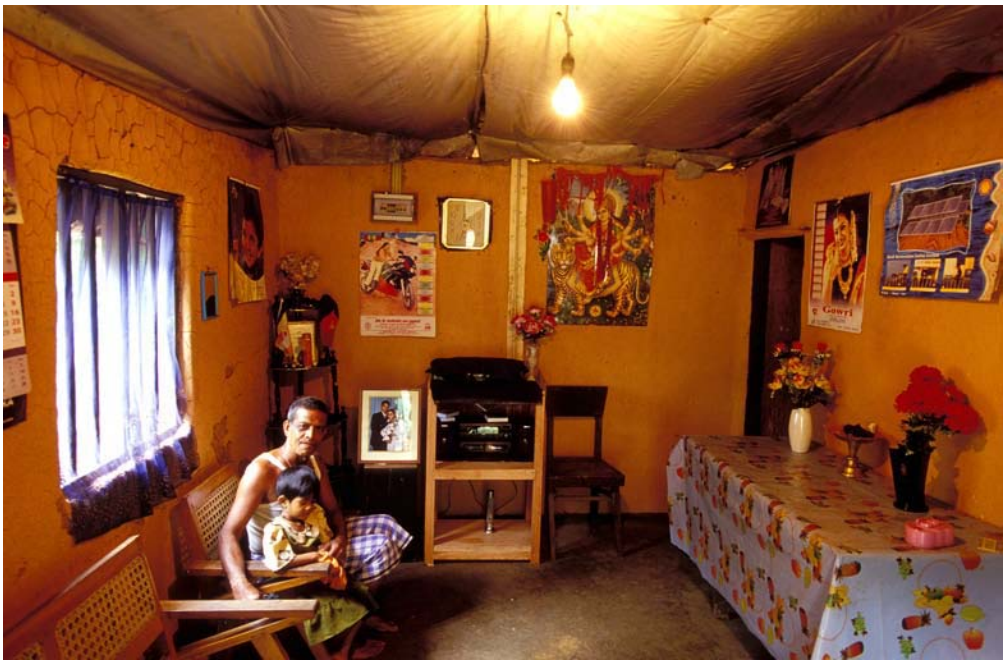
Executive Summary

Meeting the energy needs of developing countries in an environmentally sustainable manner is an urgent challenge. Clean energy underpins sustainable growth and poverty reduction. Indeed, the livelihoods and welfare of poor people in developing countries depend on the availability of energy services. Major improvements in the quality, quantity, and affordability of energy services in developing countries will be necessary to support countries' development objectives of job creation, health, and education. The increase in global oil prices since 2004 has further added to the challenge of ensuring affordable energy services, especially in the poorest countries of Sub-Saharan Africa.



Energy price volatility, supply uncertainties, and environmental concerns are leading many countries to give greater consideration to alternatives such as renewable energy and energy efficiency that can provide affordable energy services and enhance energy security and reliability in an environmentally sustainable manner. Nevertheless, renewable energy resources remain an underused resource in many developing countries, even though commercial maturity and cost competitiveness of renewable energy technologies (RETs) have improved significantly. The energy efficiency potential remains largely untapped in developing countries, though it is often the least costly and fastest way to enhance energy supplies. Recognizing the important role played by renewable energy and energy efficiency in development, the World Bank Group (WBG) has made renewables and energy efficiency an integral part of its energy strategy as it strives to support sustainable economic development in its partner countries.

The WBG committed to scaling up its support for renewable energy and energy efficiency in developing countries at the 2004 International Conference on Renewable Energies in Bonn, Germany. In addition to supporting specific programs and policies, the WBG adopted a target of a 20 percent average annual growth in energy efficiency and new renewable energy commitments between fiscal years 2005 and 2009 (the "Bonn target").[1] The WBG also reaffirmed

World Bank Group Commitments for Renewable Energy and Energy Efficiency in Fiscal Year 2006 (millions of dollars)

Source of Funds	New - RE	Hydro>10MW	EE	Total
World Bank (IBRD/IDA)	135.7	118.6	115.3	369.5
World Bank (GEF and Carbon Finance)	54.7	6.0	1.2	62.0
IFC (Own Funds)	17.4	67.0	309.0	393.4
IFC (GEF, Carbon Finance and other trust funds*)	13.0	0.0	20.1	33.1
MIGA	0.0	0.0	1.8	1.8
Total	220.8	191.6	447.4	859.8

*The IFC's "other trust funds" category includes the Environmental Opportunities Facility (EOF).

its support to larger-scale hydropower where it is economic, financially viable, and where environmental and social safeguards are met. The WBG provides investment support, policy advice, technical assistance, capacity-building and analytical services, cofinancing support from the Global Environment Facility (GEF) and Carbon Finance Operations, and mobilizes other funding that complements WBG support.

For the second year in a row, the WBG has outperformed its Bonn target. In fiscal year 2006, the WBG's financial support for renewable energy and energy efficiency was US$860 million. Commitments for new renewable energy and energy efficiency were US$668 million, more than double the Bonn 20 percent target. This represents a 45 percent increase over the amount of commitments made by the WBG to new renewable energy and energy efficiency in fiscal year 2005. Total WBG renewable energy and energy efficiency financing in fiscal year 2006 supported 61 projects in 34 different countries. These increases suggest that the concerted efforts of the WBG to scale up support for new renewable energy and energy efficiency are having a positive impact. The table above gives a detailed overview of commitments.

The use of renewable energy and energy efficiency in these projects has contributed to improving livelihoods in the developing world in line with the WBG's mission of working for a world free of poverty. As illustrated by fiscal year 2006 WBG projects, renewable energy and energy efficiency can play key roles in enhancing energy security for livelihoods, energy for lighting, and people's access to food.

The energy security of countries can be enhanced in many ways with the help of renewable energy and energy efficiency, including by diversifying fuels used and the sources from which they come, enhancing availability by increasing supply- and demand-side energy efficiency, reducing energy infrastructure vulnerability through the use of distributed energy, and promoting good governance and equitable energy sector rent distribution to reduce political and social divisions. Among the fiscal year 2006 projects that contributed to meeting these goals is the second phase of the China Renewable Energy Scale-Up Program (CRESP). This project supports the implementation of a renewable energy law and contributes to achieving the country's goal of increasing the share of renewable energy to 15 percent of total power supply by 2020.

Access to modern energy is considered a prime contributor to overcoming poverty, delivering good education and health services, creating enterprises, and generating employment and incomes. Among the various energy end uses, meeting lighting needs affordably and reliably is often the underlying key to economic development and crucial to meeting the Millennium Development Goals (MDGs). For example, the Power Sector Priority Investments Project (PSPIP) in Timor-Leste has distributed more than 27,000 compact fluorescent lamps (CFLs) free of charge to electricity consumers who have acquired prepayment meters as a means to reduce peak loads, improve energy efficiency, and reduce costs.

As 95 percent of staple foods need to be cooked to be digested, securing an affordable supply of energy for cooking is crucial. This applies especially in Africa, where roughly two-thirds of households, more than 580 million people, depend on woodfuels for their daily cooking and heating needs. To make biomass use sustainable, a comprehensive supply- and demand-side approach is needed. The Senegal Sustainable and Participatory Energy Management Project (PROGEDE), a World Bank–sponsored project, was able to establish a permanent, community-based forest management system capable of producing more than 370,600 tons of woodfuel per year on a sustainable basis for the urban household energy markets and reduce woodfuel-related deforestation by some 39,500 hectares per year. It also helped generate more than US$20 million in direct revenues to the participating villages. Ongoing development of renewable energy technologies (RETs) such as solar cookers and biofuels for cooking can also greatly contribute to improving living standards and people's health.

The WBG will continue to expand its support for renewable energy and energy efficiency in the coming years. Priority attention will include integrating support for alternative energy development with initiatives to increase energy access in Sub-Saharan Africa, and improving energy efficiency in the fastest-growing and largest energy-consuming developing countries. The WBG will continue to assist its partner countries in integrating renewable energy and energy efficiency into their development strategies, supporting renewable energy and energy efficiency investment projects, building capacity, and improving its partner countries' policy environment.

[1]New renewable energy comprises energy from biomass, solar, wind, and geothermal energy as well as hydropower with capacities up to 10 megawatts (MW) per facility.

1. Introduction

In a small village in the Lao People's Democratic Republic (Lao PDR), a woman sews at night using light from a solar home system (SHS). Across the globe, women and children in Bolivia are safer because of street lighting and the use of solar-powered lighting in public buildings. Moving eastward, we encounter Serbian school children enjoying warm classrooms due to improved district heating and, as we continue our journey, we hear about the cash savings of Timor-Leste energy users who have obtained compact fluorescent lamps (CFLs). Each snapshot is a real life example of how renewable energy and energy efficiency can have a tangible impact on the welfare of people in developing and transition countries.

Improving access to modern energy sources such as renewables and enhancing the efficiency with which energy is used can have many positive impacts on household income, health, education and security. It **contributes directly to achieving the Millennium Development Goals (MDGs)** of reducing poverty and hunger, improving education and health, and ensuring environmental sustainability.

Although it is evident that energy access can improve livelihoods, extending access is not an easy task. Energy poverty is widespread in developing countries, where more than 1.6 billion people lack electricity, primarily in Asia and Sub-Saharan Africa. There is a dire need for basic energy infrastructure and efficiency improvements in existing installations. The lack of capacity, resulting from insufficient energy infrastructure or as a result of inefficient energy supply, means that developing countries are unable to meet their basic energy demands. The International Energy Agency (IEA) estimates under its reference scenario that developing countries need an annual investment for the electricity sector alone of US$ 300 billion.[2] Under the Clean Energy and Development Investment Framework,[3] it is estimated, however, that without significant policy changes, major financing shortfalls will occur.

Energy efficiency improvements, on both the supply and the demand side, commonly represent the least-cost option for freeing up generation capacity and reducing the volume of incremental investment needs. Although energy efficiency enhancement is a "quick win" strategy, it cannot solve energy poverty by itself. In rural areas, where four out of five people lack electricity, conventional grid-connected electricity schemes are often not feasible. Because of the high costs of extending electricity coverage to these areas, renewable energy technologies (RETs) may be the least-cost solution. Technologies such as SHSs, run-of-river and small hydropower systems, and biogas plants may be more attractive options for rural energy supply.

In these areas, traditional biomass such as woodfuels and crop or animal residues remain the main energy source for cooking and heating. The 2.4 billion people in developing countries who rely on these fuels use much of their labor to gather woodfuel and are exposed daily to indoor air pollution. The World Health Organization (WHO) estimates that the pollution caused by using indoor biomass cook stoves is responsible for 1.6 million deaths per year—mostly of young children and mothers. Modern usage of biomass through comprehensive demand-side and supply-side management and improvement of practices and technologies used (such as improved cook stoves or cleaner biogas) is needed to reduce pollution, improve people's health, and improve their economic welfare.

Renewable energy use is not limited solely to off-grid applications. The use of renewable energy sources is particularly attractive in light of today's volatile and high oil prices and concerns about global climate change. Both energy efficiency improvements and the adoption of renewable energy have the threefold effect of: moderating upward pressure on energy prices; improving energy security through greater diversity in supply options; and decreasing the negative environmental impact associated with energy supply.[4]

These social, economic, and environmental implications underpin the WBG rationale for supporting renewable energy and energy efficiency. Over the past 15 years, the WBG has been assisting partner countries in integrating renewable energy and energy efficiency into their national energy strategies. This has included identifying and exploiting opportunities to improve the use of renewable energy and efficiency of energy use, production, and distribution. In doing so, the WBG makes flexible and innovative use of its wide range of assistance instruments—policy advice, technical assistance, investment and adjustment lending, and guarantees.

In June 2004, at the Bonn International Conference on Renewable Energies, the WBG committed to scaling up its renewable energy and energy efficiency financial assistance by an average of 20 percent per year over five years (fiscal years 2005–09) and to reporting on its annual performance in supporting renewable energy and energy efficiency (the Bonn target). Furthermore, in September 2005, the WBG began developing a Clean Energy and Development Investment Framework, which supports accelerating investment in energy efficiency and renewable energy.

This report examines the development outcomes and the positive changes that can be made in peoples' lives through effective use of renewable energy and energy efficiency technologies. The previous two annual progress reports informed readers of the specifics of each WBG institution's support for renewable energy and energy efficiency; this report highlights the human impact of these commitments. It draws real lessons of experience from projects that the WBG supports, and discusses how the use of renewable energy and energy efficiency has contributed to improving lives. To this end, the report discusses three areas of application of renewable energy and energy efficiency that are at the core of people's well-being: energy security, energy for lighting, and energy for food. Throughout the report, case studies describe how renewable energy and energy efficiency projects have changed people's lives. The final chapter describes the road ahead for the WBG's renewable energy and energy efficiency work.

[2] International Energy Agency (IEA). 2004. "World Energy Outlook 2004." Organisation for Economic Co-operation and Development (OECD), IEA, Paris.
[3] World Bank. 2006. "Clean Energy and Development: Towards an Investment Framework." Washington, DC.
[4] World Bank. 2006. "An Investment Framework for Clean Energy and Development: A Progress Report." Washington, DC.

Case One
The ABCs of Energy Efficiency in Serbia

In the Serbian village of Conoplja, the pupils at Mika Antic elementary school have one more reason to look forward to attending classes this winter. With the newly refurbished windows and proper insulation, the children can learn without having to wear heavy coats indoors. This is a big accomplishment in a village like Conoplja, where winters can last up to five months and improper insulation makes it difficult to retain the heat in rooms.

"Our problem is inadequate insulation -- that is, we cannot contain the heat. Even when the radiators are hot, we heat the air around the school. More than half the budget is spent on heating."

- Mr. Goran Dukic, school manager in Arlije, a small town in southwestern Serbia

With the support of the World Bank, bilateral donors, and the European Union, the Serbian Ministries of Health and Environment developed the Serbia Energy Efficiency project to improve heating efficiency in buildings, make heating more affordable, and reduce the local and global environmental impact of the use of dirty fuels for heating buildings in Serbia. In only its first phase of implementation, the project has already shown remarkable results.

The first phase of implementation in retrofitting public buildings for six schools and four hospitals has been completed. Energy savings from the retrofitted buildings have resulted in a significant reduction in energy consumption, with savings of up to 69 percent in some cases and the lowest at 33 percent. Overall, savings averaged 46 percent.

Energy savings in Backa Palanka economic high school, for example, were as high as 40 percent. When the municipal authorities who pay the local school energy bills realized how much was saved, they decided to finance refurbishing of other schools in their small town. The municipality then invested a part of the savings in refurbishing Backa Palanka further.

Under the Serbian energy efficiency program, 76 buildings at the clinical center in Belgrade—spread over 38 hectares from 19 separate boiler plants using lignite and heavy oil—will be improved by replacing the boilers with a gas-fired plant. These buildings include hospitals, specialized clinics, faculties and research institutes, as

well as administration, service, and storage buildings. The second component is the retrofitting of 60 to 70 public buildings—schools and hospitals-throughout Serbia and the heating systems that supply them.

This would not have been possible without broad government support and local buy-in from public officials and communities. Community involvement resulted in substantial progress in how the public perceived the importance of energy efficiency and its impact on health and cost savings, not just for the social service sector but also at the household level.

When Dara Ninkovic, a teacher at Mika Antic, heard about the energy savings, she decided to take action in her own home.

"It was expensive for my family—we had to get a loan, but we changed the windows in one part of our house." Ninkovic said. "It has been already paid back since we reduced the amount of the wood we burn each year from 11 to 8 cubic meters. As soon as I can afford it, I'll change all the windows."

"In the school year 2004-05 our energy bill was 1.1 million dinars. This past school year – 2005-06 – our energy bill was just 750,000 dinars. I was quite amazed to see the impact of this project."
- Mr. Vladimir Uzelac, school director for Conoplja

2. Making Lives More Secure

It is evident that the country in which people are born will crucially affect the possibilities that life will afford them. **Among the key elements that shape people's opportunities in different countries is the availability of energy.** This is reflected in a strong statistical correlation between people's energy consumption and their income.[5] The reason for this relationship is the reliance of most economic activity on the availability of energy.

Energy security in a country is reached when the energy available is sufficient and affordable so that no constraints are imposed on people's lives and the economic activities they engage in. Even in developed countries, energy shortages occur. They commonly lead to price increases and thus affect the disposable income of each individual. However, while these types of energy shortages only temporarily affect the availability of energy in developed countries, in developing countries, energy shortages can lead to regular power shortages, with serious consequences for economic development.

Over the past 10 years, many countries—both developing and developed—have been subjected to energy crises with serious consequences for their economies. The origins were diverse, but the reasons for these crises were that the underlying energy systems were not sufficiently resilient to provide the required power as external circumstances changed. In Chile, droughts and depletion of hydropower reservoirs led to serious brownouts and blackouts between 1988 and 1999. Since 2002, the Dominican Republic has been subject to haphazard outages, mainly affecting the poor, which are due to a financially unsustainable sector with no resources to buy fuel. In Uganda, drought since 2005 has brought about an energy crisis where about 40 percent of the demand is curtailed.[6] Although some countries have temporary energy crises, caused by external events, other countries find themselves in permanent crisis. In many countries in Sub-Saharan Africa, the curtailment of power is simply part of life, and in Liberia, civil war resulted in the country having no operational energy system until mid-June 2006, when a small system was set up that is barely sufficient to provide electricity for governmental offices.

When energy crises happen, they affect the poor the most. Industry is able to purchase additional power by means of power generators, but the ordinary resident may simply sit in the dark. Even when power shortages lead energy utilities to enforce outages, the residents in poorer neighborhoods are often subject to extended outages. When the outages are scheduled and publicized, they lead to a change of people's habits and lives, and the day becomes centered around those few hours when electricity is available. Business hours might be shifted well into the night, when electricity is available.

For example, in the Republic of Guinea, welders will work between midnight and early morning, because electricity is guaranteed only then. But even those parts of industry that are able to purchase and operate generators incur much higher costs than when they buy electricity through the grid. This in turn renders operations of such businesses less competitive than those of other countries and affects the productivity of the economy as a whole.

Rendering the lives of people more stable and

secure is only possible when countries are more independent and less reliant on a single source of energy. Renewable energy and energy efficiency can play key roles in reducing such risks. Renewable energy sources help diversify and decentralize existing energy resources, and energy efficiency can reduce the amount of energy needed for the same activity. The **energy security of countries can be enhanced in many ways**, including by (a) diversifying fuels used and the sources from which they come (see box 1), (b) increasing supply- and demand-side energy efficiency, (c) reducing energy infrastructure vulnerability through the use of distributed energy, and (d) promoting good governance and equitable energy sector rent distribution to reduce political and social divisions.[7]

Box 1: Valuing Diversity in Mexico's Power System

One of the major obstacles to renewable energy becoming economically competitive in its own right is the way in which its addition to the system is valued. An interesting approach to valuing the contribution of renewable energy was to apply the capital asset pricing model to power systems planning. This approach is normally used by financial investors to make investment decisions in the face of uncertain outcomes and risk to ascertain the value of a basket of diverse assets as a way of maximizing the risk-return combination of an investment portfolio. Investors would not conceive of investing all their money in one stock based on a 30-year forecast, yet this is exactly how the least-cost power system planning is currently interpreted. By applying portfolio theory to electric generation planning, Antonius and others showed that the widespread belief that adding renewable-based capacity will cost more is not necessarily true. Because renewables have high up-front costs, but few or no ongoing input costs, by including a larger percentage of renewables in the production portfolio, utilities can reduce their exposure to commodity price–derived risk. The study showed that for most countries' utilities, and certainly in the case of Mexico, a greater proportion of renewable energy could result in a production portfolio with a much more favorable risk-return ratio.

Source: Antonius, Andrés, Shimon Awerbuch, Martin Berger, Donald Hertzmark, Jorge M. Huacuz V., and Gustavo Merino. 2006. "Technical Assistance for Long-Term Program of Renewable Energy Development." ESMAP Technical Paper 093, World Bank, Washington, DC.

China is one of the WBG's partner countries that is heavily reliant on a single source of energy: domestic coal. To counter this imbalance, China has set out a comprehensive plan to **diversify its energy sources** with the aim of enhancing its energy security, including using renewable energy. The WBG and Global Environment Facility (GEF)–supported China Renewable Energy Scale-Up Program (CRESP) assisted in this effort and has supported projects as diverse as a green electricity market in Shanghai, a wind farm improvement program, and assistance in drafting regulations and building capacity for implementing a renewable energy law and investments in wind, hydropower rehabilitation, and biomass cogeneration. In fiscal year 2006, the second phase of CRESP was approved by the World Bank's Board in the amount of US$86 million to support China's commitment to increase the share of renewables in power supply to 15 percent by 2020 from 7 percent in 2005.

Europe and Central Asia (ECA) is another region of the world focusing on enhancing energy security by **improving supply- and demand-side energy efficiency**. Many countries in Central and Eastern Europe and among the Commonwealth of Independent States (CIS), as former central planning economies, have inherited economic structures that are inefficient and often use nearly obsolete manufacturing technologies in heavy industries. This in turn is reflected in the high energy intensities of these countries, which suggest a great potential for energy efficiency measures. Countries in this region have wholeheartedly accepted this challenge as an opportunity to implement new legislative, regulatory, and economic instruments to achieve reform; adopt innovative commercial practices; and use cutting-edge technologies. Large strides have been made since the fall of the Berlin Wall in 1989, and there is still a large potential to be tapped.

This is reflected in fiscal year 2006's new approval of energy efficiency projects by the WBG, 65 percent of which have been approved for this region. Among the projects are district heating, residential and commercial demand-side management, energy supply, and industrial and transport energy efficiency projects in countries such as Armenia, Belarus, Croatia, Hungary, Moldova, Romania, the Russian Federation, Serbia and Montenegro, Turkey, and

Public meeting in Kafog, Sierra Leone (Case 8): Dialogue is among the first steps toward equitable energy use.

Ukraine. How these projects affect people's lives is illustrated in case 1.

Centralized energy infrastructure efficiently exploits economies of scale in construction and operation, and when adequately designed and maintained, it has compiled an enviable record of technical reliability and environmental compliance. However, large-scale centralized facilities are also perceived to be vulnerable to large-scale catastrophe and loss. **Distributed energy resources** provide inherent security advantages through their modularity and geographic diversity. The effect is similar to that of replacing mainframe computers with personal computers linked by the Internet.

The most modular energy technology is possibly the solar cell. It can be sized to exactly fit a specific purpose or task from a calculator to a power plant of several megawatts (MW). In developing countries, SHSs and solar lanterns often present the least-cost option for providing electricity to rural households far from the electric grid. A particularly successful project that has targeted remote households is the Bangladesh Rural Electrification and Renewable Energy Development project, supported by the World Bank and the GEF, which is connecting rural households at an unprecedented rate—more than 3,000 households every month in a country where only 30 percent of households are electrified. Case 4 illustrates exactly how this project has benefited the rural poor. A fiscal year 2006 project in Bolivia, which illustrates how decentralized power can aid rural communities get electricity supply through solar power for both residential and commercial applications, is detailed in case 2.

Renewable energy and energy efficiency can also be used as tools for **promoting good governance and equitable energy sector rent distribution**. These are key factors for safeguarding energy security. Mismanagement of energy resources and their uses is a contributor to impoverishment and inequity that breeds unrest and violence and ultimately threatens sustainable energy delivery. This vicious circle takes many forms: draining of government resources for health, education, and welfare that go instead to subsidizing inefficient power utilities; capture of benefits by urban elites at the expense of energy-poor rural or periurban populations; and dissipation of energy-generated rents through corruption and diversion for private gains.

Projects that explicitly target the rural poor can counteract these effects. A new project for Guinea-Bissau, which is also part of the fiscal year 2006 portfolio, includes key renewable energy features that aim to help the country recover from civil conflict. Case 5 gives an overview of the project. Projects that focus on improving the use of traditional energy resources, such as firewood and charcoal, by rendering production and marketing more efficient and by establishing more (environmentally) sustainable practices have also shown themselves to be effective in contributing to the promotion of equity. An example is the ongoing World Bank–sponsored Sustainable and Participatory Energy Management Project (PROGEDE) in southern Senegal, which combines sustainable forestry management practices with more efficient wood fuel production and local economic and social development (see chapter 4).

[5] Feinstein, Charles. 2002. "Economic Development, Climate Change, and Energy Security—the World Bank's Strategic Perspective." Energy and Mining Sector Board Discussion Paper 3. World Bank, Washington, DC.

[6] The developed world has also been subject to serious power shortages. Examples are California (2001–02) and Japan (2003).

[7] These are mainly long-term responses. An overview of short- and medium-run policy responses for overcoming energy price shocks has been presented by Robert Bacon and Masami Kojima (2006) in "How Are Developing Countries Coping with Higher Oil Prices?" ESMAP Knowledge Exchange 6, World Bank, Washington, DC.

Case Two

Solar PV—Moving Toward Universal Access in Bolivia

The majority of rural communities in Bolivia (more than 70 percent) do not have access to electricity and basic communication services and hence suffer from considerable isolation. Many of the schools, clinics, and public service centers are not electrified. Lack of access to modern energy and communication services is one of the major constraints to rural productivity: farmers and microbusinesses have to rely on traditional methods of production with no access to information on market prices and capacity-building and knowledge-sharing tools.

These nonelectrified rural households and businesses in Bolivia are the most difficult to electrify because of a combination of low demand, limited affordability, and high connection costs associated with remoteness and dispersion. Their electrification requires innovative off-grid solutions, such as solar photovoltaic (PV) technologies, that will be able to match the varying demand profiles in a flexible and cost-effective manner.

The Government of Bolivia recognizes the importance of rural electrification in its effort to reduce poverty and redress imbalances in development, and it has called for accelerated rural electrification investments. The Decentralized Infrastructure for Rural Transformation Program is a World Bank-funded project in Bolivia aimed at increasing rural access to electricity and information and communication technologies using new service provision models based on output-based aid (OBA) mechanisms in 4 of the 13 departments—Potosí, Oruro, Cochabamba, and Santa Cruz. The project uses an innovative combination of medium-term service contracts with OBA-type subsidies to ensure affordability and long-term sustainability of service. In parallel, the project is financing productive applications of electricity in the same target areas to maximize the development impact.

In accordance with OBA principles, payment of the competitively awarded subsidies is linked to well-defined and measurable outputs. Approximately two-thirds of the subsidy will be paid to the private provider for the installation of SHSs, and the remaining one-third of the subsidy will be disbursed for a combination of service, maintenance, user-training, and other well-defined market development outputs to be carried out over four years after system installation.

The private sector welcomed the OBA subsidy tender. Of the 11 prequalified companies and consortia, 8 participated in the bid, resulting in 4 qualified bids. The balanced and transparent subsidy design was largely funded by the Global Partnership on Output-Based Aid (GPOBA).* All 14 service contracts were successfully awarded in December 2005 to two winning bidders: 10 areas to the Spanish company Isofoton and the remaining 4 areas to a consortium led by a local nongovernmental organization (NGO), Energetica.

Overall, the tender was highly successful, and the results are particularly encouraging in a country like Bolivia. The tender resulted in an increase of 25 percent of new users, exceeding the expected target

of 14,245 by 17,791. It also lowered subsidies per user to about two-thirds of that of previous projects.

The official inauguration of the first installed SHS was held in July 2006, and both companies have started installations with combined plans to reach more than 2,000 SHSs by the end of 2006. The Government has acknowledged the potential of this model and is interested in applying this approach in a more structured way within its new Universal Access Program. The GPOBA is planning to finance a second batch of pilots to test the viability of this model in the rest of the country.

*The goal of the GPOBA, a multidonor trust fund administered by the World Bank, is to provide increased access to reliable basic infrastructure and social services for the poor in developing countries through the wider use of OBA approaches.

3. Energy for Lighting

Lighting ranks among the dominant end uses of global power demand. Global electricity consumption for meeting lighting needs totals about US$360 billion per year, roughly 1 percent of the global gross domestic product (GDP). Lighting is one of the energy end-uses often associated exclusively with electricity. Consequently, 19 percent of global electricity generation goes into lighting.[8] At the same time, the lack of access to modern energy services at the global level confronts 1.6 billion people. This results in extensive use of fuel-oil-based lighting, which is expensive and inefficient, produces poor light quality, and contributes to greenhouse gas (GHG) emissions and indoor air pollution. The International Finance Corporation (IFC) estimates that US$38 billion is spent annually, mainly by the poor, on fuel-based lighting.

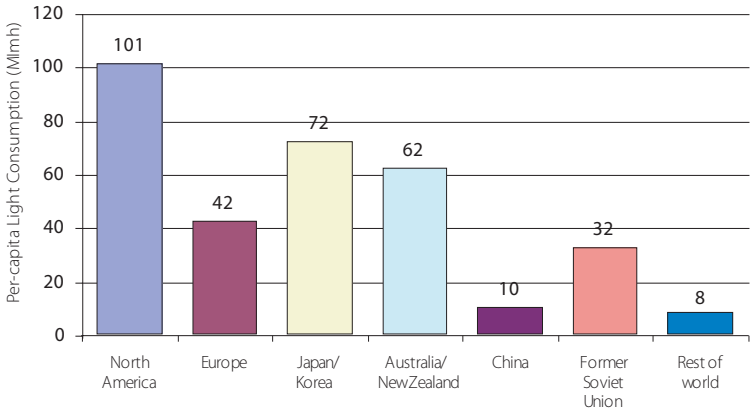
During the past decade, global demand for electric lighting increased at a rate of 1.8 percent in industrialized countries and 3.6 percent in developing countries. While developing countries move toward higher levels of energy consumption, the share of lighting energy use is expected to grow dramatically over the next few decades. This provides an opportunity to change the lives of billions of people who currently do not have access to modern lighting technologies. However, without rapid action, it is projected that the amount of energy used for lighting will be 80 percent higher in 2030 than today, and still unevenly distributed. By 2030, developing countries are expected to account for 60 percent of global lighting electricity demand because of new construction, ongoing electrification, and rising illumination levels.

Access to modern energy is considered a prime mover for overcoming poverty, delivering good education and health services, creating enterprises, and generating employment and incomes. Among the various energy end uses, **meeting lighting needs affordably and reliably is often the underlying key to economic development** and crucial to meeting the MDGs because electric lighting helps people gain additional time for working, 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-fueled light and less hazardous. Better lighting also leads to reduced cooking times and easier cleaning in illuminated rooms. However, among the poorest of the poor, lighting is often the most expensive item among their energy uses.

There is a **significant potential for saving energy** while meeting the growing demand for electricity-based lighting needs of the developing world through better, more efficient technologies.[9] On one hand, much of the electricity production in the developing world is from largely inefficient and carbon-intensive technologies; on the other hand, the lack of access to modern lighting services hinders development in many parts of the world, especially Sub-Saharan Africa. For instance, the estimated per capita consumption of electricity-based light in North America is more than 30 times that of India and 60 times that of Africa (see figure 1).

The potential for lighting energy performance improvements in the developing world is also reflected in the fact that, currently, lighting electricity demand in the 23 developed countries represents more than half of the world's total lighting use. The rest of the world depends on either inefficient lighting technologies or nonelectric, fuel-based lighting solutions.

Figure 1: Estimated Per Capita Consumption of Electric Light in 2005



Source: OECD-IEA. 2006. "Light's Labours Lost—Policies for Energy-Efficient Lighting." Paris.

Although one in three people obtains light from kerosene, paraffin, diesel, and other fuels, representing about 20 percent of global lighting costs and associated carbon dioxide (CO_2) emissions, they receive only 0.2 percent of the resulting lighting services.[10]

Despite these potentially large savings and substantial improvements in average lighting system efficiency, inefficient systems and practice are still commonplace. A global switch to efficient lighting systems would reduce the world's electricity bill by nearly one-tenth. The IEA projects that savings potential from energy-efficient lighting deployed to 2030 will be at least 38 percent of lighting-related electricity consumption even if no major advances in lighting technology take place. As much as 7 percent of power consumption in developing countries can be saved by 2020 by using currently available efficient lighting technology options.

Energy savings in lighting can be achieved with technologies that are not only readily available in the market but also economically competitive during the life cycle of the product. As the cost of efficient lighting technologies—such as CFLs for residential use, high-pressure sodium lamps for street lighting and light-emitting diodes (LEDs) for rural uses and off-grid applications—has been gradually declining, the benefits to both consumers and electric utilities are making the switch to such technologies attractive and economical. In fact, emerging solid-state lighting technologies, such as LEDs, are improving very rapidly and may allow far greater savings over the timeframe to 2050, according to the IEA.

Introduction of efficient lights faces classical barriers of noneconomic pricing of energy and the high up-front costs compared to recurring costs. In addition, there is a lack of awareness of the benefits that these lamps offer in terms of lower running costs, higher-quality light, and lower CO_2 emissions. Often, these information asymmetries are further compounded by the lack of incentives for those actors that decide on the implementation of lighting systems. For example, in the case of apartment or office rental in large buildings, energy bills are paid by renters and decisions concerning lighting systems and fixtures have been made by the building developers who procure the lighting systems.

Experience in many countries, both in WBG-financed projects and through initiatives outside the Bank, has shown that simple lifestyle changes, such as convincing people to switch off lights, commonly require massive educational and awareness-building efforts in developing countries. The impacts are larger when such awareness programs are accompanied by smart systems (motion sensors and so on), but this remains a clear challenge to the adoption of efficient lighting appliances.

There are **many ways to reduce the barriers** to the use of energy-efficient lights. They include technological developments, awareness raising, establishment of technological standards, and market transformation programs in which close collaboration with the private sector is required.

Energy efficiency standards and labels for equipment can encourage the adoption of more efficient technologies. The application of minimum lighting energy performance requirements in building energy conservation codes across the world has also helped the widespread penetration of CFLs and linear fluorescent tube lights.

Market transformation programs have demonstrated short payback periods and high internal rates of return associated with efficient lights. These programs target one or more lighting products through a wide variety of models, such as technology transfer, marketing, subsidies, labeling, codes and standards, manufacture negotiations, financing and bulk procurement or market aggregation, or a combination of models. The lessons of experience from WBG-GEF projects indicate that the use of market mechanisms to promote certain technologies or energy efficiency products is most likely to prove sustainable because it allows market actors to make decisions based on a product's commercial merits. However, where market imperfections exist or the government desires a strong push, well-designed interventions can be very effective. Such programs could be based on a need to improve local manufacturing capabilities as well as enhance competition.

Introduction of **voluntary mechanisms** (labels, standards) before moving to mandatory labels and standards is also generally accepted good practice. Judicious use of subsidies can help stimulate markets and facilitate recruitment of participating manufacturers, but such interventions should be restricted to promotional periods and target market segments, and explicit sunset provisions should be included. Enforcement, when necessary, should be effective and efficient. Well-designed marketing efforts can be critical in bridging the gap between supply and demand.

Success stories of such programs in the past from which these lessons were derived include the US$5 million Poland Efficient Lighting Project (PELP), funded through the GEF and implemented by the IFC, which transformed the market and dramatically increased the availability and selection of CFLs in Poland.[11] The market transformations that occurred in the CFL market in Poland between the beginning and the end of the project were significant. By the end of the PELP initiative, the retail price of CFLs had decreased by 34 percent in real terms relative to 1995. PELP significantly increased the number of Polish households using CFLs. The CFL penetration in Poland increased from 11.5 percent of households before PELP to 33.2 percent one year after the initiative. The penetration of CFLs was then higher than in many other countries, even some of the higher-income countries such as the United Kingdom and the United States.

CFL sales increased in Poland at more than double the rate of the rest of Central and Eastern Europe. Before PELP, distribution of CFLs was primarily from manufacturers to wholesalers to small retail shops selling a limited range of electrical products. During the program, CFLs also began to appear in the new hypermarkets and supermarkets that began to gain in popularity, and also in home centers. A survey found that 97 percent of purchasers of CFLs intended to replace their CFLs with another CFL when the current CFL burned out. Print media coverage increased and shifted from explaining CFLs to describing where and how to best use them, which was indicative that CFLs were becoming more common, rather than something that needed to be introduced to consumers. New manufacturers have also entered the Polish market.

Large-scale deployment of energy-efficient lighting technologies has featured in several ongoing and new WBG projects, as a means to overcome the barriers and meet objectives ranging from addressing power shortages faced by electric utilities, to increasing reliability of supply to consumers, to reducing the environmental impacts. These projects were carried out in countries such as Ethiopia, Rwanda, Timor-Leste, and Uganda.

In Uganda, under the World Bank's Energy for Rural Transformation Project, 600,000 CFLs are being procured at the end of 2006 for distribution by the electric utility to residential consumers as a replacement for their incandescent lamps. This intervention is expected to reduce the peak load by about 25 MW and help alleviate the supply deficit, which now stands at more than 100 MW because of the falling water levels in this hydropower-dominated system.

In a similar effort in Rwanda, under the Urgent Electricity Rehabilitation Project, 400,000 CFLs are being procured for free distribution and sales at subsidized prices. In its first phase, which covers replacement of 200,000 incandescent lamps with CFLs, it is expected to reduce peak load by 8 MW and offset the need for diesel-based power generation, resulting in emission reductions of about 50,000 tons of CO_2 equivalent. Under yet another newly approved project in Ethiopia (Accelerated Electricity Access Expansion), 200,000 CFLs are to be deployed to benefit poor communities and save an estimated 6.8 MW of peak load, increasing the reliability of power supply to consumers.

With the aim of directly targeting those without access to electricity, the IFC launched the **Lighting the Bottom of the Pyramid Project** in 2006.[12] In targeting this potential, the project, supported by the GEF, will mobilize the private sector to develop a commercial solution to providing lighting to people without access to electricity. To be initially piloted in Ghana and Kenya, the project will identify market forces and technological changes that can be mobilized toward a commercial solution with high developmental impact. Leveraging the lighting industry's motivations to break into an important new market and the exciting opportunities offered by new lighting technologies, the IFC will seek to promote a market transformation that would provide the poorest of the poor—the "bottom of the pyramid"—with greater access to reliable and affordable lighting services. The project began by engaging a wide range of power source producers (PV, fuel cell, and so on), lighting manufacturers, distributors, and energy access stakeholders to participate in the project by providing their products and technical and marketing expertise to support field tests and focus group exercises with end users.

As these examples show, with access to modern sources of energy, CFLs provide an efficient solution to meeting lighting needs more reliably and affordably. The newly emerging LEDs are considered the next generation of efficient lighting solutions to meet the needs of poorer markets—such as in Sub-Saharan Africa—that have little or no access to electricity and are highly dependent on fuel-based lighting. They represent a large and attractive, yet mostly unexplored, market for modern lighting manufacturers and distributors.

[8] Lighting accounts for about 13 percent of electricity consumption in the residential sector.

[9] Incandescent bulbs are very inefficient, converting only about 5 percent of the energy they receive into light; efficiency of fluorescent tubes can vary widely, between 15 percent and 60 percent.

[10] Fuel-based lighting is much less efficient than even the most inefficient incandescent lamp.

[11] World Bank. 2006."World Bank GEF Post-Implementation Impact Assessment: Poland Efficient Lighting Project." Washington, DC.

[12] Details are available at www.ifc.org/led.

Case Three
Lighting UP Timor-Leste

The Power Sector Priority Investments Project (PSPIP) initiated by the Government of Timor-Leste is well recognized among people in the capital, Dili—perhaps not by its official name, but certainly by the benefits that the program offers for energy access. Since September 2005, more than 27,000 CFLs have been distributed free of charge to Electricidade de Timor-Leste (EDTL) customers who have acquired prepayment meters. In addition, two 17 W CFLs are distributed to each prepaid meter customer when they purchase electricity vouchers.

This highly successful initiative under the PSPIP was a collaborative effort by the Ministry of Natural Resources, Mineral and Energy Policy, EDTL, the World Bank, and other donors to provide better electricity access to EDTL customers.

Since it gained independence in May 2002, Timor-Leste has made substantial progress in rebuilding its power infrastructure. Still, almost 80 percent of the population has no access to electricity, and those who do have to pay an electricity tariff that is among the highest in the world. Compounding this is the limited capability of the national power company, EDTL, to operate the main power system on a commercial basis and the lack of a viable business model for the operation of systems in smaller communities. The development of renewable energy and other indigenous energy sources is also needed to address the rising cost of imported fuel.

As a result, the Government designed a prepaid meter program as part of the project to counter the culture of nonpayment of bills. To date, approximately 23,000 prepaid meters have been installed in Dili. Additional meters will be installed around the capital, in Liquica, Maubara, Dare, Hera, and Metinaro with funding expected from the Norwegian Government.

When customers approach EDTL to pay their electricity bill, the company registers them and

"Many people come to my shop and ask whether I sell the CFLs. They have been looking around in all shops because the bulbs are really efficient. It is also brighter than the normal bulbs. It will be good if we can supply the CFLs in Timor not only in EDTL. It will help people from spending money for electricity bills."

- Antonio do Santo
(owner of electricity shop)

"The light bulbs (CFLs) are really good. They are very efficient and long-lasting compared to the normal bulbs. I pay less for my electricity bills since I used the CFLs. I used to pay US$ 15 a month but now I only pay US$ 11."

- Mr. Germano Bites Dias,
ETDL customer

distributes light bulbs at no cost. EDTL is responsible for the tender, purchase, storing, and distribution of the light bulbs to the customers.

Mr. Jose Manuel Pinto Gauveia, EDTL's former general manager, said, "The main objective of this project is to bring benefits to the customers of EDTL. People pay less for their power when they use these energy-efficient light bulbs compared to when they use ordinary light bulbs. They also help to increase consumer awareness about efficient uses of energy."

He said the project also helped to reduce the peak load for EDTL and reduce the need for fuel imports into Timor-Leste.

The Government aims to continue its ongoing effort to bring down the existing costs of electricity generation by promoting various types of energy conservation initiatives and working on a program to increase imports and sales of energy-efficient light bulbs while reducing imports of inefficient incandescent lights.

Case Four

Bridging the Rural Divide - Solar Systems in Bangladesh

Kali Podo Mondol lives in a small village in the Bagerhat district, along the southwestern coastline of the Bay of Bengal. Despite its remoteness, her home is busy every evening with the bustling of young children, a welcoming addition that has only recently happened since she installed an SHS and inadvertently transformed her veranda into a schoolhouse.

"My brother is a teacher, so now that I've got solar he runs a home school on my veranda. We get 500 taka (Tk) for that, which covers most of the loan repayments," says Kali. "And of course I save on kerosene. I'm so used to the solar now, that I can't see properly anymore by a hurricane [kerosene] lamp!"

Kali is only one of many in rural parts of Bangladesh now benefiting from electrification and reaping the rewards of SHS installations. The Bangladesh Solar Program, supported by the World Bank—and GEF–assisted Rural Electrification and Renewable Energy Development Project, is connecting rural households at the unprecedented rate of more than 3,000 households every month. The success of the connection rate is especially important in a country where 70 percent of the population lacks access to the main grid.

Unlike other countries in the region, Bangladesh is unique in that its demographic distribution is highly uneven and dispersed, making it difficult to connect communities to a central transmission grid. Although Bangladesh has the fastest rate of rural electrification in the region, it will take another 30 to 40 years to reach the 22 million households who still need electricity. In recognition of the need for alternative solutions, the Rural Electrification Board, a semiautonomous agency of the Ministry of Power,

"The customers love coming to shop at my stall now that I have bright light. They can see exactly what they're buying and what I have in stock. And they can watch television, too. My sales have gone up by about Tk 300 [US$5] a day."

- Faroukh Mia, shop owner, Bingmah Darghi

Energy, and Mineral Resources, created the program to reach out to households that were too isolated to be connected to a transmission grid or in areas not yet qualified for grid connection. Administered by the Infrastructure Development Country Limited (IDCOL), a nonbank financial institution in partnership with Grameen Shakti, a microcredit NGO, and Rahimafrooz, a major supplier of batteries, as well as IDCOL's 14 key partner organizations, the Solar Program has installed nearly 90,000 SHSs as of October 2006—a figure much higher than the expected target of 50,000 by 2008.

In fact, in 2005, as a result of meeting this goal three years early, the World Bank has increased its funding for an additional 70,000 systems. GTZ and KfW have also come forward with funding to meet the new target of 200,000 by 2010.

Implemented through smart financing and creative partnerships, IDCOL's Solar Program has enabled villagers to not only benefit from electrification, but also finance their installations and repay loans in effective and entrepreneurial ways. In addition, the benefits to the environment are also significant—with each SHS reducing household carbon emissions about 350–450 kilograms per year.

"I run three lights off my system: I use one for the shop, and I rent out the other two at Tk 180 [US$3] each to my neighbors. I pay Tk 600 [US$9] per month in loan repayments, but when you take the rent I get from my neighbors into account, it works out at just Tk 240. And I used to spend at least Tk 600 a month on kerosene, so as far as I'm concerned, the system's already paying for itself, and in three years time, I'll own it outright!"

- Sento Mia, fertilizer shop, owner,
Bingmah Darghi village, Singhair, Dhaka

4. Energy for Food: Focus on Africa

As 95 percent of staple foods need to be cooked to be digested, **securing an affordable supply of energy for cooking is crucial**. This applies especially in Africa, where roughly two-thirds of households, more than 580 million people, depend on woodfuels for their daily cooking and heating needs. The IEA projections indicate that by 2030, that number will grow to more than 820 million, equivalent to a 27 percent increase (table 1). According to the Food and Agriculture Organization (FAO),[13] best current estimates place total consumption at 452 million tons of wood per year, which amounts to close to 148 million tons of oil equivalent.[14] The improvement of these energy services to provide for a better quality of life has been identified as one of the key challenges in the Clean Energy and Development Investment Framework.[15]

Close to 50 percent of these woodfuels are currently traded in the urban and periurban markets, and woodfuels are being increasingly traded in rural energy markets, especially in the Sahelian countries.[16] All activities related to fuelwood use amount to an economic value of approximately US$6 billion, with more that US$1 billion of this being in charcoal production and trading.[17] The prevailing patterns of forestry resource exploitation in most parts of Africa are destructive and unsustainable, and the burning of woodfuels in poorly ventilated spaces poses a disproportionate health hazard for women and their children.

As populations continue to grow across the continent, pressure on existing forest resources

From waste to fuel: Cashew shells used as biomass for renewable energy in Guinea-Bissau

For more information, see case 5 on page 34-35.

Table 1: People Relying on Biomass for Cooking and Heating in Developing Countries

	In 2000 (million)	Projected for 2030 (million)	2000-30 (%)
China	706	645	–9
Indonesia	155	124	–25
Rest of East Asia	137	145	6
India	585	632	7
Rest of South Asia	128	187	32
Latin America	96	72	–33
Africa	583	823	27
Developing countries	2,390	2,628	9

Source: IEA. 2002. World Energy Outlook 2002, 2nd ed., p. 391. Paris.

will also increase through the clearing of land for agriculture, and the higher demand for wood and nonwood forest products and woodfuels. Over the last 30 years, most efforts to address this situation focused on the subsidized promotion of improved stoves and of interfuel substitution for liquefied petroleum gas (LPG) and kerosene. Some successes were registered, but many stove programs failed to move from a subsidized platform to market sustainability and were discontinued at the end of their underwritten donor funding. And although subsidized interfuel substitution programs achieved considerable market penetration of LPG and kerosene in the 1980s and 1990s, they resulted in macroeconomic imbalances. When subsidies were removed, penetration rates generally stabilized or declined. Within the context of slow economic and household income growth projections in the region, the prevailing US$50–60 per barrel cost of oil provides less prospect for a further rapid penetration of petroleum household fuels.

A critical review of policies, programs, and projects at the national and regional levels jointly undertaken by the World Bank, African governments[18], NGOs, and academic energy experts, spanning a decade of interactive work and research, indicated that until the early 1990s, the lion's share of donor-supported assistance in the household energy sector was limited to demand-side management activities (improved stoves, subsidized interfuel substitution for LPG and kerosene, and consumer education) and relatively narrow government-managed forestry and reforestation programs and projects. The **lessons of experience** resulted in the principal conclusions discussed below.

Demand-Side Management

- "Demand management" interventions alone were not capable of addressing the sustainability of the traditional energy markets, the environmental problems associated with the rapid deforestation in and around growing urban centers, or the negative health and social impacts of indoor air pollution from the use of woodfuels in closed quarters, especially affecting women and children.

- The implementation of improved stove programs (ISPs) for woodfuels had mixed results, as substantiated by (a) lack of proof on deforestation reduction effects, (b) limited reduction of aggregate demand for woodfuels, and (c) poor demonstrated consumer acceptance of improved stoves, as confirmed by limited market sustainability of ISPs beyond the initial donor-subsidized phase.

- The typical institutional arrangements set up for demand management programs were weak and lacked the required institutional knowledge and skill base that was necessary to make

ISPs work. Energy agencies in particular were not well suited to run ISPs.

- LPG and kerosene substitution advanced mostly on the basis of considerable consumer price subsidies, and the benefits of those subsidies were mostly captured by the wealthiest consumers in the respective markets.

Supply-Side Management

- The outcomes of the typical supply-side management programs and projects undertaken demonstrated that governments were not capable of managing woodfuels and forests sustainably. This happened because of a lack of adequate funding, human resource constraints, and lack of political incentives to do so.

- Given the low profitability, the required long investment payback periods, and high risks (land and tree tenure conflicts, regulated pricing, consumer pressures, and so on), the private sector lacked the necessary incentive to participate in sustainable woodfuel management systems in most African countries.

- Because of the need to ensure the security and availability of affordable fuels for the growing urban household energy markets, it was necessary to promote the sustainability of woodfuel supply systems across Sub-Saharan Africa. And, based on the experiences of the previous three decades, that could be achieved only through holistic, community-driven forestry and natural resource management schemes.

From that overall effort, the following **agenda for action** was elaborated by African energy experts with multidonor support and endorsement, which is **in line with the Clean Energy and Development Investment Framework**:[19] (a) rapidly increasing socially and environmentally sustainable woodfuels supply management through community-driven development approaches; (b) continuing to promote woodfuel transformation and end use energy efficiency (improved kilns, stoves, and ovens), but through market-based delivery mechanisms to ensure market sustainability, and with an increased emphasis on effectively reducing indoor air pollution effects on women and children; and (c) continuing to promote interfuel substitution away from woodfuels in the household and small and medium enterprise sectors, but doing so through market-based mechanisms and with an emphasis on mainstreaming RETs and fuels (ethanol, vegetable oil, and solar cookers) when economically viable.

As depicted in table 1, today there is a clear consensus that the large majority of the African population will continue to depend on biomass fuels for at least the next three decades. Thus, ensuring a sustainable and sufficient access to woodfuel is increasingly recognized by national governments and the donor community as an energy, environmental, and social priority. Because of the macroeconomic implications of having to rapidly increase the import of expensive petroleum household fuels to substitute for decreasing fuelwood supplies, promoting the sustainability of biomass energy supplies is now also an economic imperative for most Sub-Saharan African countries.

The cost of the government-managed forestry and reforestation programs and projects that existed until the late 1980s ranged from US$450 per hectare in southern Africa up to US$750 per hectare in the Sahelian countries. Starting in the

Cashew apples can be converted to produce ethanol, once the cashews have been separated and shells peeled for biomass cogeneration. This is all made possible by wide community involvement.

For information on Guinea Bissaue project details, see Case Study 5.

early 1990s, however, several donors (the World Bank, Japan, the Netherlands, Norway, and others) started experimenting with community-based sustainable forest and natural resource management approaches. Over the last decade, those new approaches proved to have positive results, including sizable operational experiences in Burkina Faso, Ethiopia, Madagascar, Mali, Mozambique, Senegal, and other countries.

The investment costs of the new type of community-based approaches have ranged from US$50 per hectare in southern Africa up to US$100 in the Sahelian region. But within that cost envelope, projects have by and large delivered a comprehensive rural development assistance package (crop and income diversification, increased local revenues, increased access to potable and processed water, increased delivery of health and education services, and improved local and subnational governance). Those experiences have helped stabilize the supply of woodfuels and ensure their availability for the growing urban household energy markets, while promoting considerable rural development and poverty alleviation benefits. Among those examples, Senegal's PROGEDE is one of the most successful in the region.

PROGEDE covered 317 rural villages and was able to establish a permanent community-based forest management system capable of producing more than 370,600 tons of fuelwood per year on a sustainable basis for the urban household energy markets and reduce woodfuel-related deforestation by some 39,500 hectares per year. It also helped generate employment and economic development opportunities in the 317 participating villages, generated more than US$20 million in direct revenues to the participating villages, and distributed 255,000 improved charcoal stoves and 4,000 kerosene stoves in the urban and periurban markets. In late 2006, a two-year follow-up phase of PROGEDE began implementation, and a third and final phase to extend PROGEDE nationally is presently under consideration.

Over the last two decades, there has been much discussion of the possible use of new **RETs for**

household cooking applications. The two options that have been explored and tested are solar cookers and biofuels (ethanol, gelfuel, and direct vegetable oil). The practical experience with these RETs has, however, been mixed. From the technical point of view, both solar cookers and biofuels have demonstrated their technical and economic viability as clean and renewable cooking fuels, but to date the market uptake has been limited. The significant increase in prices of petroleum products, which until now remained as the main interfuel substitution option for woodfuels, has nevertheless started to change the landscape of household energy markets. Solar cookers and biofuels are starting to show more market—as well as national policy—traction.

A considerable volume of work has been undertaken on solar cookers around the developing world in the last two decades. Most of this work has been undertaken by NGOs with bilateral donor funding (the GTZ, Danish International Development Agency, Norwegian Agency for Development Cooperation, and others). Today the GTZ is the leading agency with solar cooker expertise. Solar cooker experience has ranged from the original large-scale parabolic cookers to the newer closed-box type. A recent breakthrough in pricing is being advanced through recycling plastic residues (soft-drink bottles, plastic bags, and so on) for fabrication of a high-quality box-type cooker, which has brought down the price threshold of the box-type cooker with comparable performance parameters from US$150 to US$50, if medium- to large-scale in-country production is feasible. Consumer acceptability will remain a constraint to be managed on a project by project basis in relation to local culture. However, the significant reduction in pricing has prompted a visible market and policy response to this technology. A good example is Ethiopia, where a large plant for the manufacture of these solar cookers is now under construction with direct participation from the Oromiya regional government. The use of these new generations of lower-cost solar cookers offers interesting opportunities for water treatment in rural areas with direct and immediate health and human development impacts.

World Bank biofuels efforts between 2000 and 2004 included the Millennium Gelfuel Initiative (MGI), a public-private partnership, aimed at adapting and disseminating an existing ethanol-based cooking fuel (gelfuel) for the African household sector. This initiative was sponsored by the World Bank's Development Marketplace Program.[19]

Table 2: Comparative Cost of Household Cooking Fuels in Selected Countries, 2004 (a)

	US$ Household Cooking Costs per Month (b)					
Fuel/Stove Type	Ethiopia	Malawi	Mozambique	Senegal	South Africa	Zimbabwe
LPG Burner	30.21	18.16	7.62	6.11	12.56	13.02
Kerosene (W)	10.42	12.31	8.21	7.52	11.54	19.23
Kerosene (P)	10.32	12.20	8.13	7.46	11.44	19.06
Charcoal (T)	7.74	11.26	5.33	6.02	15.88	7.15
Charcoal (I)	5.29	7.69	3.64	4.11	10.85	4.88
Fuelwood (T)	7.02	8.94	4.20	4.10	16.81	2.52
Fuelwood (I)	4.86	6.19	2.91	2.84	11.63	1.75
Millenium Gelfuel (CR)	8.81	15.52	6.41	6.41	6.41	6.41
Direct Ethanol (CR) (c)	6.17	10.86	4.49	4.49	4.49	4.49

(W) Wick (P) Petroleum (T) Traditional (I) Improved (CR) Cover + Regulator

Source: Regional Program on the Traditional Energy Sector National Teams. Updated from RPTES (2004). "Millenium Gelfuel Initiative, Progress Report." Washington, June 2004."

Notes: (a) Does not include purchase cost of stoves. (b) 75 Meals/month = 2.5 meals/day x 30 day/month (c) direct ethanol is 30% cheaper than gelfuel as no additional manufacturing costs are necessary.

The MGI and its follow-up work on direct ethanol cooking achieved (a) development and marketing of five low-cost, high-efficiency gelfuel stoves (US$2–20), one direct ethanol stove (US$15), and gelfuel and ethanol burners (US$0.50–4.00) for retrofitting into a wide range of existing African wood and charcoal cooking stoves; (b) assessment of the competitiveness of gelfuel and ethanol compared with other household fuels in various countries in Africa (see table 2);[20] (c) demonstration of the comparative environmental advantages of gelfuel compared with other household fuels through CO_2 emissions testing; (d) confirmation of consumers' acceptance of gelfuel, ethanol, or both in the household energy market through consumer tests and marketing assessments conducted in Ethiopia, Madagascar, Malawi, Mali, Mozambique, Senegal, South Africa, and Zimbabwe; (e) establishment of private sector gelfuel plants in Durban, South Africa (200,000 liters per month), Lilongwe, Malawi (25,000 liters per month), and Harare, Zimbabwe (20,000 liters per month); and (f) stimulation of a broad international technical and policy discussion among national policy makers, the private sector, the donor community, academia, and NGOs on the opportunities and issues of ethanol and ethanol-based fuels for the delivery of modern household energy services in the developing world (cooking, lighting, heating and refrigeration).

The main constraint on a wider adoption of biofuels for household cooking has been the physical availability of the fuels on the continent, subject to their economic competitiveness compared with other uses for feedstock. Total ethanol production in Africa today is fewer than 1 billion liters per year, with 50 percent coming from fermentation processes and the remainder from the coal industry (in South Africa). The ethanol is mostly used for the beverage and pharmaceutical industries and, in a few countries, for the transportation sector. Production of vegetable oil is a fraction of that. Although the use of biofuels for the household sector holds interesting opportunities, a wider adoption will take some time to materialize because the transport sector will take priority for the allocation of increasingly available biofuels in the African markets.

[13] FAO. 1999, "The Role of Wood Energy in Africa. "Working Paper FOPW/99/3, Rome, Italy.

[14] To target the specific needs of the African continent, the WBG has endorsed the Africa Action Plan (2005). Among other things, the plan focuses on building capable states and improving government, strengthening the drivers of growth, and access to economic opportunity for the poor. Access to modern energy fuels is thus at the heart of these activities.

[15] World Bank. 2006. "Clean Energy and Development: Towards an Investment Framework." Washington, DC.

[16] Regional Program on the Traditional Energy Sector.1997. "Regional Report: Review of Policies, Programs and Projects in the Traditional Energy Sector." Regional Program on the Traditional Energy Sector and the Africa Energy Unit. World Bank, Washington, DC.

[17] FAO. 1999. "The Role of Wood Energy in Africa. " Working Paper FOPW/99/3, Rome, Italy.

[18] This refers to the Governments of Benin, Burkina Faso, Gambia, Guinea, Malawi, Mali, Mozambique, Niger, Senegal, South Africa, and Zimbabwe.

[19] Groupe Africaine d'Appui. 2002. « Plan d' action régionale pour le secteur des énergies traditionnelles». Ouagadougou, Burkina Faso.

[20] For information on the Development Marketplace Program, see www.developmentmarketplace.org.

[21] The economic competitiveness of large-scale ethanol production is highly dependent on a number of factors—including agro-climatic conditions, market price of feedstock (sugarcane, sugar beets, corn, and so forth), agriculture and agricultural trade policy, fuel pricing and subsidy policy—and inversely related to the price of sugar. For smaller-scale production, such as for use in gelfuels, the economics may be more favorable because alternative fuels will be costlier, although small-scale ethanol production cost is also higher (Kojima, Masami, and Todd Johnson. 2005. "Potential for Biofuels for Transport in Developing Countries." ESMAP Report 312/05, World Bank, Washington, DC.)

Case Five
Greening Guinea-Bissau after Conflict

Guinea-Bissau is a small, low-income West African country in a postconflict state. As a result of a 10-year national conflict and a slow recovery process, infrastructure facilities and services across the country, and especially in the city of Bissau, fell into a serious state of disrepair, with significant economically and socially negative consequences. In June 2006, the power and water services operated for an average of two hours per day. The power utility had about 2.6 MW of remaining generation capacity, extremely high technical and nontechnical losses, a weak commercial management system, and an exorbitant electricity tariff of US$0.45 per kilowatt hour.

"The 330 KVA cashew shells cogeneration system that we are installing in our plant will provide all the electrivity that we need to run our operation and will enable us to provide continuous power service to the rest of Bolama on a commercial basis." -- Daniel Nunes, General Manager, Sociedade Industrial de Caju, (SICAJU)

Water supply, treatment, and distribution are severely limited as a result of the lack of power, limited storage capacity, and broken water infrastructure. Most urban roads need major repairs and constitute a barrier to effective mobility along mass transit and essential economic corridors. Together, these issues constitute not only key impediments to reactivation of the urban economy, reengagement of the private sector, and attention to the basic social needs of the population in the city of Bissau, but also a daily threat to political stability in the country.

A fiscal year 2006 World Bank project is aiming to provide comprehensive assistance to Guinea-Bissau's ailing infrastructure. The project includes the installation of biomass power cogeneration plants (330 KVA cashew shells cogeneration plants) to support the industrialization of the cashew sector (the country's main export, responsible for two-thirds of GDP) and restore electricity service in the country's second largest city (Bolama), as well as elaboration of a Medium- to Long-Term National Energy Development Strategy and a least-cost National Energy

Sector Investment and Resource Mobilization Plan, which promotes the mainstreaming of renewable energy resources and technologies (hydro, cogeneration, biofuels, wind, and solar) within the country's energy matrix.

The strategy and investment plans, which largely focus on renewable energy, will be completed by 2008 to enable implementation of new projects by 2011, when the bridging 15 MW generation leasing scheme will be terminated. Known renewable energy potential in Guinea-Bissau includes a 20 MW hydro system at Saltinho, some 10 MW of biomass cogeneration associated with the cashew sector, 5–10 MW of wind energy in the country's major islands, and countrywide opportunities for decentralized rural solar applications. Additionally, the government of Guinea-Bissau is interested in exploring the potential to produce ethanol from the existing crop of cashew apples (600,000 tons per year). Because of the extremely high cost of electricity and petroleum products in the country, RETs are seen to have the potential to contribute to increasing access to modern energy services and poverty alleviation in Guinea-Bissau. The prospects for all viable RET options will be included and fully evaluated in the project's National Energy Development Strategy study and investment plan.

The project was approved by the World Bank Board in June 2006. By September 2006, through critical utility rehabilitation work, the project was able to increase power generation in Bissau to about 6 MW on a minimum 12-hour basis, thereby increasing electricity and water services more than twofold. The power generation leasing scheme is expected to be in operation by mid-2007.

Case Six
Waste Not - Biodigesters in Latin America

In 2005, the IFC set a new business precedent when it invested an equivalent of US$10 million in equity financing in AgCert International, PLC, a market leader that relies on the production and sale of agriculturally derived GHG emission reductions as its sole source of revenue.

Agriculture is responsible for 20 percent of GHG emissions every year, much of it a result of methane produced from animal waste. The concentration is especially potent in swine and dairy farms, where waste management systems are traditionally open-air, unlined anaerobic lagoons that emit large volumes of methane, which has a global-warming potential equivalent to 21 times that of CO_2.

Sixteen days after the installation of the biodigester, a farmer in Brazil commented, "I could not visualize how much pollution I was creating until I saw the gas bubble up in the digester. The smell that attracted mosquitoes and flies is no longer there, and I feel better living in my own house, which is next to the farm."

Working primarily with swine and dairy farms, AgCert identifies farms where the baseline waste management system is an open-air lagoon. It then installs—at no cost to the farmers—covered biodigesters that capture the methane, which is then either flared to convert it to CO2 or channeled to a generator to produce electricity. The digested waste that emerges from the other end of the biodigester can be used as organic fertilizer, providing the farmer with additional income. Unlike the open lagoons, the digesters have a lining that prevents seepage into the ground, and once set up, they receive animal waste directly from the farm through a pipe network.

From environmental, economic, and health perspectives, the benefits of AgCert technology are immense. With IFC support, AgCert is scaling up its operations to 1,600 sites across Latin America over two to three years. As of October 2006, AgCert has installed its technology at more than 600 sites in Mexico and Brazil, resulting in 1.9 million tons of CO_2-equivalent reductions per year. Upon completion of all the planned sites, AgCert is expected to produce about 15 million tons of emission reductions per year.

Because the AgCert biodigesters and the GHG emissions reduction comply with the guidelines of the Kyoto Protocol, the company can then sell the certified emission reductions (CERs) or carbon credits to the public or private sector in developed countries to help meet emission reduction obligations under the Kyoto Protocol to the United Nations Climate Change Convention. AgCert also shares a portion of the revenues with the farmers.

One farmer in Mexico said, "The biodigester has helped us comply with environmental regulations and gives us additional income, so we are very happy with this."

In addition to the revenues generated from the sale of CERs, the technology allows farmers to benefit from energy savings. For example, farmers using AgCert technology have also installed generators to use methane as a renewable energy source by converting it into electricity. So far, 10 percent of the completed sites have generators, and more are looking to install them. This technology is both environmentally sustainable and cost effective, in particular to dairy farmers, who have significant power requirements for pasteurizing and cooling dairy products. The use of these generators allows dairy farmers to generate electricity at lower costs than commercial prices.

AgCert is an innovative business with significant potential for development impact, not only in reducing GHG emissions but also in improving the water and air quality at livestock farms. The IFC's investment in the company demonstrates the importance of supporting such pioneering business ventures to effectively address environmental challenges and promote sustainable development across sectors.

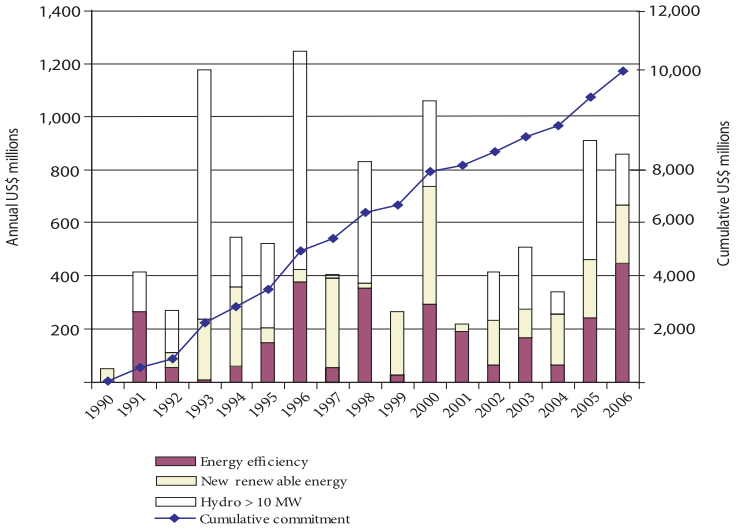
5. A Commitment Made and Kept:

Renewable Energy and Energy Efficiency Portfolio Overview

For the second year in a row, the **WBG has outperformed its Bonn target**. In fiscal year 2006, the WBG's financial support for renewable energy and energy efficiency was US$860 million. Commitments for new renewable energy and energy efficiency were US$668 million, more than double the 20 percent Bonn target. This represents a 45 percent increase over the amount of commitments made by the WBG to new renewable energy and energy efficiency in fiscal year 2005. Total WBG renewable energy and energy efficiency financing in fiscal year 2006 supported 61 projects in 34 different countries. The WBG's support can be broken down into US$412 million for renewable energy[22] and US$447 million for energy efficiency (table 3).[23]

Since 1990, the WBG has committed more than US$10 billion toward renewable energy and energy efficiency (see figure 2). Of this amount, US$2.7 billion were for new renewable energy sources and US$2.8 billion for energy efficiency projects. Hydropower projects greater than 10 MW per facility received US$4.5 billion in commitments. The share of renewable energy and energy efficiency lending as part of the overall energy portfolio has been continuously increasing, as figure 3 illustrates.

Figure 2: WBG Renewable Energy and Energy Efficiency Commitments, FY90-06



Among the various World Bank institutions and units, the IFC, IBRD, and IDA were the largest contributors, with US$393 million in commitments by the IFC and US$370 million from the IBRD and IDA. The IFC contributed US$326 million of its own funds for new renewable energy and energy efficiency and US$67 million for hydropower greater than 10 MW; the IBRD and IDA contributed US$251 million and US$119 million, respectively. World Bank–administered GEF commitments amounted to US$48 million for both new renewable energy and energy efficiency.

The IFC administered GEF and Environmental Opportunities Facility (EOF) commitments totaling US$20.1 million, of which US$600,000 was for new renewable energy and US$19.5 million was for energy efficiency. Furthermore, the IFC-Netherlands Carbon Facility committed US$13 million for two new renewable energy projects. The Multilateral Investment Guarantee Agency (MIGA) provided a US$1.8 million guarantee for an energy efficiency project.

Both the IBRD and the IFC have carbon finance units (CFUs) that leverage public and private investments for projects that generate GHG emissions reductions from projects eligible under the Kyoto Protocol's Clean Development Mechanism and the Joint Implementation Mechanism. The World Bank CFU consists of

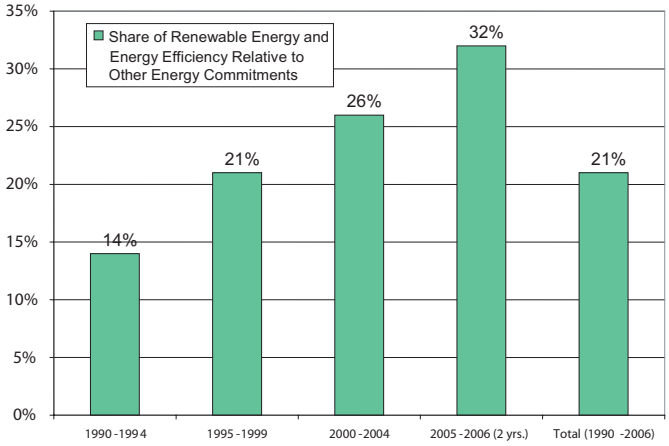
nine carbon funds amounting to approximately US$1.9 billion. Methane captured from municipal waste and renewable energy accounts for 7 percent and 12 percent of the portfolio, respectively. Energy efficiency projects represent another 5 percent. In fiscal year 2006, the World Bank CFU provided US$14 million in commitments to renewable energy and energy efficiency.

The IFC has carbon funds of about US$150 million under management in partnership with the government of the Netherlands. In fiscal year 2006, the IFC concluded emission reduction agreements of about US$13 million for two renewable energy projects: EcoPower, which operates small run-of-river hydroplants in Sri Lanka, and Enercon India, which develops windpower plants in the Indian states of Rajasthan and Karnataka.

In fiscal year 2006, the WBG share of renewable energy and energy efficiency financing was 19 percent of total energy sector[24] commitments of US$4.5 billion. Renewable energy and energy efficiency financing accounted for 35 percent of power sector[25] commitments of US$ 2.45 billion.

WBG loans, grants, and guarantees leverage millions of dollars in additional financing from private investors, governments, and other donors. In fiscal year 2006, WBG renewable energy projects leveraged an average US$3 for each dollar of WBG investment, and WBG energy efficiency projects leveraged an average US$2 for each dollar of WBG investment.[5] Because this cofinancing is critical for the development of renewable energy and energy efficiency opportunities in developing countries, the WBG attempts to maximize its ability to leverage financing from other sources.

Figure 3: Share of Renewable Energy and Energy Efficiency Releative to the WBG's Other Energy Commitments



The WBG's work on renewable energy and energy efficiency is pursuing a **two-pronged approach targeting**, on one hand, the **supply of energy** in the short to medium run and, on the other hand, providing assistance to developing policy and building capacities for scale-up of renewable energy use and **efficiency** in the

Table 3: World Bank Group Commitments for Renewable Energy and Energy Efficiency in Fiscal Year 2006 (millions of dollars)

Source of Funds	New-RE	Hydro>10MW	EE	Total
World Bank (IBRD/IDA)	135.7	118.6	115.3	369.5
World Bank (GEF and Carbon Finance)	54.7	6.0	1.2	62.0
IFC (Own Funds)	17.4	67.0	309.0	393.4
IFC (GEF, CF and other trust funds*)	13.0	0.0	20.1	33.1
MIGA	0.0	0.0	1.8	1.8
Total	220.8	191.6	447.4	859.8

*The IFC's "other trust funds" category includes the Environmental Opportunities Facility (EOF).

longer term. The success of WBG-assisted projects in improving energy access using renewable energy was recognized in 2006, when Grameen Shakti and Rahimafrooz Batteries in Bangladesh and Sarvodaya Economic Enterprise Development Services in Sri Lanka—organizations supported by World Bank projects—won the prestigious Ashden Awards for Sustainable Energy (see case 4). In Papua New Guinea, a credit scheme that makes solar PV electricity affordable encourages teachers to remain in remote rural areas to serve students. In Nepal, carbon finance supports the provision of clean biogas cooking fuels that at the same time helps reduce deforestation, improve indoor air quality, and provide nutrient-rich by-product as fertilizer that contributes greatly to improved livelihoods. Projects supporting on-grid renewables include financing of windpower in Brazil, China, Djibouti, and Mexico.

Building on experiences in core energy supply sectors, the WBG seeks to adopt a comprehensive, multisector approach to tap into efficiency opportunities in the transportation, industry, households, education, health, agriculture, and rural sectors. The WBG energy efficiency projects in fiscal 2006 encompass end use and supply-side opportunities and the removal of institutional, regulatory, financial, and technical barriers. For example, efficient and reliable heating systems and the provision of other energy services for public buildings such as schools, apartments, hospitals, and orphanages were the focus of projects in Armenia, Belarus, and Croatia. In the Armenia project, 17,000 households and 100 schools will benefit from the rehabilitation of heating systems and loans to providers of heat services. Large-scale deployment of energy-efficient lighting technologies is featured in several WBG projects in Ethiopia, Timor-Leste, and Uganda (case 3) as a means to address power shortages faced by utilities and to increase reliability of supply to residential consumers.

From a regional perspective, countries in the ECA region received the highest level of commitments in fiscal year 2006, with a total of US$313 million, including a US$42.5 million energy efficiency project, the Belarus Post-Chernobyl Recovery Project (IBRD), and an energy efficiency project of US$137 million, the Hungary OTP-Subsovereign Schools Project (IFC). East Asia and the Pacific (EAP) ranked second, with US$232 million in commitments, and Latin America and the Caribbean (LAC) was third, with US$141 million. Both the ECA and LAC regions saw increases over their fiscal 2005 commitments, with ECA commitments increasing from US$260 million in fiscal year 2005 to US$313 million in fiscal year 2006, and LAC commitments increasing from US$92 million to US$141 million, respectively. These increases suggest that the concerted efforts of the WBG to reengage in hydropower and scale up support for new renewable energy and energy efficiency are having a positive impact (see figures 2, 3, and 4).

Figure 4: WBG Renewable Energy and Energy Efficiency Commitments by Region, FY06

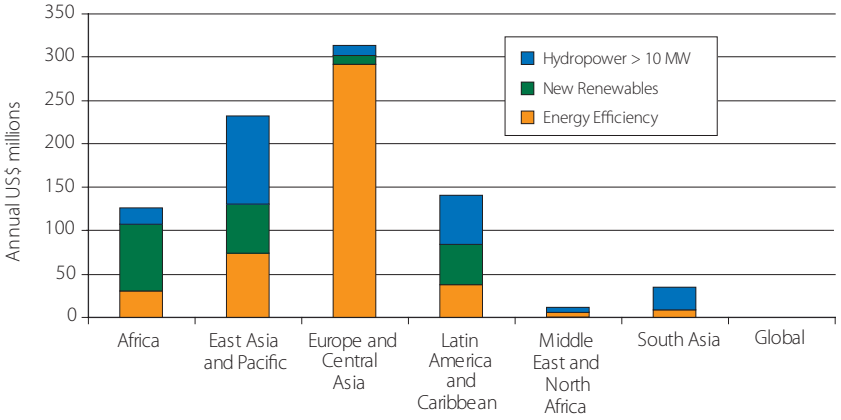
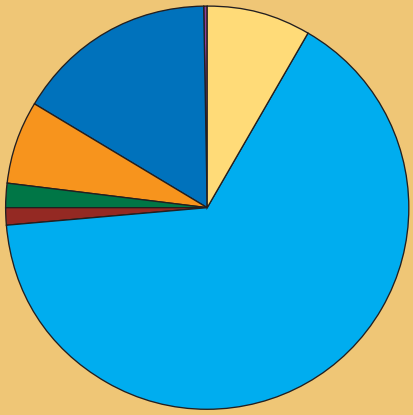


Figure 5: FY06 Commitments by Region

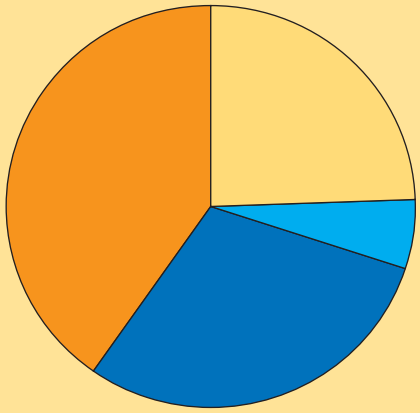
Energy Efficiency: US$447 Million



- Global US$1 million
- East Asia and Pacific US$72 million
- Africa US$30 million
- South Asia US$8 million
- Middle East and North Africa US$6 million
- Europe and Central Asia US$292 million
- Latin America and Caribbean US$38 million

The ECA region had the highest energy efficiency commitments—US$292 million. The EAP and LCR regions also showed a high level of commitments for energy efficiency projects. Among the projects were eight in the industrial sector, mostly IFC-financed, four that supported district heating, four that aimed at transport efficiency, and five that assisted in demand-side management in the residential and commercial sectors.

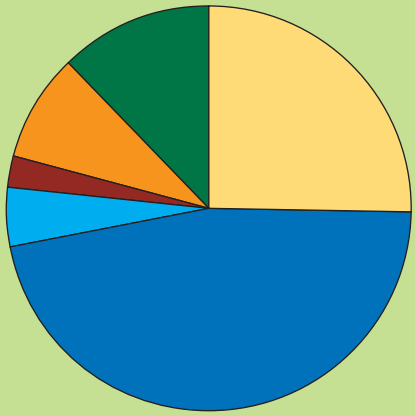
Renewable Energy—Hydropower> 10 MW: US$192 Million



- Africa US$77 million
- East Asia and Pacific US$57 million
- Europe and Central Asia US$11 million
- Latin America and Caribbean US$47 million

Three projects in the AFR region and two projects in EAP region accounted for 70 percent of nearly US$192 million in total commitments in the category of hydropower greater than 10 MW. The IBRD, IDA, and IFC classify projects as large hydropower only if the installed capacity at a single facility exceeds 10 MW. Pumped storage, run-of-river hydropower, and hydropower projects with dams are also included here if the capacity exceeds 10 MW. Hydropower rehabilitation projects, which do not result in greater increase of capacity installed (that is MW), are classified as energy efficiency projects.

Renewable Energy—New Renewables: US$221 Million



- South Asia US$27 million
- Africa US$19 million
- Middle East and North Africa US$5 million
- Europe and Central Asia US$11 million
- East Asia and Pacific US$103 million
- Latin America and Caribbean US$56 million

The EAP region received the largest contribution from WBG commitments for new renewables in FY06. This was due to a large project in China, CRESP II, with US$86 million from the IBRD. In the LAC region, US$56 million were committed for nine new renewable energy projects, of which two were IBRD carbon finance projects. There were also two IFC carbon finance projects in the SAR region. Among all regions, 13 of the projects supported hydropower up to 10 MW, 7 supported solar PV, and 6 supported windpower. There are also 3 biomass projects and 3 biofuel projects. Twenty percent of new renewable energy commitments were for hydropower less than 10 MW in capacity.

Although the level of commitments varied significantly among regions, the number of projects was somewhat more evenly distributed. As shown in table 4, the ECA region had 18 projects with renewable energy or energy efficiency components in fiscal year 2006, the LAC region was close behind with 16, the EAP region had 11 projects, and the AFR region had 7 projects. The SAR region had 6 projects, the MNA region had 2 projects, and there was 1 global project.

Table 4: Number of Projects by Region, FY06

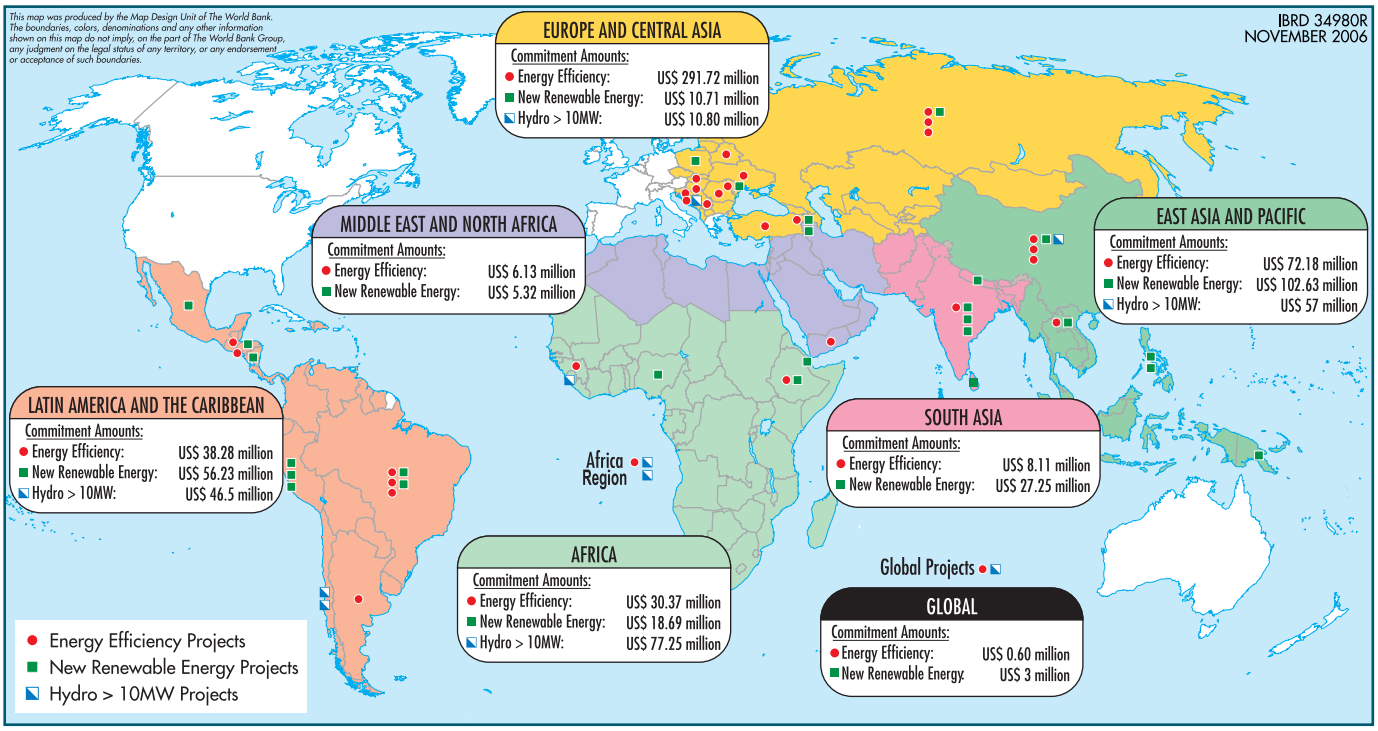
Region	Total	Renewable Energy		Energy efficiency
		Hydropower > 10 MW	New renewables	
AFR	7	2.5	2	2.5
EAP	11	2	5	4
ECA	18	1	4.5	12.5
LCR	16	2	9	5
MNA	2	0	1	1
SAR	6	0	5	1
Global	1	0	0	1
Total	61	7.5	26.5	27

Note: The AFR's Benin and Ghana Second Coastal Transmission Backbone Project had both EE and hydropower > 10 MW components and thus is counted as half a project for EE and half a project for hydropower > 10 MW to avoid double counting. The Russia Sustainable Energy Finance Program had both EE and RE components, thus each component is counted only as half a project. The Lao PDR Rural Electrification Phase I GEF and IDA projects both had EE and RE components, each of which was counted as half a project. The IFC's OTP Subsovereign Schools EE Project in Hungary has two different departments working on the same project; it was also counted half and half.

Fiscal year 2006 commitments for new renewable energy and energy efficiency were US$668 million, more than double the 20 percent per year Bonn commitment scale-up target of US$301 million. In fiscal years 2005 and 2006, total new renewable energy and energy efficiency commitments reached US$1.13 billion, compared to the Bonn commitment target of US$552 million for these two years (table 5).

Meeting the Bonn commitment requires more than just project lending. **Lending must be**

Figure 6: Locations of WBG Projects in Renewable Energy and Energy Efficiency



preceded by economic sector work ESW and technical assistance in partner countries to identify and prepare such projects. Moreover, to ensure that projects are successful and sustainable, additional support for capacity building and policy reform is needed. Consequently, a key component of the WBG's scale-up program for renewable energy and energy efficiency is made up of upstream analytical and advisory activities (AAAs). Such AAA support is often an integral part of World Bank investment projects. Examples of independent ESW undertaken in fiscal year 2006 include the Long-Term Energy Issues Study for India, the Solomon Islands Renewable Energy Study, and the Mekong Region Water Assistance Strategy, all of which addressed renewable energy.

These studies are funded by Bank resources as well as bilateral donor resources held under trust by the Bank. Technical assistance (TA) is also an important way in which the WBG assists countries, and it is often used for reforming and strengthening institutions. TA activities include workshops, consultations, training events and programs, and similar activities aimed at building capacity. Figure 7 shows how the number of World Bank–funded TA and ESW activities has fluctuated from fiscal year 2000 to fiscal year 2006, reaching a high of 16 activities in fiscal year 2003.

In addition to the WBG's AAA work, studies and reports are supported by trust fund programs. The Asia Sustainable and Alternative Energy Program (ASTAE) and the Energy Sector Management Assistance Program (ESMAP) are two multidonor trust fund programs that form a vital body of knowledge and lessons on which Bank staff and practitioners can draw. In fiscal year 2006, these products included the launch of two new Web sites: the World Bank Renewable Energy Web site (http://www.worldbank.org/re) and the Renewable Energy Toolkit, an interactive Web-based tool for renewable energy practitioners and policymakers (http://www.worldbank.org/retoolkit). Another key report issued in fiscal year 2006 was the *Technical and Economic Assessment: Off-Grid, Mini-Grid and Grid Electrification Technologies*, which was funded by a Japanese trust fund.There is a direct link to this document on our Renewable Energy Web site.

Table 5: Measuring the FY05 and FY06 Progress in Renewable Energy and Energy Efficiency Lending against the Bonn Commitment *(millions of US$)*

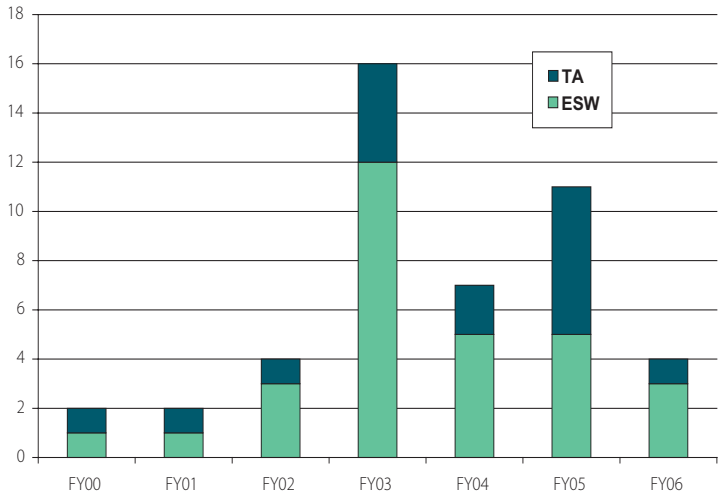
	FY02	FY03	FY04	Average	FY05	FY06	FY05 + FY06
New RE and EE commitments	204	178	245	209 [a]	4 61 [b]	6 68	1 ,129
Bonn Commitment Target					251	301	552

a. The baseline of US$209 million was set as the average annual lending commitment for new RE and EE made by the IBRD and IDA, IBRD carbon finance business, and the GEF (IBRD and IDA) in FY02, 03, and 04. The baseline comprises exclusively new RE and EE.
b. This includes the additional US$168 million in the IFC's FY05 commitments that were not reported in the FY05 RE and EE progress report (December 2005). Commitment amounts for two IFC projects included in last year's FY05 RE and EE progress report have also been revised (the Dominican Republic Basic Energy was US$12 million and is now US$6.34 million; India's Allain Duhangan Hydropower was US$49 million and is now US$47 million). The additional IFC FY05 commitments were principally EE and RE investment components of IFC projects in agriculture, industry, transport, and other nonenergy sectors.

ESMAP committed US$1.5 million for renewable energy and US$1 million for energy efficiency during calendar year 2005. The resources were used to support regional sector work and TA, including multiyear projects. These projects are expected to lead to the development of supportive policies and to the identification of prospective investments in renewable energy and energy efficiency. A complete list of these reports and studies is available on the ESMAP Web site (http://www.esmap.org).

The Asia Sustainable and Alternative Energy Program (ASTAE), like ESMAP, is a multidonor facility at the World Bank. With a focus on countries in East Asia, it is bringing renewable energy and energy efficiency into the mainstream, and providing access to modern energy services to the poor. In fiscal year 06, US$2 million were disbursed towards activities in Cambodia, China, Indonesia, Lao PDR, Mongolia, the Philippines, Papua New Guinea, Timor Leste, and Vietnam. Between 2004 and mid-2006, ASTAE-supported initatives and projects provided access to electricity for 799,500 new households, and delivered improved services to 600,000 households.

Figure 7: Number of AAAs with Renewable Energy and Energy Efficiency Focus, FY00–06



The World Bank's close cooperation with a number of networks and partnerships continues. The World Bank is represented on the boards of the Global Village Energy Partnership, Renewable Energy Network for the 21st Century, Sustainable Energy Finance Initiative, and Photovoltaic Global Approval Program. Cooperation with the Renewable Energy and Energy Efficiency Partnership is also under way.

To ensure that renewable energy and energy efficiency investments are incorporated into future WBG lending activities, the WBG has worked to integrate renewable energy and energy efficiency into country-owned development frameworks. Through its scale-up action plan, the WBG has provided assistance in identifying promising prospects and in garnering the support needed to develop such opportunities into projects. Before fiscal year 2004, little attention was given to renewable energy and energy efficiency in Poverty Reduction Strategy Papers (PRSPs) and Country Assistance Strategy (CASs)[27] documents, which provide the basis for World Bank lending to client countries.[28]

The situation has improved since then. A review of 86 CAS and PRSP documents completed in fiscal years 2004–06 revealed that the percentage of CAS and PRSP documents that include substantive references to renewable energy and energy efficiency was nearly 88 percent in fiscal year 2006 (table 6) but only 40 percent of the total number of CASs and PRSPs in fiscal year 2004. Identifying potential investment activities in planning documents is crucial because they are a leading indicator of future renewable energy and energy efficiency investments. Table 6 shows the extent to which renewable energy and energy efficiency references have actually been incorporated into CAS and PRSP documents from fiscal year 2004 to fiscal year 2006.

Table 6: References in CAS and PRSP Documents, FY04-06

		FY04 CAS and PRSP		FY05 CAS and PRSP		FY06 CAS and PRSP	
Region	Total	"None or passing" reference	"Specific" reference	"None or passing" reference	"Specific" reference	"None or passing" reference	"Specific" reference
AFR	26	7	7	3	5	1	3
EAP	11	2	1	2	3	—	3
ECA	18	—	7	1	4	—	6
LCR	15	3	3	1	4	1	3
MNA	9	1	2	—	3	1	2
SAR	7	1	1	—	1	—	4
Total	86	14	21	7	20	3	21

Source: Updated based on a study by Ted Kennedy and Yabei Zhang. 2004. "Assessment of Energy Access and Renewable Energy in PRSP and CAS Process."

[22] See annex 1 for classification of renewable energy and energy efficiency.

[23] The commitment amounts in this report have been updated from the values presented in "Right on Target: Progress on Renewable Energy and Energy Efficiency in 2005/2006" and the press release, "New Renewable Energy and Energy Efficiency: World Bank Group Exceeds Previous Year's Commitments." This update reflects several revisions to IFC and World Bank project data. The previous estimates were US$871 million for renewable energy and energy efficiency, with US $680 million for new renewable energy and energy efficiency, compared to final estimates of US$860 million for renewable energy and energy efficiency, with US$668 million for new renewable energy and energy efficiency. See annexes 2 and 3 for more details.

[24] IBRD-IDA energy sector investments include oil, gas, and coal (including coal mine closing or rehabilitation); transmission and distribution of oil, gas, and electricity; power generation and associated environmental controls and plant rehabilitation; district heating and plant rehabilitation; renewable energy; and energy efficiency and conservation. IFC investments in the energy sector include investments from the IFC's own account; MIGA investments refer to gross liability exposure. IFC and MIGA investments in the energy sector consist of investments in the power sector; oil, gas, and mining; and electricity and gas services. Previous IFC assessments referred only to stand-alone projects whose sole focus was energy efficiency or renewable energy, thus missing the full scope of investment in sustainable energy undertaken as a component of larger investments in various sectors. Subsequently, the IFC has identified additional renewable energy and energy efficiency investments in commitments it had made in other sectors as agriculture, water supply, and industry and in corporate loans to financial intermediaries. For more details see, "Choices Matter: 2005 Sustainability Report" at www.ifc.org/SustainabilityReport, last accessed November 8, 2006.

[25] The power sector comprises only those energy sector activities that relate to generation, transmission, and distribution of electric power.

[26] This is based on a review of 16 renewable energy and 8 energy efficiency projects in which 80 percent or more of the funding commitments were specifically for renewable energy and energy efficiency. The leveraging amounts used have been rounded to the nearest dollar. For other projects, identifying the amount of additional funds leveraged is difficult because these other funds also contribute to non–renewable energy and non–energy efficiency investments.

[27] PRSPs and CASs provide the basis for World Bank lending to client countries. PRSPs are prepared by IDA governments through a participatory process involving civil society and development partners, including the World Bank and the International Monetary Fund. They describe a country's macroeconomic, structural, and social policies and programs to promote growth and reduce poverty, as well as associated external financing needs. The CAS represents the Bank's business plan, developed and agreed with each client country, summarizing the status of the country in a development context and the priorities for Bank operations over the near term. The PRSP process serves as a guide for CAS development.

[28] Ted Kennedy and Yabei Zhang. 2004. "Assessment of Energy Access and Renewable Energy in PRSP and CAS Process." World Bank, Washington, DC.

Case Seven

Enterprising Through Renewable Energy in Lao PDR

In a small, remote, rural village in the Lao PDR, a young woman relies on light generated from a Solar Home System (SHS) to sew in the evenings for her growing number of customers. Nearby, another woman uses a refrigerator to store cold sweets for sale, and her husband weaves baskets for extra income. The next morning, a carpenter uses power tools to help his fellow villager build a shed for rearing poultry in the evening — now possible with the help of electricity.

When nonelectrified villagers were asked about their expectations and what applications they would use if electrified, the responses were always immediate. In fact, many would give an exact list of applications and advantages from electrification.
-Evaluation of Rural Electrification Socioeconomic Survey, 2004

For those who live in electrified villages in the Lao PDR, access to electricity is directly linked to their livelihood and has become an important aid to income generation. Those who do not have access are well aware of the benefits of electrification.

With the support of the World Bank and the GEF, the Lao PDR government and its Off-Grid Promotion and Support Office in the Ministry of Energy and Mines (MEM) have developed one of the most successful and highly ambitious electrification programs in the region.

The Lao PDR Southern Provinces Rural Electrification Project (SPRE) aimed to increase electrification access significantly and improve financial performance of the power sector. In 1995, the national access level was 15 percent.

By completion of the project in 2004, 44 percent of the rural population had access, of which a total of 51,805 households or about 25.6 percent of new connections was financed by SPRE. As part of the effort to increase access to electricity, off-grid renewable energy systems were installed throughout the country; SPRE electrified 4,910 households using SHSs and 115 households using pico hydropower. As of October 2006, the number of solar installations has increased to 5,936 with additional funding from MEM after the closing of the IDA credit.

To scale up the success of SPRE, a follow-up Lao PDR Rural Electrification (Adaptable Program Loan [APL]) Phase I Project was approved by both the GEF and IDA in April 2006 and is currently under implementation. The project team, together with MEM, has also carried out a socioeconomic assessment of the linkages between renewable energy development and its impacts to enhance the implementation of the next stages.

Results from the study showed that a growing percentage of new businesses opened in electrified villages after their electrification, in particular retail stores, weaving and knitting shops, and rice mills.

In one of the villages connected through pico hydro, families can earn income of about 300,000 kip a month, weaving baskets for tourists. The extra returns help pay the monthly hydropower tariff .

The study also showed that the use of electric tools and appliances increased overall living standards and allowed other productive activities—such as basket weaving, fishing net repairs, washing clothes, cooking, ironing, reading, and studying—to take place in far more productive conditions than without electricity. In addition, the women in the villages mentioned increased security as an important outcome of improved lighting.

The survey concluded that a major reason why households do not get connected is the high initial connection cost. To address this issue, the ongoing Phase I project has already designed a financing scheme that targets the poorest households and offers connections without requiring up-front installation payment. By the end of 2008, it is estimated that 9,000 households will be connected by SHSs and an additional 1,000 will be connected by using a combination of pico hydropower and generator sets. Based on the outcomes of Phase I and the conclusions of the survey, Phase II of the APL program will be implemented with additional GEF and IDA funding. Overall, the two-stage program is expected to electrify households using a significantly higher portion of renewable energy than SPRE.

6. The Road Ahead

In September 2005, after the Gleneagles Group of Eight summit, the WBG began preparing a Clean Energy and Development Investment Framework to simultaneously address the challenge of energy access in developing countries, look at ways to move to a lower-carbon economy, and explore options on how to "climate-proof" development. Energy efficiency and renewable energy are part of two main pillars of the framework: (1) energy for development and access for the poor and (2) transition to a low-carbon economy. The third pillar of the framework is adaptation. At the World Bank–International Monetary Fund Annual Meetings in Singapore in September 2006, the World Bank's Development Committee[28] welcomed the progress made in developing the Clean Energy and Development Investment Framework and affirmed their broad support for addressing the three pillars.

The Clean Energy and Development Investment Framework offers a structure upon which the WBG can direct its support for renewable energy and energy efficiency in the coming years. The trust-funded ESMAP and ASTAE, carbon finance operations with nearly US$2 billion in funds under management, and the GEF remain essential partners in these efforts.

Investments for supporting energy for development and for improving energy access will **focus on regions that have the majority of unserved communities** and highest dependence on biomass for cooking and heating, **Sub-Saharan Africa and South Asia**. Principal investment assistance in Sub-Saharan Africa—where 550 million people are without electricity access and 580 million people are dependent on biomass fuels—will be guided by the Africa Energy Access Plan.[29] The plan includes five parallel tracks: (1) access to clean cooking, heating, and lighting fuels, coupled with sustainable forest management; (2) scaled-up programs of electrification; (3) additional generation capacity to serve newly connected households and enterprises, including through regional projects; (4) provision of energy services for key public facilities such as schools and clinics; and (5) provision of stand-alone lighting packages for households without access to the electricity grid.

Both grid and off-grid renewable energy options are being integrated into World Bank electrification projects that are currently under preparation for a number of African countries. Projects to advance the adoption of improved cook stoves and increase sustainable woodfuel supplies will also be supported. Energy efficiency measures, including accelerated market entry of CFLs as a way to reduce peak loads and energy use, are being introduced.

Investment and policy support to increase the use of renewable energy and energy efficiency are key features of the WBG efforts to assist countries in transition to a low-carbon economy. The primary focus will be to work in partnership with fast-growing countries such as Brazil, China, India, Mexico, and South Africa that are major energy consumers. ESW is underway to strengthen the policy and institutional frameworks for improving energy efficiency and developing long-term energy plans, including formulating laws and regulations for encouraging greater use of renewable energy. Investment support will focus on energy efficiency (industry, residential, and commercial sectors as well as rehabilitation of generation, transmission, and distribution) and support for greater renewable energy use, including

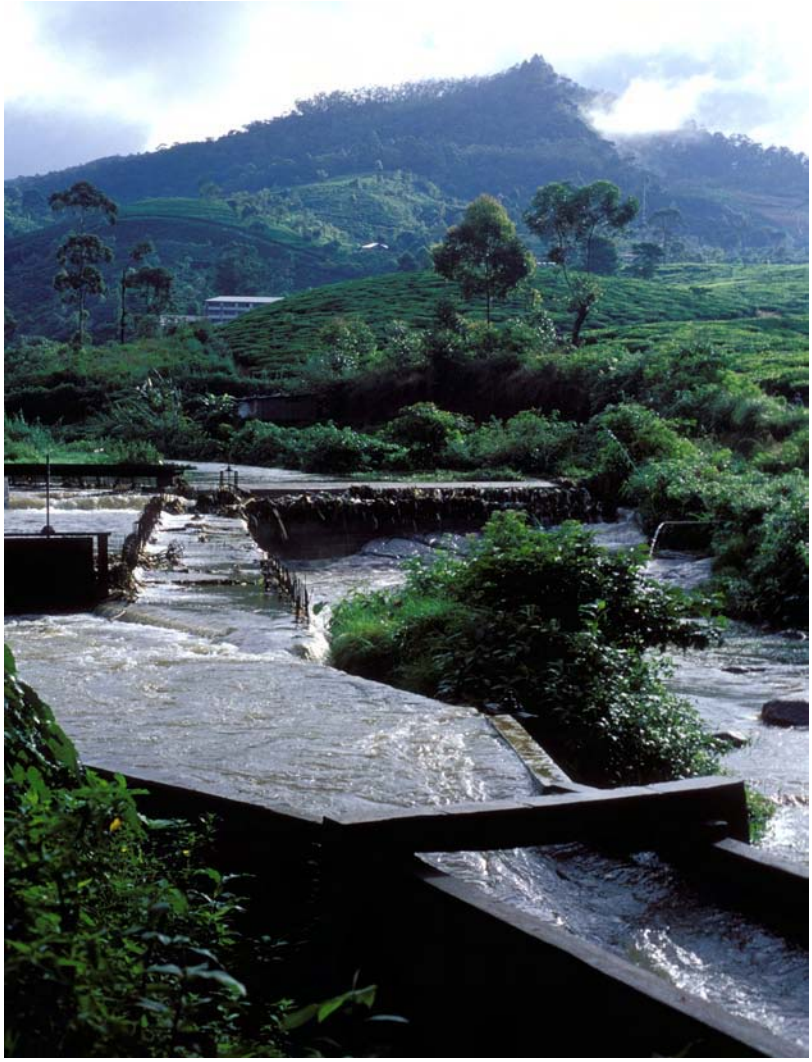
hydropower, wind, solar, thermal, and biomass cogeneration.

Training, capacity building, and knowledge dissemination will continue. The World Bank Institute, in cooperation with Carbon Finance operations, will continue the Carbon Finance Assist Program to offer country and regional TA programs for carbon finance project portfolio development and capacity building. The Renewable Energy Toolkit launched in 2005 is being upgraded to improve its usability and extend its coverage to include products requested by policy makers, project developers, and financiers. The Bank will consult with other like-minded organizations such as the GEF, Renewable Energy Network for the 21st Century, Sustainable Energy Finance Initiative, Renewable Energy–Energy Efficiency Partnership, and Global Village Energy Partnership to assess the feasibility of building renewable energy knowledge partnerships.

A confluence of events and deliberate actions is creating the right conditions for advancing renewable energy and energy efficiency development in developing countries. Increasing concerns about volatile and high energy prices, the demonstrated confidence-building effect from the rapid scale-up of renewable energy and energy efficiency in industrial countries, maturation of technologies, recognition of the value of diversity in energy supply, and **concerns about climate change** are creating the right environment for accelerating the use of renewable energy and energy efficiency. The WBG will take advantage of these conditions and, building on its experience, is reaffirming its commitment to **further strengthen the support for the scale-up of renewable energy and energy efficiency in our partner countries**.

[28]The Development Committee is a forum of the World Bank and the International Monetary Fund that facilitates intergovernmental consensus building on development issues. It is known formally as the Joint Ministerial Committee of the Boards of Governors of the Bank and the Fund on the Transfer of Real Resources to Developing Countries. The committee has 24 members, usually ministers of finance or development who represent the full membership of the Bank and Fund. They are appointed by each of the countries, or groups of countries, represented on the Boards of Executive Directors of the Bank and Fund.

[29]Africa Region 2005. "Meeting the Challenge of Africa's Development: A World Bank Group Action Plan." World Bank, Washington DC.



Case Eight
Carbon Finance for Hydropower in Sierre Leone

Sierra Leone's Bumbuna Hydropower Project (BHP) involves the completion and operation of the Bumbuna hydropower facility, located on the upper reaches of the Seli (Rokel) River about 200 kilometers northeast of Freetown, the nation's capital. The project was 85 percent complete when construction work was suspended in May 1997 because of the conflict raging in the country.

"The peace achieved in Bumbuna is a sure sign that the people are ready for development. The project contractors and authorities will now have the opportunity to work in a peaceful atmosphere…. This clearly shows the effectiveness of a bottom-up and participatory approach to conflict resolution and development."

- Thomas Moore-Turay
  Peace Process Facilitator of the
  Kalansogoia Chiefdom

Sierra Leone presently ranks among the poorest countries on the African continent despite having abundant freshwater resources, fertile land, mineral resources, fisheries, biodiversity, and tourist potential. The current power supply situation in Sierra Leone is extremely severe. There is virtually no electricity after much of the grid was ruined by war. Two thermal plants and a significant part of the transmission system were destroyed, and the main power plant in Freetown is operating well below capacity. Electricity is available to Freetown customers for only a few hours every three to seven days, and most areas in the interior are wholly or largely without power supply.

The only reliable electricity is generated by small, inefficient diesel generators supplying the residential and commercial users who can afford them. The country relies on expensive imported oil for virtually all its grid and off-grid power supply, and prices are among the highest in the world. This situation negatively impacts not only the quality of life of Sierra Leoneans, but also the competitiveness of small business and of national industry.

The objective of the BHP is to provide an adequate and reliable energy supply to the most densely populated western area, including Freetown, and meet the current energy demands at the lowest possible cost and in a sustainable manner. Moreover, the electricity generated by the project will service new towns that are currently not connected to the power grid.

The quality of life will improve as communities stop relying on noisy, polluting, and expensive diesel power generators. Completion of the BHP would bring 50 MW of clean power into the grid and greatly enhance the population's ability for produc-

tive economic activity. The project would reduce electricity costs and, by reducing fuel imports, improve the country's balance of trade.

An emission reductions purchase agreement has been signed for the World Bank–administered Netherlands Clean Development Mechanism Facility to buy 880,000 tons of CO2-equivalent emission reductions that will be generated by the project. The generation of carbon revenues will initially fund the Upper Seli Community Development Initiative (SCDI) to allow the local people near the Bumbuna facility to share the nonpower benefits of the project.

The carbon revenues will also initially fund a longer-term benefit-sharing mechanism, provisionally called the Bumbuna Trust. Although the SCDI is focused on the Upper Seli catchment area around the dam and reservoir, the Bumbuna Trust would eventually allow all citizens in the wider basin to share the benefits. Without the carbon revenues, there would be no ongoing and sustainable source of revenues for the SCDI or the Bumbuna Trust.

The trust mechanism would allow communities in the basin—ranging from small, scattered subsistence agriculture settlements to larger rural towns with formative local markets—to set their own priorities for more immediate use of their share of the benefits deriving from hydropower generation. These nonpower benefits, such as access roads, water and sanitation systems, area schools, and health clinics, will be delivered through community-driven development mechanisms.

Annex 1: Institutional Support for Renewable Energy and Energy Efficiency

This annex describes the various WBG institutions and units and the role that each plays in contributing to renewable energy and energy efficiency. It also provides definitions of renewable energy and energy efficiency. Last, it discusses the methodology used to compute the data in this report.

The WBG

In this report, the WBG refers to four closely associated World Bank institutions that directly support renewable energy and energy efficiency activities.[30] The four institutions are the IBRD, IDA, IFC, and MIGA. There are six operational regions under IBRD and IDA. The report disaggregates the commitments made by these regions and institutions. In addition, the WBG is an implementing agency for the GEF. This report provides information on WBG-administered GEF projects. The WBG's carbon finance business is reported separately because it is a unique business line that purchases emissions reductions and does not directly invest in a project.

The IBRD

The IBRD aims to reduce poverty in middle-income and creditworthy poorer countries by promoting sustainable development through loans and guarantees and, in the nonlending area, AAAs (http://www.worldbank.org/ibrd).

IDA

Contributions to IDA enable the World Bank to provide approximately US$6–9 billion a year in highly concessional financing to the world's 81 poorest countries (home to 2.5 billion people). IDA's interest-free credits and grants are vital because these countries have little or no capacity to borrow on market terms (http://www.worldbank.org/ida).

The IFC

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. (http://www.ifc.org).

The GEF

The GEF, which is the World Bank's largest partner in the area of renewable energy and energy efficiency investments, is the financing mechanism for a range of international environmental agreements, and it provides financing for projects that have global environmental benefits. (http://www.thegef.org and http://www.worldbank.org/gef).

MIGA

MIGA provides political risk insurance against noncommercial risks to eligible foreign investors and commercial banks for qualified investments in developing member countries. (http://www.miga.org)

Carbon Finance

Both the IBRD and the IFC have CFUs that leverage public and private investment for projects that generate GHG emission reductions. This helps to grow the market by extending carbon finance to both developing and transition economies. The funds are provided by private companies and governments seeking to purchase emission reductions to learn how to originate transactions in this complex emerging market. Carbon finance business is divided into separate business lines—the IBRD CFU (http://www.carbonfinance.org) and the IFC CFU (http://www.ifc.org/carbonfinance).

ESMAP

ESMAP is a global technical assistance program and knowledge partnership sponsored by a group of donors, including Canada, Denmark, Finland, Germany, the Netherlands, Norway, Sweden, the United Kingdom, the United Nations Foundation, the United Nations Development Programme, and the World Bank. ESMAP is managed by the World Bank (http://www.worldbank.org/esmap).

ASTAE

In 1992, the World Bank and donor partners established ASTAE to support the transition to environmentally sustainable energy use in developing countries in Asia. ASTAE supports upstream ESW, much like ESMAP, and it also provides assistance in renewable energy and energy efficiency project identification, preparation, and supervision (http://www.worldbank.org/astae/).

Definitions

Following are the definitions used for reporting on the WBG's activities.

New Renewable Energy

Projects that had at least one of the following were considered projects with a new renewable energy component: solar energy for heat and power, wind energy for mechanical and electrical power generation, geothermal and biomass energy for power generation and heat, and hydropower of 10 MW or less per installation.

Energy Efficiency

Energy efficiency comprises end use thermal and electricity efficiency activities (for example, industry, transport, buildings, appliances, and so on), power sector rehabilitation, loss reduction in transmission and distribution, and improvements in the efficiency of district heating systems. Hydropower rehabilitation projects, which do not result in increased capacity (MW), are also classified as energy efficiency. However, this report does not include loss reduction due to rehabilitation of transmission or distribution networks toward meeting the 20 percent growth commitment if the share of transmission and distribution investments cannot be clearly disaggregated from other objectives, such as network expansion and load increase. It also does not include Development Policy Loan commitments unless the share attributable to efficiency can be clearly determined.

Hydropower > 10 MW

The World Bank considers hydropower, regardless of scale, as renewable energy. However, for reporting purposes, hydropower projects in which the installed capacity at a single facility exceeds 10 MW are reported separately. Pumped storage, run-of-river hydropower, and hydropower projects with dams are included here if the capacity exceeds 10 MW.

The WBG supports projects that may be cross-sectoral in nature. For example, renewable energy and energy efficiency components may be embedded within an agricultural, health, or power project. In such blended projects, sometimes it is not easy to specify precisely what the size of each sectoral component is. In this report, as far as possible, great care has been taken to show only the commitment amount associated with new renewables, energy efficiency, or hydropower >10 MW. For example, in a particular project, the total commitment made by IBRD and IDA may be US$100 million. This project may have three different sectoral components: agro-industry, 50 percent; health, 30 percent; and new renewables, 20 percent. In such a case, in this report, only US$20 million has been included as the project's contribution to renewable energy.

Different Reporting Styles

The various World Bank institutions have differing styles of reporting their data because of their different kinds of business. For example, MIGA provides guarantees to projects against various kinds of risks, whereas IBRD and IDA provide project finance and guarantees. Emissions reductions purchases by carbon finance are a revenue stream. The IFC provides both equity and loan financing, as

well as guarantees. For the purposes of this report and to arrive at an estimate of the WBG's total commitments toward renewable energy and energy efficiency, we have added commitments made by each WBG institution. The following distinctions should be kept in mind when reading this report.

IBRD and IDA

For IBRD- and IDA–assisted projects, commitment amounts toward renewable energy, energy efficiency, or both for each project have been used to estimate the cumulative total for the WBG.

The IFC

The report shows IFC net investments from its own account for renewable energy and energy efficiency investment. Previous IFC assessments referred only to stand-alone projects whose sole focus was energy efficiency or renewable energy, thus missing the full scope of investment in sustainable energy undertaken as a component of larger investments in various sectors. The IFC has since revised its methodology so that it now identifies renewable energy and energy efficiency investments in commitments it has made in other sectors such as agriculture, water supply, industry, and transport and in corporate loans to financial intermediaries. The new methodology assesses the percentage of IFC investment in proportion to the full project cost and applies that proportion to the full renewable energy or energy efficiency project value. This methodology has been used to update the IFC's fiscal 2005 renewable energy and energy efficiency commitment amounts. For more details, see "Choices Matter: 2005 Sustainability Report" at www.ifc.org/SustainabilityReport.

The GEF

For approved GEF projects, this report uses the commitment amounts for each project.

MIGA

MIGA normally reports the maximum liability of its guarantee and the foreign direct investment that the guarantee leveraged. For the purposes of arriving at a cumulative total for the WBG, this report added together the MIGA maximum liability.

Carbon Finance

To compare carbon asset purchases and regular project financing, this report considered Emission Reductions Purchase Agreements signed to be the appropriate measure and added those amounts to arrive at the total commitment—that is, the carbon finance business's equivalent of Board approval for World Bank loans.

Reporting Updates

The overall commitment amounts and commitment amounts per WBG institution in this report have been updated from the amounts presented in the bulletin "Right on Target: Progress on Renewable Energy and Energy Efficiency in 2005/2006"[2] and the press release "New Renewable Energy and Energy Efficiency: World Bank Group Exceeds Previous Year's Commitments."[3] This difference occurred because only preliminary IFC data were available at the time of bulletin and press release and there were also some revisions made in the commitment amounts from GEF-IBRD blended projects. The old estimations were US$871 million for renewable energy and energy efficiency, with US$680 million for new renewable energy and energy efficiency, whereas the final data used in this report are US$860 million for renewable energy and energy efficiency, with US$668 million for new renewable energy and energy efficiency. The preliminary IFC data had inadvertently double counted the Trinidad Cement Company Group Swap Project for Trinidad and Tobago, counting it in both fiscal year 2005 and fiscal year 2006, which meant that the US$35 million commitment amount had to be subtracted from the fiscal year 2006 data. There were also a few IBRD projects that had been erroneously classified in its database as renewable energy or energy efficiency instead of power. These were corrected. Last, the percentage of GEF contributions to renewable energy and energy efficiency projects was underestimated in a few projects and was revised.

[30] There is also a fifth institution that is a part of the WBG: the International Centre for Settlement of Investment Disputes (ICSID). Because this institution does not directly support any renewable energy or energy efficiency activities, for this annual report, "WBG" precludes ICSID.
[31] See http://siteresources.worldbank.org/EXTENERGY/Resources/336805-1157034157861/reEEbrochure.pdf.
[32] See http://web.worldbank.org/WBSITE/EXTERNAL/NEWS/0,,contentMDK:21022967~pagePK:34370~piPK:34424~theSitePK:4607,00.html.

Annex 2: Annual Renewable Energy and Energy Efficiency Portfolio Review

Annual Table 1: WBG Renewable Energy and Energy Efficiency Commitments

Type of commitment	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Grand total
New renewables	53	2	56	227	300	59	47	336	15	239	444	26	169	105	192	218	221	2,709
Energy efficiency		265	54	10	59	148	380	56	356	26	295	193	67	168	67	243	447	2,832
Hydropower (> 10 MW)		150	161	938	186	317	819	15	461		320		181	237	81	447	192	4,502
Grand total 53	53	417	271	1,174	545	524	1,245	407	832	264	1,059	219	416	510	339	908	860	10,043

Annual Table 2: WBG Renewable Energy and Energy Efficiency Commitments by Institution or Unit

Institution or unit	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Grand total
GEF–IBRD/IDA			3	36	56	35	10	78	28	56	111	14	37	70	83	100	48	764
GEF-IFC							37	33		30	5		19		14	8	20	165
IBRD Carbon Finance												2	8	10	48	23	14	105
IBRD/IDA	53	392	196	1,113	303	452	1,108	146	534	137	691	197	340	290	194	445	370	6,959
IFC		25	72	26	186	7	36	135	206	15	1	6	13	135		221	393	1,475
IFC Carbon Finance																21	13	34
MIGA						30	35	15	65	26	252			5		91	2	521
Special Financing							20											20
Total commitment	53	417	271	1,174	545	524	1,245	407	832	264	1,059	219	416	510	339	908	860	10,043

Annual Table 3: WBG New Renewables Commitments by Institution or Unit

Institution or unit	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Grand total
GEF–IBRD/IDA			3	26	30	10	7	39	6	56	66	9	36	16	62	47	47	459
GEF-IFC							30	30		14					14	1		89
IBRD Carbon Finance												2	4	10	19	4	8	47
IBRD/IDA	53	2	20	201	270	19	8	132	10	128	127	9	128	64	97	139	136	1,540
IFC			33					135		15		6	1	15		18	17	239
IFC Carbon Finance																10	13	23
MIGA						30	2			26	252							311
Total commitment	53	2	56	227	300	59	47	336	15	239	444	26	169	105	192	218	221	2,708

Annual Table 4: WBG Energy Efficiency Commitments by Institution or Unit

Institution or unit	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Grand total
GEF–IBRD/IDA				10	26	25	3	39	22	1	45	5	1	54	22	53	1	305
GEF-IFC							7	3		16	5		19			7	22	78
IBRD Carbon Finance															13	4	0	18
IBRD/IDA		265	54		33	123	350	14	328	9	244	188	35	34	32	23	115	1,848
IFC									6		1		12	75		156	309	558
IFC Carbon Finance																		-
MIGA														5			1.8	7
Special Financing							20											20
Total commitment		265	54	10	59	148	380	56	356	26	295	193	67	168	67	243	447	2,832

Annual Table 5: WBG Hydropower (>10 MW) Commitments by Institution or Unit

Institution or unit	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Grand total
IBRD Carbon Finance													4		15	15	6	40
IBRD/IDA		125	122	912		310	750		196		320		177	192	66	283	119	3,571
IFC		25	39	26	186	7	36		200					45		47	67	677
IFC Carbon Finance																11	-	11
MIGA							33	15	65							91		203
Total commitment		150	161	938	186	317	819	15	461	-	320	-	181	237	81	447	192	4,502

Annual Table 6: WBG Renewable Energy and Energy Efficiency Commitments by Region

Region	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Grand total
Africa		127	73	203		3	12	30	201	7	124		78	32	46	101	126	1,163
East Asia and Pacific	51		121	410	310	367	400	145	123	139	513	8	124	177	47	368	232	3,532
Europe and Central Asia		290			33	140	381	14	238	15	68	186	75	139	147	260	313	2,299
Latin America and Caribbean	2		75	340	199	10	2	41	186	79	219	6	30	78	30	92	141	1,531
Middle East and North Africa					2	4									40	9	11	67
Global							32	148		25		12	1		13		1	232
South Asia			2	222			419	29	85		135	7	108	85	15	77	35	1,218
Grand total53		417	271	1,174	545	524	1,245	407	832	264	1,059	219	416	510	339	908	860	10,043

Annual Table 7: WBG New Renewables Commitments by Region

Region	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Grand total
Africa		2	18	3		3	8	30	5	6	124		16	32	46	46	19	357
East Asia and Pacific	51				300	49		112	2	139		3	18		37	129	103	942
Europe and Central Asia							7		9	6	6	2		0	56	10	11	107
Latin America and Caribbean	2		37	2		3	2	20		78	204	6	26	35		15	56	486
Middle East and North Africa						4									40	1	5	50
Global							30	145		10		12	1		13		0	212
South Asia			2	222				29			110	2	108	38		17	27	554
Grand total	53	2	56	227	300	59	47	336	15	239	444	26	169	105	192	218	221	2,708

Annual Table 8: WBG Energy Efficiency Commitments by Region

Region	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Grand total
Africa							4		1	1						4	30	40
East Asia and Pacific			54	10	10	8		33	121		193	5	1	32	11	77	72	624
Europe and Central Asia		265			33	140	374	14	229	9	62	183	65	131	41	79	292	1,918
Latin America and Caribbean					14			6		1	15		0	6	15	61	38	157
Middle East and North Africa					2											9	6	17
Global							2	3		15							1	20
South Asia									6		25	5	1			13	8	58
Grand total		265	54	10	59	148	380	56	356	26	295	193	67	168	67	243	447	2,832

Annual Table 9: WBG Hydropower (>10 MW) Commitments by Region

Region	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Grand total
Africa		125	55	200					196				62			51	77	766
East Asia and Pacific			67	400		310	400				320		105	145		163	57	1,967
Europe and Central Asia		25											10	8	51	170	11	274
Latin America and Caribbean			39	338	186	7		15	186				4	37	15	16	47	888
South Asia							419		79					47	15	47		607
Grand total		150	161	938	186	317	819	15	461	-	320	-	181	237	81	447	192	4,502

Annex 3: List of FY06 Renewable Energy and Energy Efficiency Projects (in millions of US dollars)

No.	Country	Project Name	Energy Type	Financing Sources	RE or EE Component Financing
		Africa Region			
1	Africa	Africa Region - Benin and Ghana Second Coastal Transmission Backbone Project	Energy supply/ distribution (EE) Hydro>10MW	IDA IDA	27.00 3.00
2	Africa	Africa Region - Mali, Mauritania, and Senegal Felou Second Hydroelectric Project	Hydro>10MW	IDA	69.75
3	Ethiopia	Ethiopia GEF Energy Access Project	Solar PV, Mini-Hydro	GEF (WB)	4.93
4	Ethiopia	Accelerated Electricity Access (Rural) Expansion	DSM (EE)	IDA	1.07
5	Guinea	Guinea Electric Sector Efficiency Improvement	Energy supply/ distribution; DSM (EE)	IDA	2.30
6	Nigeria	Nigeria-National Energy Dev SIL	Small Hydro, Solar PV	IDA	13.76
7	Sierra Leone	Sierra Leone Bumbuna Hydroelectric Completion	Hydro>10MW	IBRD Carbon Finance	4.50
		East Asia & Pacific Region			
8	China	Anhui Conch Cement Company Limited	Industrial (EE)	IFC	10.93
9	China	China: Fifth Inland Waterways	Hydro>10MW	IBRD	35.00
10	China	China Utility-Based Energy Efficiency Finance Program	DSM/residential & commercial (EE)	GEF (IFC)	19.50
11	China	China Utility-Based Energy Efficiency Finance Program	DSM/residential & commercial (EE)	IFC	40.00
12	China	China-Renewable Energy II (CRESP II)	Wind, Small Hydro	IBRD	86.33
13	China	Yunnan Zhongda Yanjin Power Generation Co.	Hydro>10MW	IFC	22.00
14	Lao PDR	Rural Electrification Phase I of Rural Electrification Program	DSM/residential & commercial (EE) Mini/Micro Hydro	GEF (WB) GEF (WB)	0.75 0.25
15	Lao PDR	Rural Electrification Phase I of Rural Electrification Program	Solar PV, Mini/Micro Hydro and Biomass Energy supply/ distribution (EE)	IDA IDA	2.06 1.00
16	Papua New Guinea	Rural Energy Fund (GEF-Teacher's Solar Lighting Project)	Solar PV	GEF (WB)	0.99
17	Philippines	20 MW Palinpinon II Geothermal Optimization Project	Geothermal	IBRD Carbon Finance	-
18	Philippines	Philippines-Support for Strategic Local Development & Investment	Mini Hydro	IBRD	13.00
		Europe & Central Asia Region			
19	Armenia	Renewable Energy GEF Project	Small Hydro, Wind, Solar, and Geothermal	GEF (WB)	3.00
20	Armenia	Renewable Energy Project	Small Hydro, Wind, Solar, and Geothermal	IDA	5.00
21	Armenia	Urban Heating Project	District heating (EE)	IDA	3.75

No.	Country	Project Name	Energy Type	Financing Sources	RE or EE Component Financing
22	Belarus	Post-Chernobyl Recovery Project	District heating (EE)	IBRD	42.50
23	Bosnia-Hezegovina	Raiffeisen Bank D.D. (Housing/EE)	DSM/residential & commercial (EE)	IFC	15.40
24	Bosnia-Herzegovina	Energy Community of South East Europe and Bosnia and Herzegovina Project	Hydro>10MW	IDA	10.80
25	Croatia	District Heating Project	District heating (EE)	IBRD	29.80
26	Hungary	OTP Bank Hungary (Sub-sovereign Schools EE)	District heating (EE)	IFC	106.42
			DSM/residential & commercial (EE)	IFC	30.58
27	Moldova	Energy Conservation & Emissions Reduction	District heating (EE)	IBRD Carbon Finance	0.48
28	Moldova	Public Heating Biomass Systems in Moldovan Rural Communities	Biomass	IBRD Carbon Finance	1.19
29	Poland	Poland-Stargard Geothermal Project	Geothermal	IBRD Carbon Finance	0.52
30	Romania	Transport Trade Services SA	Transport (EE)	IFC	7.65
31	Russia	Bema Gold Corporation	Industrial (EE)	IFC	1.89
32	Russia	United Metallurgical Company (OMK)	Industrial (EE)	IFC	8.48
33	Russia	Russia Sustainable Energy Finance Program (RSEF)	Industrial (EE)	IFC	3.00
			Biofuel	IFC	1.00
34	Serbia and Montenegro	Energy Community of South East Europe- Montenegro Project	Energy supply/ distribution (EE)	IDA	1.71
35	Turkey	Eren Expansion	Industrial (EE)	IFC	10.00
36	Ukraine	Industrial Union of Donbass (ISD)	Industrial (EE)	IFC	30.06
		Latin America & Caribbean Region			
37	Argentina	Arcor S.A.I.C.	Industrial (EE)	IFC	0.26
38	Brazil	Itambe	Industrial (EE)	IFC	0.02
39	Brazil	MRS Logistica SA	Transport (EE)	IFC	4.50
40	Brazil	Sugar Bagasse Cogeneration Project	Biofuel	IBRD Carbon Finance	0.55
41	Brazil	Energia Renovaveis do Brasil Ltda.	Wind	IFC	5.50
42	Brazil	TAM Airlines	Transport (EE)	IFC	25.00
43	Chile	Chile Quilleco Hydropower Project	Hydro>10MW	IBRD Carbon Finance	1.50
44	Chile	Hidroelectrica La Higuera	Hydro>10MW	IFC	45.00
45	El Salvador	Biothermica Energy Inc.	Biomass	MIGA	1.80
46	Guatemala	Municipality of Guatemala (CGP)	Transport (EE)	IFC	6.70
47	Honduras	Honduras Rural Infrastructure Project	Solar PV and Mini Hydro	DA	3.76

No.	Country	Project Name	Energy Type	Financing Sources	RE or EE Component Financing
48	Honduras	Rural Electrification Project	Micro Hydro, Wind, Biomass, and Solar PV	GEF (WB)	2.35
49	Mexico	Large-Scale Renewable Energy Development Project	Wind	GEF (WB)	25.35
50	Peru	Peru -Rural Electrification	Small Hydro; other RE	GEF (WB)	10.00
51	Peru	Peru -Rural Electrification	Hydro and other RE	IBRD	6.50
52	Peru	Peru Huaycoloro Landfill Gas Recovery	Biomass	IBRD Carbon Finance	2.22
		Middle East & North Africa Region			
53	Djibouti	Djibouti-Power Access and Diversification	Wind	IDA	5.32
54	Yemen, Republic of	RY-Power Sector	Energy supply/ distribution; DSM (EE)	IDA	6.13
		South Asia Region			
55	India	DCM Shriram Consolidated Limited (DSCL - II)	Biofuel	IFC	3.75
56	India	India Hydro Development Corporation (IHDC)	Energy supply/ distribution (EE)	IFC	8.11
57	India	India Hydro Development Corporation (IHDC) - Ascent Hydro Projects Limited (Ascent)	Small Hydro	IFC	7.12
58	Nepal	Nepal - Biogas Program	Biofuel	IBRD Carbon Finance	3.38
59	Sri Lanka	INCaF Eco Power Ltd.	Small Hydro	IFC Carbon Finance	5.00
60	India	INCaF Enercon	Wind	IFC Carbon Finance	8.00
		Global			
61	Global	Support to Sustainable Energy-Turbo Tech Expansion	Industrial (EE)	TFs (EOF-IFC)	0.60

Notes:
1) RE stands for renewable energy, and EE stands for energy efficiency.
2) In the absence of a precise methodology, the IFC assesses the percentage of IFC investment in proportion to the full project cost and applies that proportion to the full RE/EE project value. For more details see "Choices Matter: 2005 Sustainability Report" at www.ifc.org/SustainabilityReport/, last accessed November 8, 2006.
3) Fuel cells are categorized as RE by IFC disregarding of whether the energy resource used to generating the hydrogen has been a fossil fuel or renewable energy resource. For the World Bank fuel cells are only filed as renewable energy if the energy resource used to generating hydrogen is a renewable energy resource. Thus this report does not include the IFC (GEF) Fuel Cells Project (US$3.3M), because it does not match the World Bank's definition of renewable energy.
4) Hydropower rehabilitation projects, which do not result in greater output, are classified as EE (by both the IBRD/IDA and IFC).

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