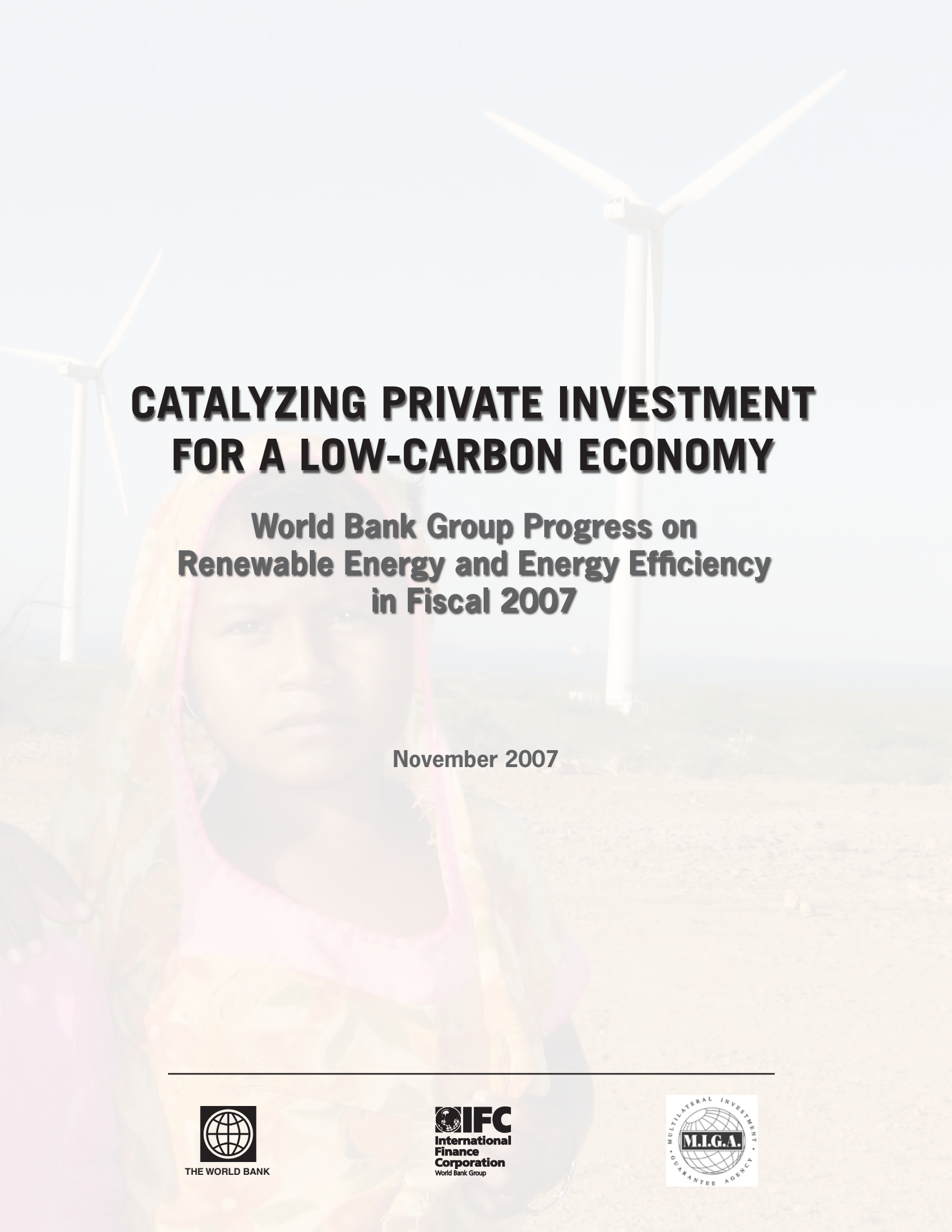
CATALYZING PRIVATE INVESTMENT FOR A LOW-CARBON ECONOMY

World Bank Group Progress on Renewable Energy and Energy Efficiency in Fiscal 2007

THE WORLD BANK

IFC International Finance Corporation World Bank Group

M.I.G.A. MULTILATERAL INVESTMENT GUARANTEE AGENCY



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Acronyms and Abbreviations

AAA	Analytical and advisory activity
AFR	Africa Region
ASTAE	Asia Alternative Energy Program
BEL	Bujagali Energy Ltd.
BOOT	Build-Own-Operate-Transfer
CEIF	Clean Energy Investment Framework
CEPALCO	Cagayan Electric Power and Light Company
CFB-IBRD	The World Bank's Carbon Finance Business
CFU	Carbon Finance Unit
CG	Competitive Grant (Facility)
CHEEF	China Energy Efficiency Financing Project
CNG	Compressed natural gas
CRESP	China Renewable Energy Scale-Up Program
DVD	Digital video disc
EAP	East Asia and Pacific Region
ECA	Europe and Central Asia Region
EE	Energy efficiency
EEfSD	Energy Efficiency Action Plan for Sustainable Development
EETG	Energy Efficiency Thematic Group
EIA	Environmental Impact Assessment
ESCO	Energy service company
ESMAP	Energy Sector Management Assistance Program
FI	Financial institution
FINESSE	Financing Energy Services for Small-Scale Energy Users
FYR	Former Yugoslav Republic
GDP	Gross domestic product
GEF	Global Environment Facility
IBRD	International Bank for Reconstruction and Development
IDA	International Development Association
IEA	International Energy Agency
IFC	International Finance Corporation
IPO	Initial public offering
IPP	Independent power producer
IREDA	India Renewable Energy Development Agency
IRIN	Integrated Regional Information Networks (IRIN), U.N. Office for the Coordination of Humanitarian Affairs
IUCN	World Conservation Union
LCR	Latin America and Caribbean Region
LED	Light-emitting diode
LLC	Limited liability corporation
MBIL	Moser Baer India Ltd.
MIGA	Multilateral Investment Guarantee Agency
MNA	Middle East and North Africa Region
NGO	Nongovernmental organization
NOZ-PV	Netherlands Research Program PV
OECD	Organisation for Economic Co-operation and Development
PNOC-EDC	Philippines National Oil Company's Energy Development Corporation
PV	Photovoltaic(s)
PVMTI	Photovoltaic Market Transformation Initiative

QR	Quick Response (Facility)
RE	Renewable energy
REDP	Renewable Energy Development Project (China)
RETG	Renewable Energy Thematic Group
SAR	South Asia Region
SDG	Solar Development Group
SHP	Small hydropower
SHS	Solar home system
SME	Small and medium enterprise
SSMP	Sustainable Solar Market Package
UETCL	Uganda Electricity Transmission Company Limited
UNEP	United Nations Environment Programme
UNF	United Nations Foundation
VCD	Video compact disc
WBG	World Bank Group
Y	Yuan (currency of China)

Units of Measure

GWh	Gigawatt-hour
km	Kilometer
kWp	Kilowatt-peak
MW	Megawatt
Wp	Watts-peak

Foreword

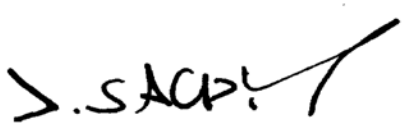
Renewable energy and energy efficiency are at the nexus of the goals of the World Bank Group's energy work: poverty alleviation, energy security, and climate change mitigation. Oil and gas price rises, the instability of energy markets, the major impacts of climate change that the Intergovernmental Panel on Climate Change and Sir Nicholas Stern's reports convincingly articulated, and the need to meet the Millennium Development Goals by 2015 have given even greater urgency to enhanced support for clean energy.

To overcome these challenges and do so in a sustainable manner, the World Bank Group has committed more than US$11 billion since 1990 for renewable energy and energy efficiency with commitments in fiscal 2007 rising to US$1.4 billion, or 40 percent of total energy sector lending. Every dollar of our funds has leveraged about two dollars of investment from the private sector, governments, and others. The progress we have achieved establishes the base of experience for implementing the Clean Energy Investment Framework (CEIF). The CEIF was launched in 2006 to give greater impetus to addressing the challenge of energy access for growth and the causes and impacts of climate change. Renewable energy and energy efficiency will also be central to the World Bank Group's Climate Change Strategy that will be issued shortly.

Achieving the goals of the CEIF and the Climate Change Strategy demands actions on a number of fronts—policy, governance, capacity, and investment. The investment challenge remains paramount, and more so for renewable energy and energy efficiency, which are more capital intensive than other forms of energy. The World Bank Group, although one of the largest multilateral lenders for energy, is only one player in the field, and cannot possibly meet the investment needs alone. Our total financial commitment for the energy sector in the 2007 financial year was US$3.6 billion. Although we continue to grow our energy investments in absolute terms, we increasingly see our role as a catalyst in working with the private sector and others to leverage our resources. This is a vital mission if we are to help our partner countries in their transition to a low-carbon economy. The poor are, after all, the most vulnerable and the least able to adapt to the devastating impacts of climate change.

Previous renewable energy and energy efficiency progress reports focused on how the World Bank Group was meeting the commitment it made in June 2004 in Bonn, Germany, to increase our support for new renewable energy and energy efficiency by 20 percent per year; and defining the impact our support has had in improving lives. This report focuses on the efforts we are making to work in partnership with the private sector in order to leverage our resources. Accordingly, we are pleased that this report is jointly prepared by the International Finance Corporation and the World Bank.

Rachel Kyte, Director
International Finance Corporation



Jamal Saghir, Director
Chair, Energy and Mining Sector Board
The World Bank

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Cover: Jepirachi wind power project, Colombia (Adriana Valencia)

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Executive Summary

Evidence is mounting that developing countries will be disproportionately affected by the adverse impacts of climate change, putting at risk hard-earned development gains. Sir Nicholas Stern's 2006 economic review of climate change estimated that "business as usual" emissions of greenhouse gases might lead to damages between 5 and 20 percent of gross domestic product (GDP) over the next 200 years. The poor are the most vulnerable and least able to adapt. At the same time, increasing energy supply and services are critical for economic growth for all developing countries. A consensus is growing that moderating and managing climate change is central to every aspect of poverty reduction, economic growth, and development.

> *We are working with our Board to significantly step up our assistance to the international efforts to address climate change.... Our main objective will be to help countries "mainstream" adaptation and mitigation actions within their growth strategies, including plans for energy development, agriculture, and land use*.
>
> —Robert B. Zoellick, President, World Bank Group.[1]

Leveraging World Bank Group Resources

The response of markets and the private sector will be critical for successfully increasing energy access and mitigating and adapting to climate change. The continuing focus of WBG efforts will be to support the engagement of the private sector and other partners in this effort, through diverse measures, including investment support, barrier removal, and competitive markets as sources of investment and solutions. The role of governments remains important for establishing the required policy and regulatory environment and other efforts at barrier removal. The many lessons learned are being applied regionally, from country to country and from one sector to another. This report draws out such lessons from our experiences in solar photovoltaics (PV), energy

[1] "Catalyzing the Future: An Inclusive and Sustainable Globalization," Annual Meeting Board of Governors of the World Bank Group, Washington, D.C., October 22, 2007.

efficiency, and hydropower. Among them are the following:

- Improve the policy and regulatory environment to reduce energy price distortions, mitigate regulatory risks, streamline approval processes, and increase transparency in decision making.
- Adhere strictly to good environmental and social management principles and ensure that all parties—from consumers and affected communities, to energy suppliers and financiers—benefit. Embed sustainability principles in executing agencies.
- Although economic viability may be compelling, financial viability, as well as market and consumer confidence, are sine qua non for project success and scale-up. Pay heed to quality and meet consumer expectations in service and value.
- Increase access to pre-investment and investment financing, and introduce risk management and credit enhancement instruments. Benefit from new instruments, such as those offered by the carbon markets.
- Introduce business models better suited to renewable energy and energy efficiency, including distributed generation. Be adaptable and take advantage of innate capacities within each country.
- Build capacity and increase knowledge among the domestic financial sector, industry, utilities, engineering, policy makers, and consumers. Support South–South knowledge exchanges.
- Facilitate access to improved technologies and strengthen the capacity to plan, design, construct, and integrate such technologies into the energy supply sectors.

The WBG brings to bear a wide range of financial and nonfinancial instruments to support the development of renewable energy and energy efficiency. Among them are conventional lending instruments; equity and quasi-equity; partial risk guarantees; currency, commodity, and interest rate risk management; and carbon finance; as well as capacity building and policy, legal, and regulatory support.

World Bank Group Financial Support for Renewable Energy and Energy Efficiency

World Bank Group funding for renewable energy—comprising wind, solar, biomass, geothermal, and hydropower—and energy efficiency projects rose by two-thirds in fiscal 2007 to US$1.43 billion.

In fiscal 2007 (July 1, 2006, to June 30, 2007), total WBG financial commitments for renewable energy, including hydropower of all sizes, and energy efficiency rose to US$1.4 billion (Table 1). This represents a 67 percent scale-up in financing for renewable energy [2] and energy efficiency from US$860 million in fiscal 2006. The GEF has been an important partner, contributing US$128 million in co-financing for World Bank projects. The World Bank's Carbon Finance Unit has been an important contributor—its impact is even greater, since every dollar of carbon financing is estimated to leverage five to six dollars in investment funds. In fiscal 2007, the WBG supported 63 renewable energy and energy efficiency projects in 32 countries with more than half the financing going to Africa. Commitments for new renewable energy and energy efficiency were US$683 million, and US$751 million was committed for hydropower projects greater than 10 MW per facility. As shown in Figure 1, the cumulative WBG financial commitments to renewable energy and energy efficiency from fiscal 1990 to fiscal 2007 exceeded US$11 billion, with a nearly steady increase in commitments from 2002.

The World Bank (IBRD and IDA), in partnership with GEF, committed US$821 million for

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

Table 1: World Bank Group Commitments for Renewable Energy and Energy Efficiency in FY07

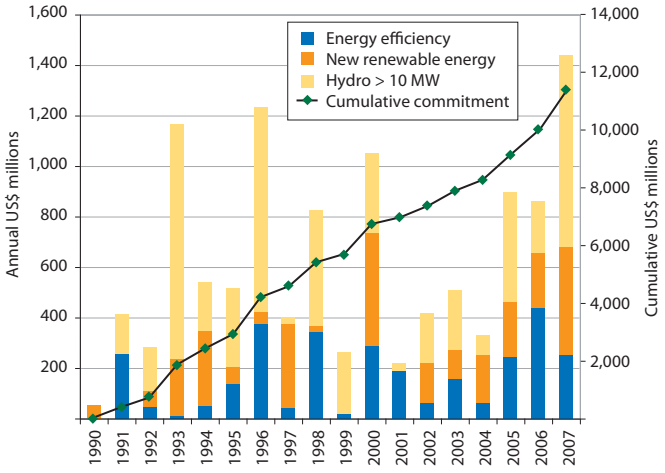
Source of funds	*New renewable energy*	*Hydro > 10MW*	*Energy efficiency*	*Total*
World Bank (IBRD/IDA)	70	430	49	549
GEF (World Bank)	121	0	7	128
World Bank (Carbon Finance)	68	66	10	144
IFC (own funds)	154	140	156	450
IFC (Carbon Finance)	7	0	0	7
MIGA	0	115	40	155
Total	421	751	262	1,433

Note: Some columns may not add up exactly because of rounding.
Source: WBG databases.

renewable energy and energy efficiency projects and activities. MIGA committed US$155 million in guarantees for clean energy–related investments, with significant expected leverage in additional private sector financing. The IFC made 25 investments totaling US$450 million in energy efficiency and renewable energy, such as biomass cogeneration systems, hydropower, wind, geothermal, solar PV manufacturing. The total value of the renewable energy and energy efficiency investments supported by the IFC exceeded US$1.1 billion, of which US$763 million came from commercial investors. Thus, every dollar of IFC lending was associated with US$2 of private sector investment.

In fiscal 2007 the share of renewable energy and energy efficiency financing reached 40 percent of total energy commitments.

Figure 1: World Bank Group Commitments for Renewable Energy and Energy Efficiency, FY90–07

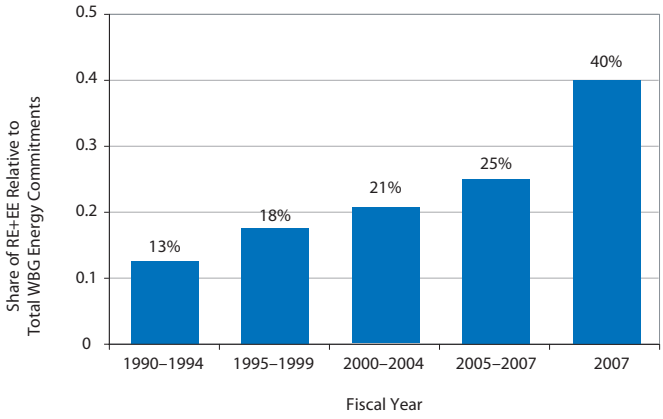


Source: WBG databases

There has been a steady rise in the share of financing the WBG committed for low carbon renewable energy and energy efficiency since 1990 (Figure 2). In 1990–94 the share was about 13 percent of total energy sector commitments. The share of renewable energy and energy efficiency financing rose to 25 percent of total energy commitments in the three years, fiscal 2005–07, and 40 percent in FY 07.

At the Bonn International Conference on Renewable Energies in June 2004, the WBG made a commitment to accelerate its support for new renewable energy and energy efficiency.The WBG committed to increasing our financial commitments for new renewable energy and energy efficiency at a growth rate of 20 percent per year between fiscal 2005 and 2009, compared with a baseline commitment of US$209 million (equal to the average of the previous three years). The WBG has exceeded its Bonn commitment by almost 100 percent. From fiscal 2005 to fiscal 2007,

Figure 2: Share of World Bank Group Commitments for Renewable Energy and Energy Efficiency Relative to Total Energy Commit-



Source: WBG databases.

we committed US$1.8 billion for new renewable energy and energy efficiency compared with the Bonn commitment goal of US$913 million for the same period.

Technical Assistance

Increasing adoption of clean energy options is supported by a variety of economic sector work and technical assistance. We are supporting the preparation of low-carbon energy strategies in advanced developing countries. Work began in fiscal 2007 on four Low-Carbon Country Growth Case Studies (Brazil, China, India, Mexico), and South Africa beginning in FY08. Other activities performed in the past year include studies, reports, and policy notes on renewable energy policy in Colombia and Morocco, energy security in Uruguay, and rural electrification in Mexico, Peru, and Timor-Leste. Energy efficiency also received considerable attention, for example, building energy efficiency in China and energy efficiency policy formulation in Morocco.

The Energy Sector Management Assistance Program (ESMAP) and the Asia Alternative Energy Program (ASTAE) have been major resources for this work. Of special note is the ESMAP-funded Investment Climate Assessment for Renewable Energy in India supported by the WBG. It is examining barriers and barrier removal options related to the development of economically viable renewable energy, encompassing policy, regulatory, financing, and entrepreneurial constraints. The outcome of the study will be guidance to policy makers and regulators for establishing a framework to support faster development of renewable energy by reducing transactions costs and risks to private investors.

Previous renewable energy and energy efficiency progress reports focused on the progress the WBG was making in meeting its Bonn commitments and the impact the projects were having in improving the lives of people in developing countries. This report again details progress on clean energy, but in addition focuses more specifically on the efforts we are making to work in partnership with the private sector to leverage our resources, since the WBG, despite being one of the largest multilateral development bank lenders for energy, can meet only a small part of the investment needed. Consequently, as the WBG continues to grow our energy investments in absolute terms, we increasingly see our role as a catalyst in working with our client countries and the private sector to leverage our resources.

Introduction

Presently, renewable energy's contribution to global primary energy is only 13 percent of the total, with traditional biomass and large hydropower contributing the largest share. The share of new renewable energy is tiny at about 0.5 percent of global primary energy use.[3] Energy efficiency opportunities are hardly tapped. Nevertheless, with high oil prices, energy supply uncertainties, and climate change concerns, there is a greater appreciation of the role that renewable energy and energy efficiency can play in increasing supply and moderating demand, and in helping to move toward a low-carbon economy.

There is also recognition that multilateral financial resources and government resources are inadequate to meet the investment needs. Therefore, the large amounts of financing needed for transitioning to a low-carbon economy will only be available through the efficient mobilization of private capital. From the point of view of private investors, mobilizing private capital for renewable energy and energy efficiency in developing countries will require obtaining risk-adjusted returns from such investments comparable with returns from more traditional energy alternatives.

Renewable energy and energy efficiency scale-up demands concerted action on a number of fronts—policy, legal, regulatory, technical, financial, and risk mitigation. The three WBG agencies—the World Bank, IFC, and MIGA—bring to bear their individual strengths to offer a menu of services to their member countries. A few examples illustrate this unique capability (Box 1).

[3] International Energy Agency, "Renewables in Global Energy Supply," Paris, January 2007.

Box 1: Applying WBG Instruments for Renewable Energy and Energy Efficiency Scale-Up

Meeting a national renewable energy goal in China. China committed itself to raising its share of renewable energy to 15 percent of total electricity generation by 2020 as a substitute for coal-fired power generation and for uplifting regions where economic development lags. To support this commitment, the Government of China promulgated its landmark Renewable Energy Law. The World Bank supported this effort first with technical assistance and then with IBRD and GEF financing, and approved the Renewable Energy Scale-Up Project. Financing for the first phase is US$174 million from IBRD and US$40 million from GEF. In parallel, an IFC loan of up to US$22 million to Zhongda Sanchuan, a local hydropower development company based in Zhejiang, supports three run-of-river hydropower stations along the White Water River in Yunnan Province. The World Bank Carbon Finance Unit is purchasing carbon offsets from a 100 MW wind farm in Huitingxile, Inner Mongolia.

Building markets for renewable energy in South Africa. The Renewable Energy Market Transformation Project supported by the Bank will help establish policy and regulatory frameworks and build institutional capacity for renewable energy development. The US$17 million is funded by a US$6 million grant from GEF, US$2.3 million contribution from the South African government, and US$9 million leveraged from the private sector. The project's four-year objective is to assist the government meet its target of supplying 4 percent of electricity with renewable energy by 2013.

Leveraging private finance for energy efficiency by IFC. Over more than a decade, IFC has developed and refined a highly successful approach to leveraging commercial lending for energy efficiency investments through training and risk mitigation instruments provided to local financial institutions in emerging markets. The IFC model started in Hungary with a US$5 million grant from the GEF that was expanded with additional GEF support to cover several countries in Central Europe, and subsequently was adapted to projects in China, Russia, and a new facility in development in the Philippines.

Creating the foundation for a global wind industry in India. The WBG support for new renewable energy began in 1994 when the Government of India set policy targets and offered financial incentives to stimulate new renewable energy development. These have had the desired effect of producing a large and vibrant market for wind energy and small hydropower, among others. Today India is the third largest wind market globally. It has a strong domestic wind turbine manufacturing industry that is expanding internationally. In 2007 the IFC made a corporate loan of up to US$33 million to MSPL Limited, one of India's largest iron ore manufacturers to help them construct two new wind farms in Maharashtra State to increase their installed capacity from 111 MW to about 150 MW. This financing also illustrates the growing global trend toward investment in wind and other renewable energy projects by industrial companies from outside the energy sector—a trend that India set in the early 1990s.

Geothermal industry privatization in the Philippines. The IFC made a US$50 million equity investment in the Philippines National Oil Company's Energy Development Corporation (PNOC-EDC) as part of the state-owned enterprise's initial public offering (IPO) on the Philippines Stock Exchange. The investment supported the Philippine government's goal of privatizing energy sector assets and expanding the geothermal energy sector. It is expected that with the success of the IPO and competitive selection of a new private sector majority shareholder, PNOC-EDC can both expand its development of local renewable energy projects and become a global player in the development of geothermal resources. This project used a new instrument that was developed jointly by the World Bank and IFC—Subnational Finance—to support well-run subnational entities, such as local governments and public economic enterprises, in their financing programs without the need for national government guarantees.

Carbon finance for leveraging investments. The World Bank was a pioneer in establishing the carbon market beginning with the Prototype Carbon Fund. Today, the World Bank manages ten carbon funds and facilities which are public-private partnerships bringing together ten governments and 65 private sector firms from industrialized countries. They have entrusted the World Bank to manage more than US$2billion in funds for the purchase of carbon emissions reductions in developing and transition economies.

Given the scale of investments needed to increase or improve access to energy in developing countries, there is an urgency to move beyond traditional investment vehicles to leverage private investment. The WBG is employing its full range of financial and nonfinancial instruments to overcome the hurdles to private investment in developing countries. Among them are project risks, subsidies for fossil fuels, unfavorable utility regulatory policies, and other factors that increase the perceived risks. The result of these barriers is reduced availability and higher costs for financing, particularly when dealing with new technologies or those not widely used in a particular region. Even when financial markets are well developed within a country, financing large infrastructure projects may be difficult without some additional support—again particularly if new technology is involved. Smaller, widely dispersed opportunities (such as improvements in the energy efficiency of buildings) are also typically difficult to finance because of relatively high transaction costs. There is also a higher risk perception because of the lack of awareness and experience among investors and financiers. An integrated approach combining country support, technological support, and creative financing is therefore most likely to be effective.

This report examines how the WBG has supported renewable energy and energy efficiency to respond to calls for urgent action on clean energy, improve energy security, and increase access to energy for development. The WBG's renewable energy and energy efficiency progress

in fiscal 2007, including our response to the commitment made in Bonn, Germany, in June 2004, is described in Chapter 5.[4]

The previous report focused on the development outcomes and the positive changes that can be made in peoples' lives through the effective use of renewable energy and energy efficiency technologies. The fiscal 2004 and fiscal 2005 reports informed the readers of the specifics of each WBG institution's support for renewable energy and energy efficiency.

This report highlights the role of the WBG in leveraging and mobilizing private investment for renewable energy and energy efficiency. It draws lessons from projects that the WBG supports and discusses how a range of financial instruments at our disposal is used to leverage private capital. To this end, the report discusses three areas of applications—hydropower, energy efficiency, and solar PV. Case studies throughout the report illustrate different models used to partner with the private sector to support renewable energy and energy efficiency development.

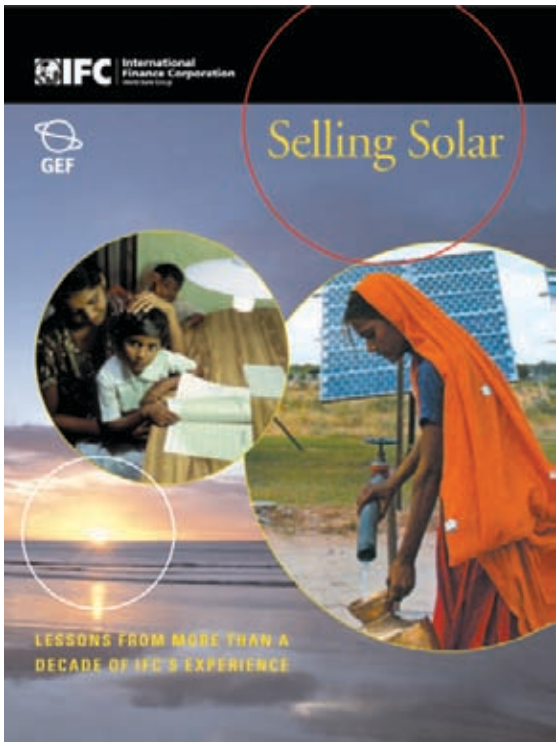
The private sector response has been positive, and the outcomes encouraging. The results have established the basis for an enduring partnership to support the dual goals of development and climate protection. Looking forward, the emphasis on renewable energy and energy efficiency development within the WBG will continue as we operationalize the Clean Energy Investment Framework (CEIF).[5] The World Bank Group launched the CEIF in 2006 to address climate change not only as a risk to development, but also as an opportunity for Bank clients to accelerate their economic transformation and take advantage of new technologies. Renewable energy and energy efficiency will contribute significantly to this enhanced strategy.

[4] In June 2004, at the Bonn International Conference on Renewable Energies, the World Bank Group committed to scaling up its renewable energy and energy efficiency financial assistance by an average of 20 percent per year over five years (FY05–09) and to reporting on its annual performance in supporting renewable energy and energy efficiency (the "Bonn target").

[5] World Bank Sustainable Development Network, "Clean Energy for Development Investment Framework: Progress Report on the World Bank Group Action Plan." Report to the Development Committee, World Bank, Washington, D.C., September 27, 2007.

Selling Solar: Lessons from a Decade of IFC and World Bank Experience

Together the World Bank and the IFC constitute a major financier of PV in developing countries with projects valued at more than US$600 million that serve about 1.3 million households and other facilities in about 30 countries in Africa, Asia, and Latin America (see Table 2). They range from support for the installation of 400,000 PV systems in China, and financing solar lighting for teachers in remote areas of Papua New Guinea, to the provision of lighting and basic electricity services for rural Ethiopians to a grid-connected 1 MW PV system in the Philippines that demonstrates the value of conjunctive use of PV and hydropower. The chapter highlights lessons emerging from WBG experiences in supporting PV for development.



World Bank Group Solar Photovoltaics Projects

With its mandate to further economic development through the private sector, the IFC had its first involvement with investing in PV markets in 1989 when it made a US$3 million investment (debt and equity) in Shenzhen YK Solar PV Energy Co., Ltd., a solar PV manufacturer in China. Although the investment, made using regular IFC funds, did not meet its original expectations, it established an important precedent for investing in solar PV businesses in frontier markets by not only demonstrating confidence in viability of the PV technology, but also by focusing on commercializing the deployment of this technology in the developing world.

In the mid-1990s, the World Bank began supporting PV systems (or solar home systems, SHSs), as a least-cost alternative to grid extension for governments to deliver on promises of energy for development. The high priority accorded to rural electrification, the large numbers of unelectrified households, and the availability of financing through public programs also appeared to be potentially well suited to introducing PV for off-grid electrification on a large scale. World Bank experience is encouraging, with about 0.65 million installations completed out of its 1.2 million portfolio in 23 countries.

To date, the IFC has managed five GEF-funded solar PV initiatives: IFC/GEF Small and Medium Scale Enterprise Program (SME Program), Photovoltaic Market Transformation Initiative (PVMTI), Solar Development Group (SDG), Renewable Energy and Energy Efficiency Fund, and

Table 2: World Bank Group Solar PV Initiatives

Country	*Project*	*Target number of systems*	*Solar PV capacity (kWp)*	*Total cost (US$ million)*
Argentina	Renewable Energy in the Rural Market	30,000	2,843	36.0
Bangladesh	Rural Electrification & Renewable Energy Development	198,000	9,900	91.4
Bolivia	Decentralized Energy, ICT for Rural Transformation	60,000	2,600	38.6
Burkina Faso	Energy Access Project	2,100	100	2.0
Cambodia	Rural Electrification and Transmission	10,000	400	4.0
Cape Verde	Energy and Water Project	4,500	129	2.5
China	Renewable Energy Development	400,000	10,000	144.9
Ethiopia	Energy Access	6,300	407	5.4
India	Renewable Resources Development	45,000	2,500	24.0
Indonesia	Solar Home Systems	8,500	425	3.8
Lao PDR	Southern Provinces Rural Electrification, and Rural Electrification Projects	13,000	460	4.3
Mali	Household Energy and Universal Access Project	10,000	350	3.5
Mexico	Renewable Energy for Agriculture, and Rural Electrification (FY08)	8,345	1,767	27.6
Mongolia	Renewable Energy and Rural Access	50,000	520	5.2
Mozambique	Energy Reform and Access, and PV for Schools and Health Clinics	9,800	1,096	13.5
Nicaragua	Off-grid Electrification for Rural Development	6,000	215	3.0
Pacific Islands	Regional Sustainable Energy Finance	21,000	630	16.5
Papua New Guinea	Teachers Solar Lighting	2,500	100	2.2
Philippines	Rural Power and IFC 1 MW grid-tied project	135,000	10,000	120.0
Sri Lanka	Energy Services Delivery, Renewable Energy for Rural Economic Development (RERED), and RERED Additional Financing	180,000	7,200	62.3
Tanzania	Energy Development and Access (FY08)	11,800	800	20.0
Uganda	Energy for Rural Transformation	8,300	600	18.8
Zambia	Increased Access to Energy (FY08)	8,300	415	11.0
Multiple countries	IFC-financed financing facilities	100,000+	8146	25.3
Totals		1.33 million	61.62 MW	US$686 million

* Includes projects of the SME Program in Bangladesh, Dominican Republic, Honduras, Tunisia, and Vietnam, and PVMTI in India, Kenya, and Morocco.

Source: Anil Cabraal, 21st European Solar Photovoltaics and Solar Energy Conference, Dresden, Germany, September 2006 (with data updated, November 2, 2007).

the grid-tied solar power plant of the Cagayan Electric Power and Light Company (CEPALCO). Case studies on these PV financing initiatives, as well as examples of some of the projects that these initiatives supported, are available in an IFC publication, "Selling Solar: More than a Decade of the IFC's experience" (available on-line at http://www.ifc.org/ifcext/enviro.nsf/AttachmentsByTitle/p_SellingSolar/$FILE/SellingSolar.pdf). Although these programs have been responsible for the installation of more than 80,000 SHSs, they have been less successful from a financial standpoint, because they have not resulted in significant market transformation or a sizeable number of financially sustainable businesses.

In some of the initiatives the main challenge was not in the technology per se, but rather in accurately judging market reality and trends and the major risks that PV entrepreneurs face. There were also a number of unanticipated developments, including a failed prediction that the price of solar PV panels would decline markedly, a decrease in the supply of smaller modules, and several economic shocks that disrupted markets. Hindsight shows that the initial beliefs of many market players about a large scale, fully commercial solar PV off-grid market were overly optimistic even though such off-grid PV markets are slowly emerging, most notably in Kenya. Much more is now known about the type of financing required to support solar PV market growth and what it takes to develop a successful solar PV company and market. Perhaps one of the most important lessons is that supporting the solar PV market is far more complex than first envisioned, particularly because of the level of market segmentation that is rooted in income level, lifestyle, and various regional and geographical differences.

Key Lessons of Experience

Lesson 1: Project designs must remain flexible and adaptable to address issues of affordability, risks and other market constraints.

Affordability varies among market segments (such as relative income levels or market applications), and it remains a challenge for PV companies to sell to the niche market segments even where PV is the least-cost energy alternative for the consumer. High first costs, lack of financing, limited awareness are among the constraints faced. Project designs must therefore be able to quickly adapt to market conditions so that responsive solutions are created to address barriers. Four such examples are projects supported by the World Bank and GEF:

- Bangladesh Renewable Energy for Rural Electrification project where 8,000 solar home systems are being installed monthly.
- The Off-Grid Rural Electrification Project in Nicaragua brings electricity services to households, public centers, and productive uses by facilitating access to microfinancing and strengthening the institutional capacity to implement a national rural electrification strategy.
- Papua New Guinea Teachers Solar Lighting Project where financing for solar lighting systems for teachers posted in remote areas is provided through the Teachers Savings and Loan Society.
- The Sustainable Solar Market approach first introduced in the Philippines under the World Bank and GEF-assisted Rural Power Project and now being considered in Tanzania and Zambia (see Box 2).

In these and other solar projects, it was imperative during implementation to adapt to changing market needs, such as by extending the eligibility of PV system sizes to smaller, more affordable systems, such as solar lanterns, or by introducing loan guarantee facilities or capacity building support to entrepreneurs and microfinance institutions.

Lesson 2: PV must be considered as one of several options for rural electricity provision.

All consumers prefer access to unlimited supplies of electricity at low prices. As grid-based rural electrification is often a highly valued political tool, significant government resources are employed in grid extension, even when it is a drain on government budgets and where economic justification is weak. As a result of these subsidies the cost of grid electricity to the end user is significantly less than alternative options.

However, there is now an increasing appreciation by governments and rural electrification authorities that PV is an economic least cost option

Box 2: Sustainable Solar Market Packages

The Sustainable Solar Market Package (SSMP) is a contracting mechanism that provides for the supply and installation of PV systems along with a maintenance and repair contracts (five years with option to extend) to schools, clinics, and other community facilities in a defined rural area, bundled with requirements and incentives for commercial sales to households, businesses, and other nongovernmental customers in the same area. By bundling institutional, community, and household applications in a particular area, the SSMP approach addresses some of the important affordability and sustainability issues of the past PV projects: standardization, reduced transactions costs, and larger business volume, and reduced risks. In the Philippines, 7 SSMP contracts to benefit 76 villages are under implementation with more SSMP packages under preparation to benefit 572 villages. In Tanzania and in Zambia, under World Bank projects that will be approved in FY08, about 10 SSMP packages are planned to be implemented in each country.

for rural electricity provision, especially where the alternatives are small generators, batteries or kerosene lighting. With oil prices exceeding US$90 per barrel, and kerosene subsidies becoming untenable, PV's attractiveness is increasing. The Philippines, for example, has a formal rural electrification planning process that demarcates villages where grid extension is not viable.

Where solar PV is least cost, market and willingness to pay studies must be conducted to confirm that consumers will indeed demand these systems before PV financing programs are established. Subsidies to buy down first costs, access to financing through rural banks or microfinance organizations may be necessary to enhance affordability.

Lesson 3: Private equity is not the most appropriate financial mechanism for investing in PV businesses in developing countries.

An important lesson for the IFC was that, while private equity and venture capital firms are heavily involved in the manufacturing of PV for developed country markets (Box 3), the risks and economics of PV in the developing world mean that the returns that such investors typically seek are less than they could obtain in other ventures. Nevertheless, China is an exception, where PV dealers depend primarily on private equity to finance their businesses. As experiences from China, India, the Philippines, and several other countries show, there are profitable opportunities for entrepreneurs in developing countries to supply PV modules to developed-country markets that are highly subsidized.[6]

Lesson 4: Good government relations and support are strong success factors

Although there are examples of companies able to establish successful PV rural electricity ventures without government support, those companies fortunate enough to operate with such support (or with some form of subsidy or market aggregation support) tended to be more successful than companies operating without explicit government support. Given the value of mobilizing private enterprises to extend PV electricity services as an economic alternative to grid extension, public-private partnerships for risk sharing or to buy down the first cost of PV systems can be effective. Such commercial retail market opportunities do exist in developing countries, as experiences in China, India, Kenya, and Sri Lanka, among others, have demonstrated.

Lesson 5: Quality must not be compromised

The most expensive form of electricity is a power supply that is not working. Quality of systems and ability to obtain spare parts and repair services must be an integral part of any PV electricity program. The World Bank was a pioneer in introducing quality requirements enforcement beginning with a project in Indonesia. All World

Box 3: Moving Up the Value Chain—Moser Baer in India

Moser Baer India Ltd. (MBIL) is the third-largest manufacturer of recordable optical storage media products (CDs and DVDs) in the world. MBIL is also an existing IFC client. Currently, MBIL is undertaking a two-year diversification program that involves setting up an export-oriented solar PV cell and module manufacturing facility with an installed annual production capacity of 80 MW in Greater Noida, India. The IFC has recently approved a US$22.5 million long-term loan to the company to support a total investment of US$92 million. The project has the potential to avoid 80,000 tons of CO2 emissions annually and will contribute to the creation of about 600 new jobs.

[6] See the report, "Renewable Energy Network for the 21st Century," on power generation policies at http://gsr.ren21.net/index.php?title=Power_Generation_Promotion_Policies.

Bank–funded projects now rigorously enforce quality requirements. In both Indonesia and China, the project specifications eventually were adopted as national standards. In China, additional support was provided for technology improvement (Case One) and they have introduced a "Golden Sun" quality mark to help consumers identify quality-certified products.

Lesson 6: Access to financing is essential

Solar PV is capital intensive—both for manufacturers of key components, such as PV modules, and for consumers who purchase PV products. Therefore financing and financing vehicles that reach the target consumer are essential.

On the supply side, financing is needed to increase manufacturing capacity, supply new materials that bypass the global bottlenecks caused by the limited supply of silicon and newer and higher efficiency solar PV materials and end-user devices (such as lighting with LEDs). Demand for larger utility-scale PV may also emerge, especially for reducing peak electricity demands. The IFC is well positioned to provide its own funding on commercial terms, without reliance on donor subsidies, to support such ventures through its Infrastructure Department, as well as solar PV module manufacturing companies through its Global Manufacturing Department.

Demand for PV for rural electricity will grow. World Bank financing for solar PV will be primarily provided as part of rural electrification programs, where PV is considered a least cost supply option. Financing, often through microfinancing institutions, will be coupled with efforts to remove policy and price distortions. Addi-

tional support will be provided to strengthen the capacity of governments, the private sector, nongovernmental organizations (NGOs), and financial intermediaries.

IFC support for PV for rural electricity will continue. Instead of solar PV–focused initiatives, such as the SDG and PVMTI, the IFC will employ financial vehicles open to a wider range of clean energy opportunities, such as the Environmental Business Finance Program and the Sustainable Energy Facility. Important features are a more streamlined approval process and emphasis on debt instruments over equity, with convertibility features to take advantage of any potential upside.

Future Support for Photovoltaics

Having extensively evaluated not just its own experience, but also the experience of several important players in the solar PV business, the WBG remains cautiously optimistic that it is not a question of "if," but "when," the goal of a self-sustaining solar PV market in developing countries will be reached. We also recognize that PV is but one rural electricity option and therefore should be offered as one option on a menu of options to meet rural electricity service goals. Moreover, we recognize that electricity is merely an intermediate product and that it is the services rendered by electricity that matters for operating motors, lighting, refrigeration, communications, and so forth. To this end, the World Bank and IFC have embarked on a joint project, Lighting Africa (Case Two). It will catalyze local and international lighting-related companies into offering the unelectrified population greater access to modern and affordable off-grid lighting products while displacing fuel-based lighting products, such as kerosene lamps or candles, for which developing-country consumers spend about US$40 billion annually. PV technology is expected to be a principal source of power for such off-grid lighting applications.

Case One
Stimulating Solar Technology Improvement in China

China, along with the World Bank and GEF, launched the China Renewable Energy Development Project (REDP) in December 2001. Since then, the Photovoltaic Market Development and Technology Improvement Components of this project have achieved impressive results. By June 2007 it had supported the installation of 374,000 PV systems with a total PV module capacity of about 9 MW, benefiting more than 2 million people in the northwestern provinces. More than 30 companies have established dealerships throughout these provinces, which provide PV components and systems that meet the project's quality standards.

The Technology Improvement Component offered Chinese PV companies assistance in research, development, demonstration, and innovation. It has helped improve the quality of PV components and systems through a number of means including cost-shared research and development, national standards setting and enforcement, strengthening testing and quality monitoring.

The REDP introduced two innovations: a Competitive Grant (CG) Facility and a Quick Response (QR) Facility that specifically addressed the problem of low-quality PV components and systems found in the Chinese market before the REDP. The design of these facilities was based on the successful Netherlands Research Program PV (NOZ-PV) from 1997 to 2001.

The CG and QR facilities received about 200 proposals seeking US$3.3 million. These funds leveraged US$8.3 million from the proponents. The supported projects have had direct impact on the market by rapidly introducing into the Chinese and international markets high-quality and innovative PV products. Results from two of the beneficiaries are outlined below.

Beijing Sunpu developed a new Solar Home System "plug and play" unit built of durable plastic. The plastic casing gives the PV system an attractive appearance and provides room for including a radio, VCD or DVD player, and speakers. Two casing sizes have been developed—one for small systems (10–30 Wp) and one for larger systems (30–60 Wp). The total project cost was Y 572,000 (US$77,000), with a CG Facility grant of Y 150,000 (US$20,000).

Ningbo Solar Electric Power Company developed a new silver paste for its PV cell production process using CG funding. The increased performance permitted the company to increase the rating of their large PV modules from 160 to 170 Wp at a lower unit cost. The total project cost was Y 844,000 (US$114,000), and the CG Facility grant was Y 250,000 (US$34,000), which amounted to 30 percent of the project cost.

The technology improvement approach has been replicated under the World Bank/GEF–assisted China Renewable Energy Scale-Up Program (CRESP) where a CG Facility is used to facilitate technology transfer of wind turbine technology to China, improve the technology of biomass energy equipment manufactured in China, and demonstrate innovative renewable energy technologies.

The companies surveyed have also reported that they invested about US$75 million equivalent in 2004 and 2005 in their companies and manufacturing facilities to produce these new and improved technologies.

The Grant from REDP can be regarded as the fire in snowing winter. Our company sold the PV integrated system with a metal case in the domestic market. The shape of the metal case was often distorted because of the pressure it was under during transportation. And it always led to a refund.

Under the support of TI component of REDP, our company developed a plastic case for the PV integrated system. It solved the problem mentioned above, won the satisfaction of the dealer and user, and doubled our sales. At the same time, we improved the outward appearance and the coherence of the system. The improved system also sold abroad, for example, in Southeast Asia.

So, we will say thanks to the Project Management Office of the REDP, wish REDP will continue in China.

—Mr. Mingshan Xiao, Chief Marketing Officer, Sanpu

Case Two
Lighting Africa: Catalyzing Markets for Modern Lighting

For the poorest of the poor, lighting is often the most expensive item in their energy budget, typically accounting for 10–15 percent of total household income. The "energy poor" in Africa spend about US$17 billion a year on fuel-based lighting sources (Box 4).

Beyond household use, commercial use of fuel-based lighting can have even more acute economic impacts. Fishermen on Lake Victoria in Kenya, for example, often spend half their income for the kerosene they use to fish at night. Yet, while consuming a large share of scarce income, fuel-based lighting provides little in return.

Fuel-based lamps, such as kerosene lamps, are costly, inefficient, and provide poor lighting. The smoke they emit is directly linked to health issues associated with inhalation and eye damage. The flames from kerosene lamps are responsible for thousands of severe burns among children annually and untold numbers of devastating house fires.

Lighting Africa aims to catalyze by the year 2030 access to modern, non fossil, safe and low cost lighting to 250 million people in Sub-Saharan Africa who rely on fuel-based (typically kerosene-fueled) lighting systems due to a lack of access to reliable electricity.

Lighting Africa is supported by significant contributions from the GEF, European Commission, ESMAP, PPIAF, Norwegian Ministry of Foreign Affairs, Renewable Energy and Energy Efficiency Partnership and Good Energies Inc.

In Lighting Africa, the Bank Group seeks to unleash the potential represented by newly emergent lighting technology, including light-emitting diodes (LEDs), whose ability to deliver high-quality light

Box 4: The Price of Poor Lighting

As a result of surging kerosene prices, schools in rural Senegal are running out of light. The schools are not connected to the electricity grid, and they rely solely on fuel lamps. With the oil price shock in 2006, fuel for lighting became too expensive to buy. In Thiancone Bogual, a town in northeastern Senegal, some 690 km from the capital, Dakar, students must squeeze in the few houses equipped with solar energy to read after dark. According to the headmaster of the local school, 100 percent of the students finished elementary education in 2005, but in 2006 when the school could no longer pay for fuel, just 60 percent got their elementary certificate.

Source: Integrated Regional Information Networks (IRIN), U.N. Office for the Coordination of Humanitarian Affairs, October 23, 2007.

with very low levels of electricity input offers an alternative to fuel-based lighting using a variety of renewable sources of electricity where the electric grid is unavailable. Because of the energy efficiency and low power requirements of these lights, self-generated packaged lighting systems that include a solar cell or mechanical hand crank, for example, can be priced at an affordable level—and marketed on self-sustaining commercial terms. Thus, Lighting Africa is not a give-away program, but rather undertakes a number of market-catalyzing actions to do what the industry cannot efficiently do itself in aggregating market demand, capturing market information, catalyzing consumer and supplier financing, and ensuring product quality in the market.

The initiative will facilitate the transition to modern lighting services in the following ways:

- **Catalyzing the private sector**, including strengthening ties between the international lighting industry and local suppliers and service providers to profitably manufacture, market, and distribute significantly lower cost products.
- **Facilitating consumer access** to a range of affordable, reliable, and high-quality lighting products and services—for example, by providing consumer education services and consumer finance, and by executing a product quality assurance program.
- **Improving market conditions** for the scale-up of modern lighting products by reducing existing technical, financial, policy, information, and institutional barriers. This includes the development of methods for obtaining CDM credits for distributed lighting.
- **Mobilizing the international community**—governments, private sector, international organizations and NGOs—to aggressively promote the use of modern lighting services for the poor in Africa.

See http://www.lightingafrica.org for more information.

Night market shoe seller in Dar es Salaam (Tanzania), with handmade kerosene tin lamp (left), and 1-watt LED (right)

Expanding Energy Efficiency Interventions

It is possible to improve energy efficiency in many ways. The production, distribution, and use of energy all offer opportunities. Buildings can be insulated better, industries can upgrade equipment, and inefficient power plants can be rehabilitated or replaced with more efficient ones. These opportunities can be captured in every sector of the economy, but despite cost savings, this does not happen readily because of a variety of barriers. It can be that the companies are not informed about the possibilities, that they lack the money and cannot obtain financing, that the laws in place are not favorable, that the projects are too small, or that the technology is not available or proven in a particular location. The solutions need to be as diverse as the problems, and they need to include modifying laws, improving technologies, setting the right prices, and opening markets. The World Bank Group has projects in each of these areas with the goal of transforming energy markets and bringing other sources of investment to capture energy efficiency opportunities.

Opportunities and Benefits of Energy Efficiency

Every country and every sector of the economy have the potential for energy savings (see Table 3). The production of energy can be more efficient by improving power plants and transmission systems. The use of energy in buildings, industries, and transports can be reduced by 33 percent by 2050 according to the International Energy Agency.[7]

The lighting sector in developing countries has enormous potential for energy savings and improved quality. The demand for electric lighting is increasing twice as fast in developing countries (3.6 percent) as in industrial countries (1.8 percent). Developing countries are using more and more electricity, including for lighting. Whereas lighting is on the order of 5–15 percent of energy use for households in industrial countries, in the developing world it is typically much greater. Remarkably, poor households without access to electricity can pay as much for kerosene used in lanterns as their wealthier counterparts pay for

[7] IEA, "Energy Technology Perspectives," Paris, 2006.

Table 3: Energy Efficiency Opportunities in Important Consuming Sectors

Sector	*Energy efficiency improvement opportunities*
Buildings	Integrated building design, better insulation, advanced windows, energy-efficient lighting, space conditioning, water heating, and refrigeration technologies.
Industry	Industrial processes, cogeneration, waste heat recovery, preheating, and efficient drives (motor, pump, compressors).
Cities and municipalities	District heating systems, combined heat and power, efficient street lighting, efficient water supply, pumping, and sewage removal systems.
Agriculture	Efficient irrigation pumping and efficient water use, such as drip irrigation.
Power supply	New thermal power plants: Combined cycle, supercritical boilers, integrated gasification combined cycle (IGCC), and other advanced combustion technologies. Existing generation facilities: Refurbishment and repowering (including hydropower), improved operation and maintenance practices, and better resource utilization (higher plant load factors and availability). Reduced transmission and distribution losses: High-voltage lines, better-insulated conductors, capacitors, efficient and low-loss transformers, and improved metering systems and instrumentation.
Transport	Efficient gasoline and diesel engines, urban mass transport systems, modal shifts to inter- and intracity rail and water transport, improved fleet usage, and compressed natural gas (CNG) vehicles.
Households	Lighting, appliance efficiency, and improved cook stoves.

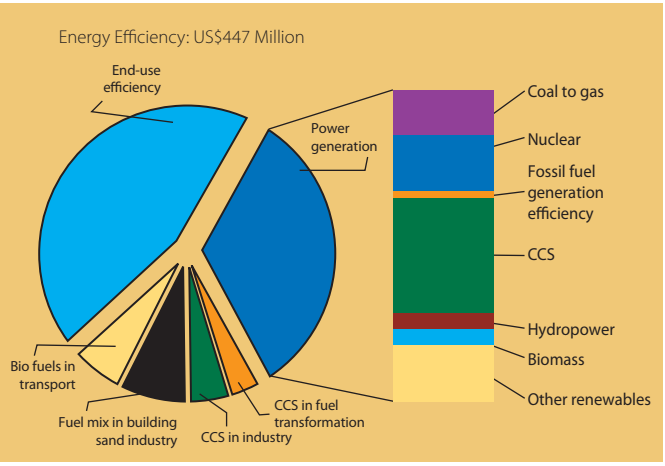
much higher-quality electric lighting. The quality and efficiency of lighting technologies adopted in the next twenty years will have significant implications for the environment and development.

Energy efficiency reduces the demand for funds in developing countries by deferring the need for new power plants and fuel whose cost is rising. It also reduces costs of operation and maintenance, and can improve productivity. Companies increase their financial performance and countries become more competitive thanks to an efficient private sector. Less energy use also provides public benefits by reducing pollution and improving work conditions from better light and indoor air quality. When it comes to climate change, energy efficiency is the largest, least expensive, and fastest way to reduce its effects over the next decades (see Figure 3).

Barriers to Energy Efficiency Investments

Although the economics of energy efficiency measures are compelling and often underlie the financial decisions that drive larger project designs, a focus on energy efficiency is rarely the primary rationale of an investment decision. More often, an industrial operator seeks to modernize or expand its operations, or a commercial building operator seeks more reliable space conditioning equipment or more attractive and

Figure 3: Reductions in Greenhouse Gas Emissions by Consuming Sector through 2050



Source: IEA, "Energy Technology Perspectives," Paris, 2006.

functional lighting, and the associated energy efficiency cost savings provides the financial return necessary for the project to go ahead.

While projects with strong energy efficiency components are appealing financially, cost-saving measures are rarely recognized as creditworthy by banks, and even less frequently viewed as a target business for lending. Since debt financing is usually critical for energy efficiency investment, this lack of recognition is a serious constraint. Financial institutions traditionally have not organized products and marketing efforts to capture energy efficiency opportunities—a major missing force for investment. The lack of a systematic business focus on the energy efficiency market opportunity has transcended global financial markets—from the larger international financial institutions to local commercial banks and leasing companies.

World Bank Group Energy Efficiency Investments

Since 1990, the World Bank Group has invested nearly $3.1 billion in energy efficiency in about 120 projects in 40 countries. There are projects in all regions with a significant concentration in Europe, Central Asia, East Asia and Pacific. A few sectors have received a larger share of the investments, in particular industries, district heating, and electric power. In the past much of the energy efficiency investment was for improving district heating systems. This fiscal year saw the beginning of several projects to provide modern and efficient lighting technologies for grid-connected and off-grid consumers.

Private Sector Finance for Energy Efficiency

Convincing private banks to invest in energy efficiency is a key feature of the World Bank Group approach as it allows leveraging its own resources. The World Bank offers technical assistance and financial intermediary loans for this purpose. For example,

- The World Bank brought together domestic banks in Brazil, China, and India to share experiences, create partnerships, and explore opportunities for energy efficiency investment.[8] This project highlighted the importance of a dialogue between banks and technology suppliers. One such exchange led to new lending programs for energy efficiency in several Indian banks. Major Chinese banks created a concept for an energy

[8] The project is funded by the Energy Sector Management Assistance Programme (ESMAP) and the United Nations Foundation (UNF).and is implemented with the United Nations Environment Programme (UNEP). A World Bank book expected for the end of 2007 will synthesize the practical knowledge from the project, together with additional knowledge from efforts in different countries on this topic.

efficiency financing project (see Case Study Three). In Brazil, banks developed a loan guarantee for energy service companies.

- In the Second Renewable Energy Project with the India Renewable Energy Development Agency (IREDA), energy efficiency investments were supported through an IDA credit of US$17 million that leveraged an additional US$58 million from IREDA's own resources, loans from other commercial sources, and developer's equity and saved an equivalent of 86 MW of generation capacity at an investment cost of under US$900/kW. Five million dollars in cofinancing from GEF helped offer advice on setting up energy efficiency service companies, training, and outreach.

The IFC's strategy to mobilize energy efficiency investments makes the most of its position as a lender for private sector projects in developing countries. First, it targets opportunities emerging from its own investment business, and second, it explores the corporation's network of more than 400 commercial financial institution clients (see Box 5).

Energy Efficiency Action Plan

After years of effort to catalyze substantial energy efficiency investment in client countries, the WBG began evaluating its own business in order to understand best how to more systematically and strategically support client countries in energy efficiency. The World Bank launched an Energy Efficiency Action Plan for Sustainable Development (EEfSD) in 2007 to guide actions in client countries on multiple fronts. The Action Plan comprises four tracks:

1. Integrating energy efficiency within economic and sector work.
2. Mainstreaming energy efficiency in investment operations by systematically integrating energy efficiency operations within the core energy practice by replicating the "business-as-usual" and proven energy sector project designs and instruments.
3. Improving the internal operational, learning, and analytic capacity to provide broad-based analytical and operational support, including developing new finance instruments or adapting existing ones.

Box 5: IFC Financial Intermediation in Energy Efficiency

The size of investments in energy efficiency is often smaller than the amount the IFC and World Bank find most efficient, despite the potential for high returns and development impact. These projects, however, are a perfect fit for many financial institutions in developing countries, such as commercial banks and leasing companies.

In 1997 the IFC began to work with some of the 400 financial institutions among its clients. Although energy efficiency is not a specific business for most of them, they all have loans for sustainable energy projects in their portfolio. The IFC works with the institutions to align energy efficiency investments with their business strategy. This may include, for example, lending to small and medium enterprises (SMEs), marketing new products to existing clients, or using a bank's position as a holder of accounts for municipal governments. The IFC then works with their management to develop financial products, train the bank staff to market the new product, and develop credit procedures for what might be a new class of borrowers in their pipeline. This includes how to assess risk and value in investments for energy efficiency.

The IFC will choose to use financial tools or advisory services depending on the needs of each client. This includes enabling long-term financing in local currency or sharing the risk with the financial institution while it builds experience. In each case, IFC support is a short-term boost to build capacity and enthusiasm for a growing investment business.

Results to date are impressive. The IFC has supported more than 20 financial institutions, leading to an estimated more than US$120 million in energy efficiency lending and a much larger pipeline of expected future investment.

4. Monitoring, evaluation, and outreach in relation to developmental outcomes and results.

In 2004, IFC started to identify clean energy components within its own investments as part of a process to determine whether such efforts could be expanded. This new tracking system will be extended to the World Bank to identify new energy efficiency investment opportunities (Box 6).

Box 6: Identification of New Energy Efficiency Opportunities through the IFC's Investment Tracking System

Starting in fiscal 2005, by developing and refining an investment tracking system that identifies the energy efficiency and renewable energy components embedded in its core investment business, the IFC has developed a full understanding of where energy efficiency opportunities emerge across the industry sectors in its portfolio. The exercise has identified a broad range of energy efficiency investments across the power generation and distribution business, municipal water system investments, and throughout the general manufacturing, chemicals, agribusiness, and mining businesses. In the process, the IFC identified close to US$2 billion in energy efficiency and renewable energy investment resident in 25 projects in its portfolio of fiscal 2007 new investment commitments. These investments are typically a small part of a much larger loan, and most often take place without any deliberate promotion or incentives from IFC, but driven by the production efficiency gains inherent to energy efficiency applications. Based on this profile, the IFC has identified a portfolio of energy efficiency investment opportunities it is seeking to replicate and expand by systematically identifying similar opportunities in the market and working with project sponsors as part of the IFC's appraisal process. The IFC seeks to leverage its financial appraisal and review procedures to promote greater energy efficiency investment and offering more value to its clients and greater overall development impact.

Case Three

Promoting Energy Efficiency Investments through Financial Intermediation in China

The National Development and Reform Commission of China launched the "1000 Large Industrial Enterprises Energy Conservation Action Plan" in April 2006, targeting the top 1,008 largest industrial energy consumers. Together, these account for approximately 30 percent of China's total primary energy consumption. The conservation opportunity in these industries is often referred to as a "goldmine" of energy savings by Chinese energy conservation experts because of the potential for significant savings.

The estimated energy conservation investments needed to achieve the 20 percent energy efficiency target of the National Development and Reform Commission surpass US$50 billion—most of them in the industrial sectors. The World Bank-GEF funded First and Second China Energy Conserva-

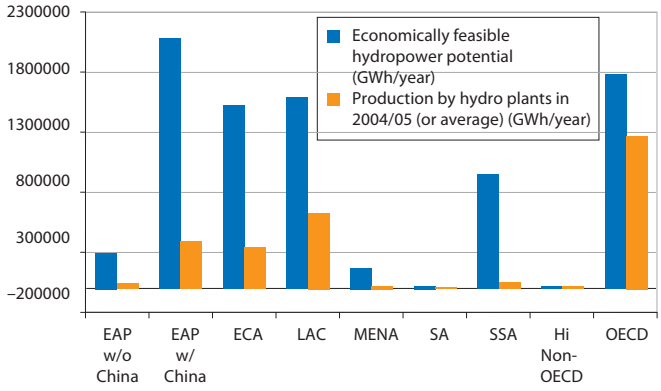
tion Projects in the 1990s successfully introduced an energy performance contracting mechanism through energy management companies to support small commercially viable energy conservation projects. The proposed China Energy Efficiency Financing (CHEEF) project, prepared by the World Bank in fiscal 2007, is an important follow-up. The CHEEF project complements and reinforces several ongoing World Bank/IFC energy efficiency projects through a focus on the medium-size and large industrial energy conservation investment market. The proposed CHEEF project will provide (a) a Bank loan of US$200 million to support energy conservation investments in target industries through the selected participating financial institutions; and (b) a GEF technical assistance grant of US$13.5 million to strengthen the government capability to enforce related laws, regulations, and standards; and (c) assist the private financial institutions to develop and sustain energy conservation lending business lines.

This integrated IBRD/GEF funded project is designed to help remove the principal barriers impeding investments in medium-size and large industrial energy conservation projects. The GEF grant-financed technical assistance activities will address the knowledge, institutional, and capacity gaps of the banking sector, mitigate the risk concerns of enterprises, and strengthen the governmental supervision of industrial energy conservation. The efforts of the energy conservation financial intermediary lending program are expected to demonstrate the financial viability of medium-size and large industrial energy conservation investments, and provide direct support to the government's energy conservation priorities during the 11th Five-Year Plan period.

Building a Sustainable Hydropower Partnership

Hydropower is the largest global source of affordable renewable energy, yet in the developing world less than a quarter of the potential of this abundant resource has been tapped. When developed appropriately, with attention to social and environmental risks, hydropower projects can provide multiple economic and environmental benefits to the world's poor. For these reasons, after a decade of declining lending, the WBG is re-engaging in hydropower as a way to contribute to its mission: to eradicate poverty and help build sustainable development. However, the financing requirements of many large projects exceed the funds available from public sources, like the WBG, and thus the private sector plays a critical role in hydropower development. To ensure the financial, environmental and social success of these projects, the World Bank is working in partnership with national governments, civil society organizations, and the private sector to support and plan quality hydropower projects in developing countries.

Figure 4: Hydropower Potential and Production by Region



Source: *World Atlas and Industry Guide (2006 edition), a publication of The International Journal on Hydropower and Dams.* Aqua~Media International, Sutton, Surrey, U.K.

An Abundant Resource

Hydropower potential of varying sizes and configurations (pico, micro, mini, run-of-river, through to dams and storage reservoirs) amounts to roughly 7 billion GWh per year in developing countries[9]. Yet, only 23 percent of the energy potential has been developed, compared with 72 percent in OECD countries (see Figure 4). And, in terms of water management, per capita water storage in Africa amounts to less than one fiftieth of that in North America or Australia.

The Multiple Benefits of Hydropower

Appropriate multipurpose hydropower development, as part of a menu of options, can bring significant benefits in terms of access to electricity, diversified energy options, managing water scarcity (and over-abundance), and support-

[9] The international community considers hydropower of all sizes and configurations to be renewable, as acknowledged at the World Summit on Sustainable Development in Johannesburg, South Africa, and the International Renewable Energies Conference in Bonn, Germany.

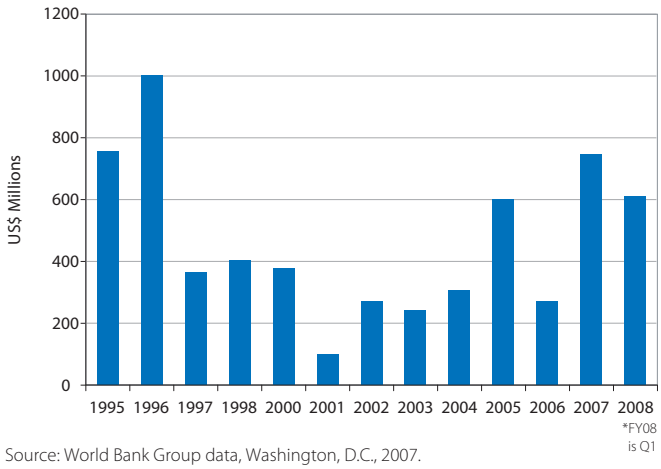
ing water-dependent activities. Hydropower contributes to the energy security agenda as a low-carbon source of electricity drawn from an indigenous natural resource that reduces susceptibility to the oil price shocks that developing countries have experienced in the last five years. It also provides unique, complementary services to an energy system that mixes thermal and renewable sources, adding reserve capacity to back up intermittent sources, such as wind and solar. Beyond energy, hydropower storage projects—when designed and operated sustainably—can help manage the drought and flood stresses of naturally volatile hydrology and the allocation of this increasingly scarce resource across multiple users, thereby contributing to water security. Finally, hydropower also offers the opportunity to build transboundary cooperation through regional initiatives in both water management and the development of power pools, with benefits beyond the river.[10]

Financial benefits of low carbon generation are being exploited in hydropower projects. Between 2005 and 2007, carbon credit was extended to 15 WBG projects valuing US$110 million. Increasingly, the carbon market is accessed by larger projects in both the private and public sectors. For example, the 59 MW Felou project in Senegal recently accessed US$3.1 million through the signature of an Emissions Reduction Purchase Agreement with the World Bank Spanish Carbon Fund, and the larger 412 MW plant in India is exploring carbon financing of US$15 million.

The World Bank Group's Hydropower Investments

The WBG is re-engaging in hydropower for both energy and water security. After a decade of declining lending, the Bank now supports a range of projects, from small run-of-river and rehabilitation to large multiyear storage and multipurpose investments. Thirty-five hydropower projects have been approved in the last three years, amounting to US$1.6 billion in commitments (to support a total of US$4.9 billion in project investments and 6,224 MW; see Figure 5). Major projects have recently been approved in Africa (Democratic Republic of Congo, Senegal, Sierra Leone, and Uganda) and Asia (India and People's Democratic Republic of Laos), with several rehabilitation projects in Eastern Europe (Georgia, Macedonia, and Ukraine). New projects are under discussion in Brazil, Ethiopia, Georgia, Guinea, India, Rwanda/Nile Equatorial Lakes, Tajikistan, and Vietnam, along with carbon finance projects in Madagascar and Sri Lanka (Figure 6).

Figure 5: World Bank Group Annual Hydropower Financial Commitments



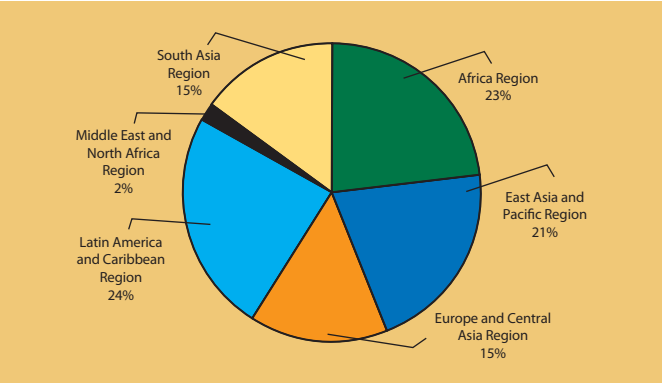
Source: World Bank Group data, Washington, D.C., 2007.

Regionally, the hydropower story varies considerably:

- *In India*, the focus is on addressing an **electricity gap** that is compromising growth and on realigning the balance among renewable and nonrenewable energy resources. The Rampur project benefiting from a combination of IBRD financing and carbon finance

[10] C. Sadoff and D. Grey (2003), "Beyond the River: The Benefits of Cooperation on International Rivers," in *Water Science & Technology*, Vol. 47, No. 6, pp. 91–96, IWA Publishing.

Figure 6: Regional Distribution of World Bank Group Hydropower Projects



Source: World Bank Group data, Washington, D.C., 2007.
Note: The number of projects counts separate WBG engagements, which in some cases support a single hydropower.

will add 412 MW into the Northern India Electricity Grid.

- *In Africa*, hydropower needs to be addressed from a **water management** perspective, given the challenges of multiple demands for water and the predominance of international rivers. On the Niger River, for example, the Bank is aiding nine countries in developing a river basin organization that will enhance regional coordination, development, and sustainability of water resources along the third longest river in Africa. The **regional context** is also an important driver from the energy side as well. A recently approved project in the Democratic Republic of Congo will rehabilitate two Inga plants for a total increase of 600 MW in supply to the Southern Africa Power Pool. Coupled with investments in transmission and distribution, this additional energy will increase the reliability of electricity supply in the region.
- *In Eastern Europe*, the WBG is assisting countries in **rehabilitating** and upgrading facilities to feed into an emerging regional power pool.
- *In East Asia*, challenges and opportunities are arising in the effort to ensure that projects **alleviate poverty** in host countries while feeding demand for energy in multiple countries, such as the Nam Theun 2 project in Laos that serves Laos, Thailand, and Vietnam.

Managing the Risks of Hydropower Projects

Along with the potential development benefits of hydropower, the WBG also recognizes that hydropower, like many natural resource projects, poses risks, particularly when it involves regulation of rivers or resettlement of local communities. Hence, hydropower must be developed cautiously in the context of broader development goals, including (a) responsible environmental management, (b) poverty alleviation and social development, (c) integrated water and energy management, and (d) institutional development.

There has been exceptional development in the past decade in understanding how to address what used to be overwhelming environmental and social risks. The contraction of Bank lending in the 1990s was in part a response to concerns about the environmental and social impacts of dams, and the balance between benefits and costs of development. The World Commission on Dams, in which the World Bank participated, produced a useful reference document that identifies important issues and outlined important strategic priorities for dams. The WBG also actively participated in the United Nations' follow-up to the Commission: the Dams and Development Program.[11] Its final report, "Dams and Development: Relevant Practices for Improved Decision-Making," provides a positive and constructive compendium for addressing environmental and social concerns. These endeavors complement the industry's own efforts to raise awareness and improve practices through the International Hydropower Association's Sustainability Protocol.[12]

[11] http://www.unep.org/dams.
[12] http://www.hydropower.org.

WBG projects are themselves subject to the "most sophisticated set of policies, operational procedures, and guidelines among the international donor community,"[13] which has prompted innovative approaches to sustainability. The Nam Theun 2 project, for example, includes a conservation offset to protect a regionally significant biodiversity area. Nearly 10 times the inundation area in the Nakai Nam Theun watershed, the offset is supported by long-term financing (US$1 million per year for 30 years) and an innovative institutional and capacity building arrangement. In the Nile Basin, the proposed Rosumo Falls multipurpose project undertook a comprehensive strategic environmental assessment to compare various options from a "triple bottom line" perspective.[14] With this ongoing experience, the Bank continues to synthesize lessons learned and refine "best practices" to improve the outcomes of hydropower projects.

Engaging the Private Sector

The private sector plays a critical role in hydropower. The financing requirements of many large projects exceed funds available from governments and public sources. Private participation can also bring additional skills in financial management, procurement, and project management. However, the financial crises of the second half of the 1990s, coupled with reduced lending from multilateral development banks for hydropower, greatly cooled the prospects for private sector participation. Today, the lack of strong regulatory and enabling environments set against intense scrutiny of larger projects raises considerable risk for private capital. The inherent complexities of large hydropower (such as large upfront costs, long project development time, and environmental and social impacts) further compromise investment.

The WBG is addressing the challenge and opportunity for private sector participation by (a) taking a programmatic approach to institutional

[13] World Commission on Dams, *Dams and Development: A New Framework for Decision-Making*. Earthscan, 2000.
[14] *Triple bottom line* refers to the three values in sustainable development: economic, environmental, and social.

and regulatory development (as in the recently approved Development Program Loan to the state of Himachal Pradesh in India) and (b) acting as financial intermediary, providing targeted financial support, convening multiple parties, and accessing a range of financial instruments and models.

Given the hiatus in new project development for hydropower, knowledge and experience in attracting private participation in these projects is lacking. A recent study of financing water infrastructure explored project financing models, instruments, and project structures (for example, BOOT and government).[15] The extent of private sector involvement and appropriate structure for public-private partnership will depend on site- and country-specific circumstances. It will also depend on the type of project. Many small and medium run-of-river projects that have limited financial risk, low environmental consequences, and no resettlement complications are bankable by the private sector. The WBG has been successful in supporting the entry of the private sector for small and medium hydropower projects as exemplified by projects in several countries:

- The World Bank Carbon Finance Unit began purchasing carbon offsets from La Esperanza, a run-of-river private hydropower project located in the waters of Intibucá River, Honduras, in 2007. The project developer is also developing forestry and land protection programs around the river basin, cleaning the garbage from the lake area, and generating local direct and indirect jobs. Further, La Esperanza electrifies the local village. More recently, La Esperanza has funded a tree planting program in the surrounding community with more than 30,000 trees that were donated by La Esperanza.

[15] C. Head, *The Financing of Water Infrastructure: A Review of Case Studies.* World Bank, Washington, D.C., 2006.

- In India, the World Bank supported two financial intermediation projects over the last 15 years that has resulted in 79 small hydropower projects with 276 MW in total capacity. The projects helped launch several small hydropower project developers, some of whom are also investing in other countries. The success of the schemes funded by the World Bank and IREDA has also raised interest from commercial banks, leading to the gradual emergence of a competitive commercial market for funding such schemes. Consequently, total small hydropower capacity in the country stands at more than 2,000 MW as of 2007.
- The IFC is financing Hidromaule S.A. in Chile, a hydropower generation company owned by an Italian-Chilean consortium. The company's initial project, Lircay, is a 20 MW run-of-river hydropower project located along the Lircay River in the VII Region of Chile, approximately 30 km to the northeast of the city of Talca. The Lircay hydropower project takes advantage of water rights owned by the Canal Maule Association, a long-established irrigation group formed mainly by small and medium agriculturists and with approximately 2,200 shareholders.
- In Sri Lanka, an indigenous renewable energy industry was born in 1997 that today has invested more than US$130 million in more than 100 MW of small hydropower plants (Case Four). This industry emerged thanks to policy, legal, regulatory, and financial support from the World Bank to establish a small power purchase framework and to invest in renewable energy. This achievement also led the IFC to set up a facility in Sri Lanka to create more standardized financial terms for distributed generation to expand and extend this small power model.

At the other end of the spectrum, large storage projects with multipurpose operations demand a more complex mix of public and private structures in order to balance public and private benefits and a range of risks. The Nam Theun 2 project's complex private-public partnership involved more than 30 parties, with explicit allocation of risks across Nam Theun Power Company equity holders, project sponsors, and private participants, as well as the Government of Laos and the WBG (see Table 4).

Generally, risks are allocated to the party best able to manage it at the least cost to the overall project. Risk instruments, such as guarantees, have had a significant role in recent Bank projects. Three projects—Bujagali (see Case Five), Bambuna in Sierra Leone, and Nam Theun 2—took advantage of risk guarantees from IDA or MIGA, or both, as in the case of Nam Theun 2. MIGA guarantees against political risks, such as war, civil disturbance, expropriation, and foreign exchange inconvertibility, and the insurance requires no host country backing. IDA partial risk guarantees cover commercial bank debt. During the past three years, the value of risk guarantees for WBG hydropower was valued at US$518 million.

The World Bank Group's Hydropower Strategy

Looking forward, the WBG will continue to build a pipeline of sustainable projects that add value to water management and mixed energy portfolios. The portfolio, a combination of lending, technical assistance, and analytical advisory services will continue to be characterized by diversity, with projects ranging from small local plants and rehabilitation of existing facilities to pumped storage and multipurpose transnational projects. The contribution of hydropower to the renewable energy portfolio will build on the following:

- Region-specific lending strategies, taking into consideration country programs and

Table 4: Nam Theun 2 Project Risk Allocation

Phase	*Risks/Obligation*	*NTPC Equity Holders, Project Sponsors and Private participants*[a]	*Lao PDR*[b]	*IDA PRG*
Pre-Construction	Project design	●		
	Pre-construction works	●		
	Financing	●		
Construction	Cost overruns	●		
	Construction delays	●		
Operation	Operations and maintenance	●		
	Tariffs	●		
	Transmission	●		
	Hydrological	●		
	"B-period" tariffs	●		
Concession Team	Thai Baht devaluation	●		
	Lao political force majeure	●	●	●
	Changes in Lao PDR law		●	●
	Natural force majeure[c]	●	●	●
	Lao—expropriation		●	●
	Thailand political force majeure	●		
	Thailand —expropriation	●		

(a) Including EGAT as an off-taker; Engineering, Procurement and Construction (EPC) contractors; project lenders and GOL, as shareholder in NTPC.
(b) Excludes risks taken by GOL as an NTPC shareholder.
(c) Natural force majeure: acts of God, earthquakes, fires, typhons, etc.

Source: World Bank, "IDA Guarantee Paves Renewed Interest in Private Hydropower—the Nam Theun 2 Project," Project Finance and Guarantees Group, Washington, D.C., June 2005, p. 5.

capacities, sector needs, and constraints, and Bank value added.

- Attention to environmental and social management and cross-cutting issues, such as revenue management and benefit sharing across all stakeholders, retaining water flows to sustain the environment, and climate change.
- Alignment of financial instruments to hydropower needs, addressing public-private partnerships, funding for regional projects, and transaction costs of Bank lending.
- Continued emphasis on capacity building to enhance regulatory environments and embed sustainability principles in executing agencies.

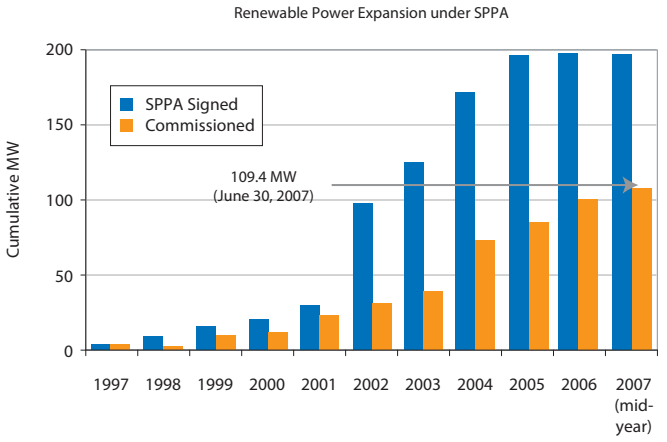
Case Four
Sri Lanka—Private Sector Leadership in Small Hydropower

Sri Lanka's small hydropower (SHP) industry has received international acclaim in recent years. Ten years since the first grid-connected, privately owned small hydropower project was commissioned by Premasiri Sumanasekera in Dick Oya, the industry has grown into a 109 MW success story (Figure 7). Domestic private sector investment in the industry of about US$130 million has contributed 4 percent of the nation's gross generation. Between 2005 and 2006 the only new generation that was added was from these private small hydropower generators. In a world pressured by escalating oil prices, the Government of Sri Lanka is now committed to build on the SHP industry's achievement and reduce the burden on the consumer by prioritizing the development of indigenous, economical sources of energy. The National Energy Policy and Strategy has set a target of meeting 10 percent of the total demand from new renewable energy sources by 2015.

An effective framework has evolved over a decade to attract private sector investment for the development of small-scale, run-of-river hydropower projects in Sri Lanka. This framework rests on six important cornerstones, which together provide a powerful incentive and support structure that tilts the scale toward continued investor confidence, which in turn overcomes numerous obstacles in the process (see Box 7).

The SHP industry is now endowed with a skilled pool of local engineers and engineering firms. Local engineers have ingeniously adapted imported technology and know-how to suit indigenous conditions. As a result of their efforts, the cost of development in Sri Lanka is 20–30 percent less than internationally accepted benchmarks. Their technical prowess has evolved over the years and enabled them to resourcefully counter ever-increasing input costs. Consequently, local expertise is now sought after internationally, and three Sri Lankan engineer-

Figure 7: Sri Lanka Small Hydropower Growth



Source: DFCC Consulting (Pvt) Ltd.

ing firms are already designing, constructing, and investing in small hydropower projects in Africa.

Indigenous, new renewable energy generation is having a significant positive impact on the economy, society, and environment of Sri Lanka. The country's energy security is improved because of the diversification of the energy mix, local private sector investment is mobilized to develop the nation's infrastructure, and policy makers are encouraged to steer the country toward sustainable development by balancing economic progress with the conservation of the environment and empowerment of rural communities. The quality of life of villagers in the vicinity of SHP plants has improved in large part because of better road access, bigger bridges and, in some areas, access to grid electricity. The provision of basic infrastructure facilities undoubtedly translates into enhanced income-generation opportunities for these communities. The country as a whole also benefits from a significant foreign exchange savings of about US$30 million generated by the 346 GWh that these SHPs supplied to the national grid in 2006 (assuming 60 percent of generation displaced oil-based power at US$80/barrel of oil). Sustainable development has thus become a reality as tangible economic gains are derived, while the environment profits from the reduction of polluting emissions equivalent to 221,000 metric tons of carbon every year.

Box 7: Cornerstones of Progress

1. A straightforward application process to reserve a site for development based on a Letter of Intent issued on a first-come, first-served basis.
2. A 15-year standardized, non-negotiable power purchase agreement with the utility ensures that this Must Run facility is operated and maintained in a manner consistent with Prudent Utility Practices.
3. A power purchase tariff with a guaranteed floor price based on the avoided cost of marginal generation of utility-owned thermal power plants.
4. Tax and import duty concessions that are available to other energy and nonenergy investments meeting Board of Investments criteria.
5. Medium- to long-term project financing through the World Bank–funded Energy Services Delivery Project and thereafter the Renewable Energy for Rural Economic Development Project (additional financing of US$40 million was injected into the RERED project in FY07 by the World Bank).
6. Strong domestic entrepreneurial capacity and local technical expertise.

Case Five
Bujagali Hydropower: Financing and Risk Mitigation

An ongoing electricity crisis is a major impediment to foreign investment in Uganda. It has placed a significant strain on economic growth and has contributed to a decline in GDP growth down to 5 percent in 2006 from 6 percent in previous years.

The 250 MW run-of-river Bujagali Hydropower Project is a major component of the Ugandan government's least-cost energy sector expansion strategy that will supply enough power to meet the country's needs once it is commissioned in 2011. The associated transmission line is being financed by the African Development Bank.

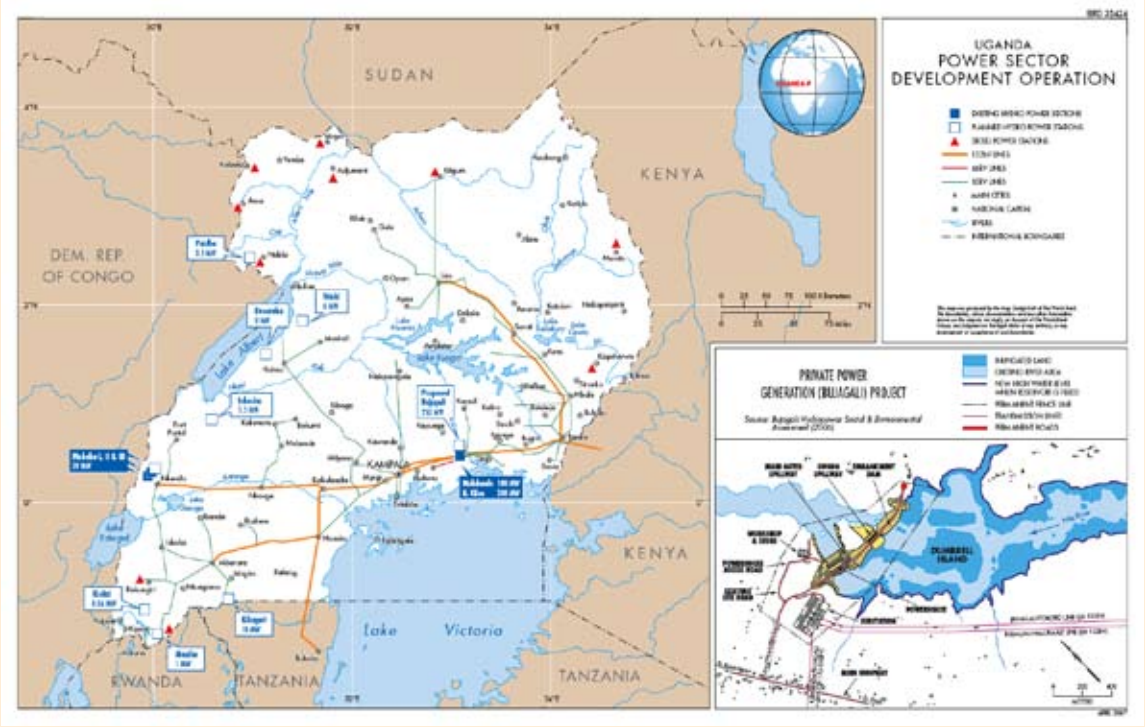
The estimated US$870 million project is structured on an IPP basis. The project company, Bujagali Energy Ltd. (BEL), will sell power to Uganda Electricity Transmission Company Ltd. (UETCL, Uganda's national transmission company) under a 30-year Power Purchase Agreement. The WBG's support of this project has been pivotal in mobilizing the financing package needed for what is the largest single private investment in Uganda—and among the largest in East Africa.

Major Challenges and Lessons Learned

The Bujagali project faced the normal challenges of engineering, environmental, and social issues, as well as financing, involved in any large hydropower project. However, the project's large size with respect to the economy and the sector, as well as the country environment, called for both innovation and dedication to see the transaction through.

The Ugandan government's commitment to developing Bujagali has played a defining role in meeting these challenges. The government undertook a transparent selection process for the project sponsor and required the sponsor to follow a transparent process for selection of the engineering, procurement, and construction contractor. The government has also engendered public support through a well-orchestrated communications campaign. In addition, the government retained highly qualified legal services for support throughout the transaction, which provided confidence to all participants that Uganda's interests were adequately represented.

To lay the groundwork for such substantial investments in the sector, the government had previously undertaken a comprehensive power sector reform program, including unbundling of the power utility, promotion of private sector participation, and creation of a sound legal and regulatory framework. The robust sector framework created by the government has allowed electricity prices to remain at or near cost-reflective levels. The bankability of



projects such as Bujagali depend heavily on the general confidence that a committed government can establish through reform actions, as well as sustained support of the donor community.

The challenges faced by the project required focused and carefully crafted strategies for WBG engagement. The main features of this experience can be summarized as follows:

- **Leveraging effect:** An innovative combination of a US$115 million IDA partial risk guarantee, US$130 million in IFC loans, and US$115 million of MIGA guarantee for equity investment resulted in the mobilization of nearly US$870 million of project financing for this project.
- **Rigorous analysis and effective external communication:** The WBG team pursued rigorous analysis and external communication with the wider public, business, and investment community to ensure compliance with policies.
- **Efficient collaboration within the WBG team:** The success of this project hinged on cooperation within the IDA/IFC/MIGA WBG team in close collaboration with key project stakeholders in the government, the project sponsor, and other members of the lending consortium.
- **Strong package of accompanying support to the energy sector:** In parallel to the Bujagali preparation, IDA supported the power sector reform process with technical assistance and with financial support to the privatization of the distribution company (which also received MIGA support). IDA also provided a power sector development loan supporting the sector's finances and 50 MW of additional temporary thermal generation capacity to help mitigate the short-term power shortage.
- **Signaling effect:** The substantial participation of the WBG in the Bujagali Project has signaled to its clients, financing partners, and to the private sector its willingness and capacity to re-engage in the development of a public-private partnership in support of "transformative" energy and infrastructure projects in Africa, especially the largely untapped hydroelectric potential.

Toward a Low-Carbon Economy: Renewable Energy and Energy Efficiency Portfolio Review

A number of factors are influencing the trend in World Bank Group support for renewable energy and energy efficiency. The steadily rising support for such energy options are due to the WBG's increased commitment towards such energy options coupled with external factors such as high oil prices, commercial maturation of the technologies, greater awareness, and climate change concerns.

Financial Commitments

Renewable energy and energy efficiency projects continue to perform strongly in the WBG energy portfolio and are increasingly being mainstreamed in the WBG's energy lending. In fiscal 2007 a total of US$1,433 million supported 63 renewable energy and energy efficiency projects in 32 countries. This represents a 67 percent scale-up in commitments from fiscal 2006. The WBG's support can be broken down into US$421 million for new renewable energy, US$751 million for hydropower greater than 10 MW, and US$262 million for energy efficiency (Table 5).

Thus, with combined commitments of US$683 for new renewable energy and energy efficiency, **the WBG outperformed its Bonn Commitment by a wide margin, as in previous years.** Cumulatively, between fiscal 2005 and fiscal 2007, the WBG has exceeded its Bonn Commitment target by almost 100 percent—committing US$1,812 million against the cumulative target of US$913 million over the same timeframe (Table 6).

Since 1990, the WBG has committed about US$11.4 billion toward renewable energy and energy efficiency (see Figure 8). Details are provided in Annexes 1, 2, and 3. Of this amount, US$3.1 billion each were for new renewable energy and energy efficiency. Another US$5.2 billion went

Table 5: World Bank Group Commitments for Renewable Energy and Energy Efficiency, FY07
(*millions of U.S. dollars*)

Source of funds	*New renewable energy*	*Hydro greater than 10 MW*	*Energy efficiency*	*Total*
World Bank (IBRD/IDA)	70	430	49	549
GEF (World Bank)	121	0	7	128
World Bank (Carbon Finance)	68	66	10	144
IFC (own funds)	154	140	156	450
IFC (Carbon Finance)	7	0	0	7
MIGA	0	115	40	155
Total	421	751	262	1,433

Note: Some columns may not add up exactly because of rounding.
Source: WBG databases, 2007.

Table 6: Measuring Progress in New Renewable Energy and Energy Efficiency Lending against the Bonn Commitment
(*millions of U.S. dollars*)

New RE and EE commitments	*FY02*	*FY03*	*FY04*	*FY02–04 average*	*FY05*	*FY06*	*FY07*	*Total FY05–07*
Actual	204	178	245	**209***	461	668	683	1,812
Bonn commitment target	n.a.	n.a.	n.a.	n.a.	251	301	361	913

n.a. Not applicable.

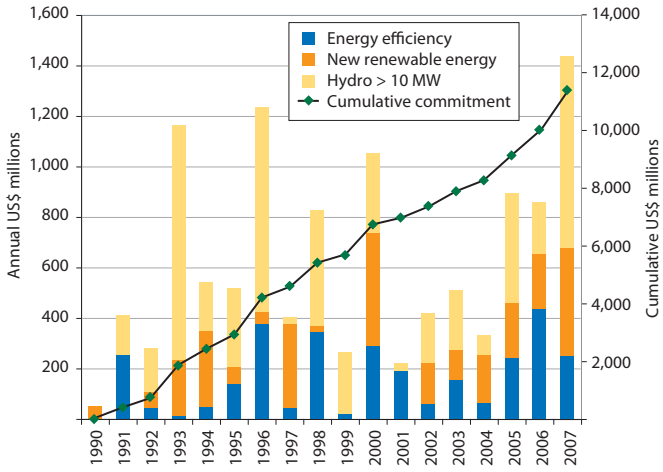
* The baseline of US$209 million was set as the average annual lending commitment for new renewable energy (RE) and energy efficiency (EE) made by the IBRD and IDA, the World Bank's Carbon Finance Business (CFB-IBRD), and the GEF (IBRD and IDA) in fiscal 2002, 2003, and 2004. The baseline comprises exclusively of new RE and EE.

Note: This includes the additional US$168 million in IFC fiscal 2005 commitments that were not reported in the fiscal 2005 RE and EE progress report (***World Bank Group Progress on Renewable Energy and Energy Efficiency: Fiscal Year 2005***, December 2005). Commitment amounts for two IFC projects included in last year's RE and EE progress report have also been revised (Dominican Republic Basic Energy was US$12 million and is now US$6.34 million, and India Allain Duhangan Hydropower was US$49 million and is now US$47 million). The additional IFC fiscal 05 commitments were principally EE and RE investment components of IFC projects in agriculture, industry, transport, and other nonenergy sectors.

to hydropower projects with capacities greater than 10 MW per facility. During the same period, the share of total WBG energy lending devoted to renewable energy and energy efficiency has been steadily increasing. **The average share of renewable energy and energy efficiency of total energy commitments has doubled since 1990–94 to 25 percent in 2005–07 and reached 40 percent in fiscal 2007** (Figure 9).[16]

Commitments for large hydropower projects increased substantially over previous years, most prominently in Sub-Saharan Africa. The continent's vast underexploited hydropower resources offer large potential for further expansions as a low-carbon solution to increasing energy access. The WBG has renewed its efforts to support countries' benefit from this resource while at the same time continuing to maintain and refine its stringent and comprehensive envi-

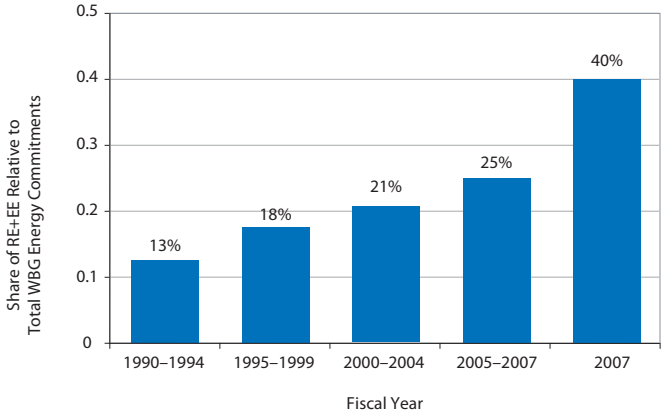
Figure 8: World Bank Group Commitments for Renewable Energy and Energy Efficiency, FY90–07



Source: WBG databases.

[16] 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 energy sector consist of investments in the power sector, oil, gas, and coal mining, as well as electricity and gas services. Previous IFC assessments referenced only "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 IFC had made in other sectors, such as agriculture, water supply, industry and in corporate loans to financial intermediaries. For more details, see *Choices Matter: 2005 Sustainability Report* at www.ifc.org/SustainabilityReport.

Figure 9: Share of World Bank Group Commitments for Renewable Energy and Energy Efficiency Relative to Total Energy Commitments, FY90–07



Source: WBG databases.

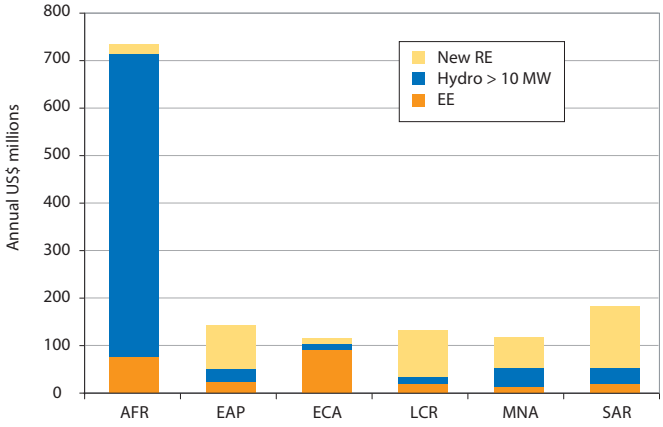
ronmental and social safeguard policies. The Bujagali Hydropower Project in Uganda (see Case Five) and the Regional and Domestic Power Markets Development Project in the Democratic Republic of Congo accounted for the majority of large hydropower commitments last year.

With US$549 million of combined commitments, the IBRD and IDA provided the largest funding for renewable energy and energy efficiency of all the WBG institutions. These commitments focused predominantly on large hydropower projects, which received US$430 million in funding, followed by US$70 million for new renewable energy and US$49 million for energy efficiency. In addition, the GEF has been an important partner by contributing US$128 million in co-financing for World Bank projects. IFC committed a total of US$450 million, with US$154 million going to new renewable energy, US$156 million to energy efficiency, and US$140 million to large hydropower projects. World Bank Carbon Finance activities contributed an additional US$144 million and MIGA contributed US$155 million.

Sub-Saharan Africa received US$735 million in renewable energy and energy efficiency commitments for 12 projects, which accounted for 51 percent of total renewable energy and energy efficiency commitments (Figure 10). The majority of these commitments were devoted to large hydropower projects, followed by investments in energy efficiency improvements. Eleven projects were developed in South Asia, which accounted for US$183 million in funding devoted mostly to new renewable energy. Also in East Asia and Pacific, Latin America and Caribbean, and Middle East North Africa regions, WBG activities were focused mainly on new renewable energy. In contrast, activities in Europe and Central Asia were focused predominantly on energy efficiency improvements, which attracted US$97 million in commitments.

A total of 32 projects with new renewable energy projects or components of projects were approved in fiscal 2007. For example, solar thermal power generation received two large commitments from GEF in Mexico and Morocco, with a combined value of US$93.6 million. Geothermal power generation received about US$72 million in commitments with projects in Kenya, Philippines, and Europe and Central Asia. Wind power was supported with almost US$70 million (see Box 8)—mostly through Carbon Finance and the IFC—and biomass energy received US$51 million in commitments. In addition, several projects supported a portfolio of different new

Figure 10: World Bank Group Renewable Energy and Energy Efficiency Commitments by Region, FY07



Source: WBG databases.

renewable energy technologies. Such projects include a US$40 million IDA commitment to Sri Lanka supporting small hydropower, solar home systems, and bioenergy, and a US$9.5 million GEF project in the Pacific Islands supporting solar PV, picohydro, and biodiesel technologies.

See Table 7 and Figure 11 for breakdown of the number of projects by region and sector. Figure 12 shows the funds committed for new renewable energy, energy efficiency, and hydropower greater than 10 MW, by region.

Energy efficiency improvements were supported in 21 projects worldwide. On the electricity supply side, for example, these include a US$39.6 million MIGA guarantee on investments into improving energy efficiency in power transmission and distribution in Uganda. Similarly, a US$9 million carbon finance project in the Nigerian city of Aba focused on improving efficiency through the development of a gas-fired cogeneration plant and reduction of transmission and distribution losses through upgraded transmission lines. On the demand side, examples include a US$27 million IBRD commitment to a residential energy efficiency project in Serbia (see Box 9).

Technical Assistance and Sector Studies

In addition to operational activities, the WBG engages in a variety of economic sector work and technical assistance focused on renewable energy and energy efficiency. This work is an integral part of the WBG activities, which is valued as an important source of information and advice for policy makers and other stakeholders. In addition, these activities are an important component in the preparation of future lending activities. As shown in Figure 13, Analytical and Advisory Activities in renewable energy and energy efficiency have sharply risen in fiscal 2007, with 21 activities completed. Activities performed in the past year include studies, reports, and policy notes on renewable energy policy in Colombia and Morocco, energy security in Uruguay and rural electrification in Mexico, Peru, and Timor-Leste. Energy efficiency also received considerable attention, for example, building energy efficiency in China and energy efficiency policy formulation in Morocco. These figures show increasing interest in activities related to renewable energy and energy efficiency on the part of client countries and pave the way for strong operational and lending activities in the coming years.

Table 7: Number of Projects by Region, FY07

Region	*Energy efficiency*	*Hydro > 10 MW*	*New renewable energy*	*Total*
AFR	5	3	4	12
EAP	3	3	8	14
ECA	5.5	1	2.5	9
LCR	4	1	9	14
MNA	0.5	1	1.5	3
SAR	3	1	7	11
Grand total	21	10	32	63

Note: Projects that contain both a new RE and an EE component have been divided and counted as 0.5 to avoid double counting. These projects include LCR's Bertin Ltd., FYR Macedonia Sustainable Energy, Peru BBVA Banco Continental, and Morocco's Energy Sector Development Policy Loan.

Source: WBG databases.

Energy Sector Management Assistance Program

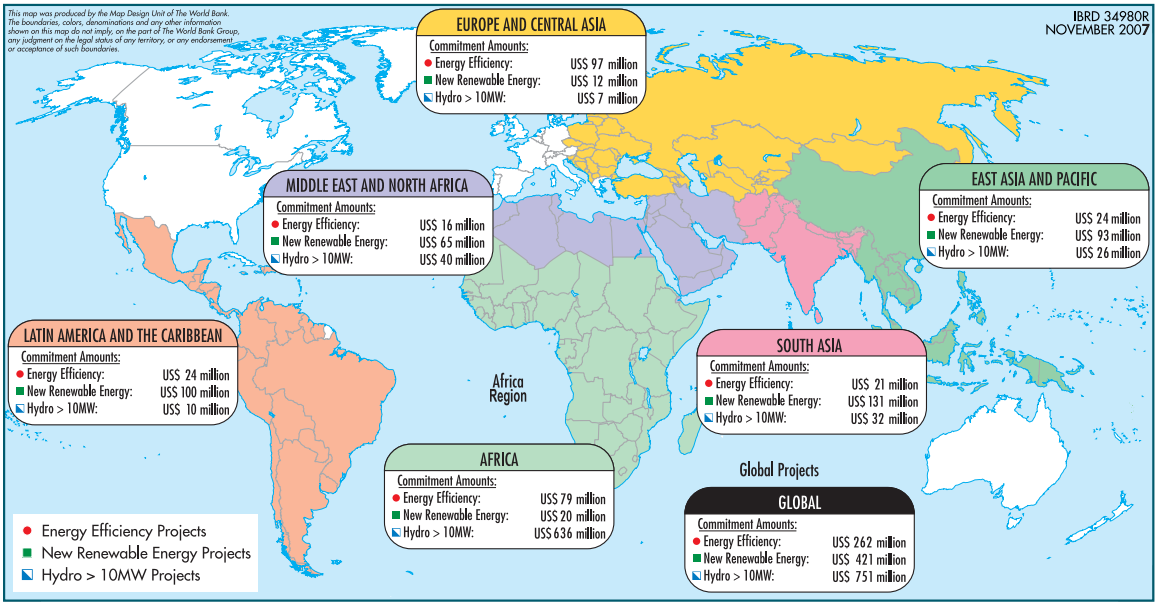
The Energy Sector Management Assistance Program (ESMAP), is a multidonor trust-funded global technical assistance program that has reached its 25th anniversary. This program provides policy advice on sustainable energy development to governments of developing countries and economies in transition. ESMAP promotes the role of energy in poverty reduction and economic growth in an environmentally responsible manner to achieve the Millennium Development Goals.

ESMAP helps build consensus on energy policies, develops innovative energy solutions, and facilitates the leveraging of incremental financing among both public and private development partners. ESMAP offers support to the WBG in four thematic areas, Energy Security and Energy Efficiency, Renewable Energy, Energy Poverty, and Market Efficiency and Governance. It supports both regional activities that provide better service to individual developing countries, and cutting-edge research and global projects.

Box 8: Wind Umbrella Project, Mexico

This Carbon Finance project aims at promoting investments in wind energy to reduce greenhouse gas emissions, to contribute to the further development of the international carbon market in Mexico through the supply of Emissions Reductions under the Clean Development Mechanism and to improve energy security. The project is the first large-scale investment in wind energy in the country and is expected to reduce about 4 million tCO2e over a 20-year operating period and produce an equivalent amount of emissions reductions for sale. At the same time, the project is expected to facilitate the development of other wind projects in Mexico through its demonstration effect and by building capacity, knowledge, and experience in the development, operation, and maintenance of wind energy generation facilities.

Figure 11: World Map with Distribution of Renewable Energy and Energy Efficiency Projects



Box 9: Improving Residential Energy Efficiency in Serbia

The principal aim of the project is to provide additional financing to expand an existing demand-side energy efficiency project in the Republic of Serbia that aims at reducing the rate of electricity use in buildings. Especially for heating, electricity consumption in the Serbian residential sector is very large, which leads to high heating costs, unsustainable electricity demand, and avoidable greenhouse gas emissions. To alleviate these problems, the project aims at improving energy efficiency in three social care buildings, eight schools, and six hospitals that were left out of the original project because of a cost overrun. Moreover, it expands the scope of the original project to include the rehabilitation of the heat supply system of the Nis Clinical Center, other demand-side efficiency improvements at the University of Kragujevac, 20 schools, 7 social care buildings (such as orphanages), and 11 hospitals across Serbia.

ESMAP supports collaboration across the energy sector and shares ideas, good practices, and project experiences across regions. ESMAP has established an Energy Efficiency Thematic Group (EETG) and a Renewable Energy Thematic Group (RETG) within the World Bank. In July 2007, the EETG sponsored a joint roundtable in Tokyo with the World Bank and the Government of Japan on market opportunities and best practices in the area of energy efficiency policies and investments. The RETG held its first meeting in June 2007, focusing discussions on "deep green" RE scenarios and the global wind power outlook.

In 2006, ESMAP's energy efficiency portfolio comprised 23 projects for a total commitment of US$3.8 million while renewable energy comprised 15 projects and US$2.2 million of commitments.

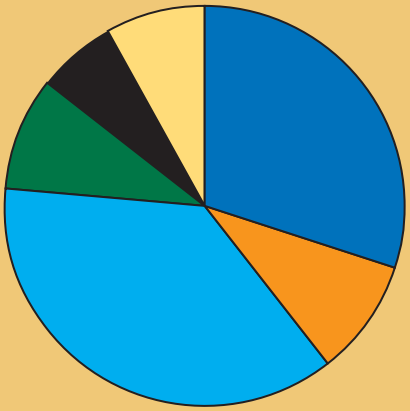
In fiscal 2007, ESMAP supported a variety of studies, including *Shanghai: Developing a Green Electricity Scheme* (see Box 10), a survey and analysis of different existing green electricity schemes worldwide, and *Considering Trade Policies for Liquid Biofuels*, an international analysis of the interaction between national biofuels policies, agricultural policies, and trade policies and their effect on international markets of biofuels and other agricultural products. Moreover, *Risk Assessment Methods for Power Utility Planning* analyzes the methods currently used for planning power generation technology portfolios. It concludes that most current planning methods are inadequate for comparing fuel-intensive thermal generation technologies with free-fuel capital intensive renewables, such as hydro, wind, and geothermal because of difficulties in handling fuel price risk systematically. ESMAP and the World Bank are now working on incorporating these lessons into new activities and developing more appropriate planning methods.

Box 10: Shanghai: Developing a Green Electricity Scheme

Upon the request of the City of Shanghai, China, in 2003, the World Bank—supported by grants from ESMAP and ASTAE—launched a project to help the city in designing and introducing a practical green electricity scheme. The scheme allows consumers to purchase, on a voluntary basis, part or all of their electricity from renewable energy resources, such as wind and solar, thereby contributing to making the city's electricity portfolio more sustainable and reducing local air pollution. At its launch in 2005, the project enlisted 14 large electricity-consuming companies to commit to buying a total of 6.54 GWh of renewable electricity branded as "Jade Electricity" annually. With this critical mass of demand ensured, the scheme was subsequently able to attract additional customers, including businesses of varying sizes and households. It is believed that the success of this project can be replicated in other cities in developing countries. A more detailed description of the scheme and the lessons derived from it can be found in the report *Shanghai: Developing a Green Electricity Scheme* (ESMAP technical paper 105/06).

Figure 12: Sectoral Commitments by Region, FY07

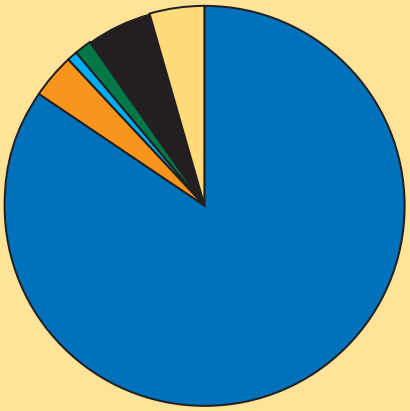
Energy Efficiency: US$262 Million



AFR US$79 million
EAP US$24 million
ECA US$97 million
LCR US$24 million
MNA US$16 million
SAR US$21 million

As in FY06, the ECA region continued to receive the highest energy efficiency commitments in FY07—US$97 million. AFR performed similarly well with US$79 million. The majority of projects improved energy efficiency in the power transmission and distribution sector, followed by industry and demand-side approaches in the residential and commercial sectors.

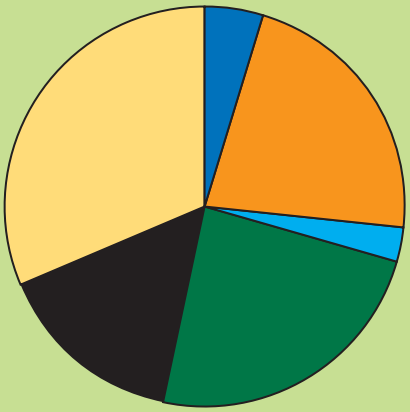
Renewable Energy—Hydropower> 10 MW: 751 Million



AFR US$636 million
EAP US$26 million
ECA US$7 million
LCR US$10 million
MNA US$40 million
SAR US$32 million

Large hydropower projects were supported with US$751 million in FY07. The majority of these projects, valued at US$636 million, were in AFR. Both IBRD/IDA and IFC only classify projects as large hydropower if the installed capacity at a single facility exceeds 10 MW. Pumped storage, run-of-river hydropower, and hydropower projects with dams are included here as well, as long as the capacity exceeds 10 MW. Hydropower rehabilitation projects, which do not result in a greater increase of capacity installed (that is, MW), are classified as energy efficiency projects.

Renewable Energy—New Renewables: US$421 Million



AFR US$20 million
EAP US$93 million
ECA US$12 million
LCR US$100 million
MNA US$65 million
SAR US$131 million

SAR made the largest contribution to the new renewable energy portfolio, accounting for US$131 in commitments. LCR and EAP followed with commitments of US$100 million and US$93 million, respectively. Solar thermal, geothermal, wind, and biomass power projects received the bulk of these commitments.

Asia Alternative Energy Program

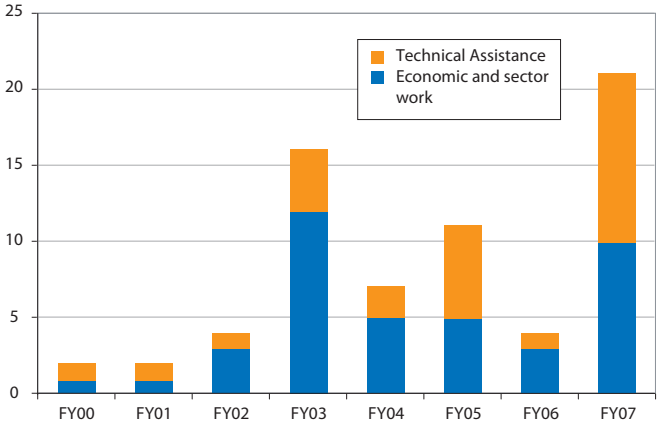
The Asia Alternative Energy Program (ASTAE) grew out of the Financing Energy Services for Small-Scale Energy Users (FINESSE) project initiated by ESMAP and bilateral donors in 1989. Following a joint request from Asian borrowers and donor partners, the Bank acted to implement the FINESSE recommendations by creating ASTAE in January 1992. The original objective of ASTAE—to mainstream energy efficiency and renewable energy in World Bank operations—was achieved. The initial target of a 10 percent share of renewable energy and energy efficiency lending in the Asia energy sector was surpassed during FY97–00. With the support of ASTAE, more than US$1 billion of renewable energy and energy efficiency projects or project components were developed, including about US$500 million in World Bank loans and GEF grants. The projects supported by ASTAE and approved between FY93 and FY02 provided access to 660,000 households, installed 570 MW of renewable electricity-generating capacity, and avoided 720 MW of conventional electricity-generating capacity as a result of efficiency improvements.

Since then, ASTAE has embarked on a more ambitious strategy to scale up renewable energy and energy efficiency to make a direct and immediate impact on the World Bank's overall mission of poverty alleviation and growing emphasis on environmental protection in the two regions—South Asia, and East Asia and Pacific. ASTAE's work plan focuses on the following key components:

- *Support successful implementation*. ASTAE will continue to provide support for the projects currently under implementation. In the past, ASTAE assistance has been extremely valuable in helping to redesign projects to adapt to shifting conditions.
- *Scale up impact of renewable energy and energy efficiency through programmatic approaches*. To make a measurable impact on reducing greenhouse gas emissions and providing increased access to modern energy, more and larger projects are required. This will require a shift from working on stand-alone projects to working strategically on multiple projects on a programmatic basis. The projects will not be ends in themselves, as in the past, but will be seen as vehicles to build capacity and provide the momentum for policy and institutional change and the creation of an enabling environment for scale-up.
- *Strengthen the enabling environment*. Large-scale renewable energy and energy efficiency development requires that countries establish an institutional, policy, financial and regulatory framework that helps attract capital from international financial institutions, export credit agencies and, most importantly, the domestic and international private sector. ASTAE will use its cross-country experiences to share best practices.
- *Develop project pipeline*. ASTAE will continue to support new project development using the programmatic approach. The new projects will include both grid-connected and off-grid renewable energy applications, as well as market-based energy efficiency projects. ASTAE will continue its work in meeting energy needs in the agriculture, health, rural, and urban sectors.

The ASTAE work is supported by the World Bank, Government of the Netherlands, Canadian International Development Agency, United Nations Development Programme, and U.K. Department for International Development. Other sponsors have included the U.S. Department of Energy, U.S. Agency for International Development, Government of Finland, Government of the Swiss Confederation, European Community, U.S. Export Council for Renewable Energy (US/ECRE), German Federal Ministry for Economic

Figure 13: Number of AAA Products with Renewable Energy and Energy Efficiency Focus, FY00–07



Source: WBG databases.

Cooperation, and the Royal Danish Ministry of Foreign Affairs.

The Way Forward

Broad consensus is now emerging that the world needs to address the dual challenges of increasing energy supply and services that are critical for economic growth for all developing countries and moderating and managing climate change. The World Bank Group launched the CEIF in 2006 to address these challenges. The growing recognition of the enormous challenge of climate change has led to calls from governments, the private sector, and the public for the WBG to adopt a more comprehensive approach beyond the CEIF. This approach would address climate change not only as a risk to development, but also as an opportunity for Bank clients to accelerate their economic transformation and take advantage of new technologies. The WBG would expand its role in supporting meaningful, country-specific, and country-driven climate actions, focusing on the highest development and climate impacts. Broadening the WBG strategy would mean including the following elements: (a) a comprehensive approach to climate change, extending beyond clean energy and addressing sectors such as transport, agriculture, forests, and urban development; (b) a stepped-up program in policy research and knowledge sharing; (c) an enhanced role in the acceleration of new technology; and (d) an increased engagement in climate risk management.[17] Renewable energy and energy efficiency will contribute significantly to this enhanced strategy.

[17] World Bank Sustainable Development Network, "Clean Energy for Development Investment Framework: Progress Report on the World Bank Group Action Plan." Report to the Development Committee, World Bank, Washington, D.C., September 27, 2007, p. 5.

Case Six

Creating a Framework for Renewable Energy and Energy Efficiency in Morocco

Morocco is 95 percent dependent on imported fossil fuels. This has focused the attention of the government on the need to ensure energy supply security and absorb energy price shocks. Morocco is well endowed with renewable energy resources, and has a substantial potential for energy efficiency improvements. Since 2005 the government has been actively engaged in an energy sector dialogue with the World Bank in order to prepare an energy sector development policy loan. ESMAP, the trust-funded World Bank Energy Sector Management Assistance Program, provided support to this dialogue. ESMAP is now catalyzing activities for energy efficiency and renewable energy in Morocco by giving assistance to formulate policies and regulations. The projects have provided a legal framework for energy efficiency and renewable energy in Morocco, including special financing mechanisms. They have also created a new energy management agency focused on the following:

- Increasing the role of renewable energy in Morocco with the objective of generating 20 percent of electricity from domestic renewable energy sources by 2015.
- Promoting more efficient utilization of energy in industry and public buildings and for residential use.
- Reducing greenhouse gas emissions by 10 percent by 2015.

In 2006, ESMAP-supported projects focused on building consensus among stakeholders on goals and measures that will promote wind electricity and energy efficiency. These projects supported working groups within the government that were able to draw on lessons learned from previous efforts in Morocco and best practices from elsewhere. This process helped the government prepare a comprehensive legal framework for energy management. The framework eventually took the form of a single law on energy efficiency and renewable energy that will be used to prepare additional necessary regulations to promote investments. The law sets up goals, such as 1,000 MW of additional wind-electricity generation capacity by 2012, mandatory energy efficiency audits, and the preparation of improved sectoral energy efficiency standards. The law also establishes an energy management agency. The agency will be charged with promoting energy efficiency and supporting small renewable energy technologies for households and businesses.

The law also launches two special funds. One fund will pool donor financing to support private sector investment in large wind and power generation capacity. Another fund will support energy efficiency investments. In 2007 ESMAP supports additional work to prepare the business plans and to design the organization of the new energy management agency and the funds.

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.

Roles of the Institutions

The World Bank Group

In this report, the WBG refers to four closely associated World Bank institutions that directly support renewable energy and energy efficiency activities.[18] The four institutions are the IBRD, IDA, the IFC, and MIGA. There are six operational regions under the 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 (CFB-IBRD) is reported separately because it is a unique business line that purchases emissions reductions and does not directly invest in projects.

The IBRD

The IBRD (International Bank for Reconstruction and Development) 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 (International Development Association) enable the World Bank to provide approximately US$6–9 billion a year in highly concessional financing to the world's 80 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 (International Finance Corporation'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).

MIGA

MIGA (Multilateral Investment Guarantee Agency) 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 Carbon Finance Units (CFUs) that leverage public and private investment for projects that generate greenhouse gas 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

[18] There is also a fifth institution that is a part of the World Bank Group: the International Centre for Settlement of Investment Disputes (ICSID). Because this institution does not directly support any RE or EE activities, for this annual report, World Bank Group precludes ICSID.

reductions to learn how to originate transactions in this complex emerging market. The Carbon Finance Business (CFB-IBRD) is divided into separate business lines—the IBRD CFU ( ) and the IFC CFU (http://www.ifc.org/carbonfinance).

ESMAP

ESMAP (Energy Sector Management Assistance Program) 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 (Asia Alternative Energy Program) to support the transition to environmentally sustainable energy use in developing countries in Asia. ASTAE supports upstream economic and sector work, much like ESMAP, and it also provides assistance in renewable energy and energy efficiency project identification, preparation, and supervision (http://www.worldbank.org/astae/).

The GEF

The Global Environment Facility (GEF), established in 1991, helps developing countries fund projects and programs that protect the global environment. GEF grants support projects related to biodiversity, climate change, international waters, land degradation, the ozone layer, and persistent organic pollutants.

GEF is an independent financial organization that provides grants to developing countries for projects that benefit the global environment and promote sustainable livelihoods in local communities. The GEF is the WBG's largest partner in the area of renewable energy and energy efficiency investments (http://www.thegef.org).

Definitions

Following are the definitions used for reporting on the WBG's activities. Commitment amounts used in the report were prorated to include only those project components that clearly fall into one of the following categories.

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, and appliances), 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 if the share of transmission and distribution investments cannot be clearly disaggregated from other objectives, such as network expansion and load increase. Neither does it include Development Policy Loan commitments unless the share attributable to efficiency can be clearly determined.

Hydropower Greater Than 10 MW

The World Bank considers hydropower, regardless of scale, to be 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 greater than10 MW. For example, in a particular project, the total commitment made by the 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, 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 the 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. Only those project components that could clearly be attributed to a renewable energy and energy efficiency category were counted.

The IFC

The report shows IFC (International Finance Corporation) 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.

MIGA

MIGA (Multilateral Investment Guarantee Agency) 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 only the MIGA maximum liability.

Carbon Finance

For purposes of this report, to compare carbon asset purchases and regular project financing, this report considered signed Emission Reductions Purchase Agreements to be the appropriate measure and added

those amounts to arrive at the total commitment—that is, the Carbon Finance Business' (CFB-IBRD's) equivalent of Board approval for World Bank loans.

The GEF

For approved GEF (Global Environment Facility) projects, this report uses the commitment amounts for each project.

Annex 2: Annual Renewable Energy and Energy Efficiency Portfolio Review

Annual Table 1: WBG Renewable Energy and Energy Efficiency Commitments (US$ millions)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Grand total
New Renewables	53	2	56	227	300	59	47	336	15	239	444	26	169	105	192	218	221	421	3,129
Energy Efficiency	0	265	54	10	59	148	380	56	356	26	295	193	67	168	67	243	447	262	3,094
Hydropower (>10 MW)	0	150	161	938	186	317	819	15	461	0	320	0	181	237	81	447	192	751	5,253
Grand total	53	417	271	1,174	545	524	1,245	407	832	264	1,059	219	416	510	339	908	860	1,433	11,476

Annual Table 2: WBG Renewable Energy and Energy Efficiency Commitments (US$ millions) by Institution or Unit

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Grand total
GEF	0	0	3	36	56	35	10	78	28	56	111	14	37	70	83	100	48	128	892
GEF-IFC/TF	0	0	0	0	0	0	37	33		30	5	0	19	0	14	8	20	0	165
IBRD Carbon Finance	0	0	0	0	0	0	0	0	0	0	0	2	8	10	48	23	14	144	249
IBRD/IDA	53	392	196	1,113	303	452	1,108	146	534	137	691	197	340	290	194	445	370	549	7,508
IFC	0	25	72	26	186	7	36	135	206	15	1	6	13	135	0	221	393	450	1,925
IFC Carbon Finance	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	13	7	34
MIGA	0	0	0	0	0	30	35	15	65	26	252	0	0	5	0	91	2	155	675
Special Financing	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	20
Total commitment	53	417	271	1,174	545	524	1,245	407	832	264	1,059	219	416	510	339	908	860	1,433	11,476

Annual Table 3: WBG New Renewables Commitments (US$ millions) by Institution or Unit

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Grand total
GEF	0	0	3	26	30	10	7	39	6	56	66	9	36	16	62	47	47	121	580
GEF-IFC/TF	0	0	0	0	0	0	30	30	0	14	0	0	0	0	14	1	0	0	89
IBRD Carbon Finance	0	0	0	0	0	0	0	0	0	0	0	2	4	10	19	4	8	68	115
IBRD/IDA	53	2	20	201	270	19	8	132	10	128	127	9	128	64	97	139	136	70	1,610
IFC	0	0	33	0	0	0	0	135	0	15	0	6	1	15	0	18	17	154	393
IFC Carbon Finance	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	13	7	23
MIGA	0	0	0	0	0	30	2	0	0	26	252	0	0	0	0	0	0	0	311
Total commitment	53	2	56	227	300	59	47	336	15	239	444	26	169	105	192	218	221	421	3,129

(continuous from previous section)

Annual Table 4: WBG Energy Efficiency Commitments (US$ millions) by Institution or Unit

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Grand total
GEF	0	0	10	26	25	3	39	22	1	45	5	1	54	22	53	1	7	312
GEF-IFC/TF	0	0	0	0	0	7	3	0	16	5	0	19	0	0	7	20	0	76
IBRD Carbon Finance	0	0	0	0	0	0	0	0	0	0	0	0	0	13	4	0	10	28
IBRD/IDA	265	54	0	33	123	350	14	328	9	244	188	35	34	32	23	115	49	1,897
IFC	0	0	0	0	0	0	0	6		1		12	75	0	156	309	156	715
IFC Carbon Finance	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MIGA	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	1.8	39.6	7
Special Financing	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	20
Total commitment	265	54	10	59	148	380	56	356	26	295	193	67	168	67	243	447	262	3,094

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

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Grand total
IBRD Carbon Finance	0	0	0	0	0	0	0	0	0	0	0	4	0	15	15	6	66	106
IBRD/IDA	125	122	912	0	310	750	0	196	0	320	0	177	192	66	283	119	430	4,001
IFC	25	39	26	186	7	36	0	200	0	0	0	0	45	0	47	67	140	817
IFC Carbon Finance	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	0	0	11
MIGA	0	0	0	0	0	33	15	65	0	0	0	0	0	0	91	0	115	203
Total commitment	150	161	938	186	317	819	15	461	—	320	—	181	237	81	447	192	751	5,253

Annual Table 6: WBG Renewable Energy and Energy Efficiency Commitments (US$ millions) by Region

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Grand total
AFR	0	127	73	203	0	3	12	30	201	7	124	0	78	32	46	101	126	735	1,898
EAP	51	0	121	410	310	367	400	145	123	139	513	8	124	177	47	368	232	143	3,676
ECA	0	290	0	0	33	140	381	14	238	15	68	186	75	139	147	260	313	117	2,416
LCR	2		75	340	199	10	2	41	186	79	219	6	30	78	30	92	141	133	1,664
MNA	0	0	0	0	2	4	0	0	0	0	0	0	0	0	40	9	11	121	188
OTH	0	0	0	0	0	0	32	148	0	25	0	12	1	0	13	0	1	0	232
SAR	0	0	2	222	0	0	419	29	85	0	135	7	108	85	15	77	35	183	1,402
Grand total	53	417	271	1,174	545	524	1,245	407	832	264	1,059	219	416	510	339	908	860	1,433	11,476

(continuous from previous section)

Annual Table 7: WBG New Renewables Commitments (US$ millions) by Region

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Grand total
AFR	0	2	18	3	0	3	8	30	5	6	124	0	16	32	46	46	19	20	377
EAP	51	0	0	0	300	49	0	112	2	139	0	3	18	0	37	129	103	93	1,035
ECA	0	0	0	0	0	0	7	0	9	6	6	2	0	0	56	10	11	12	119
LCR	2	0	37	2	0	3	2	20	0	78	204	6	26	35	0	15	56	100	586
MNA	0	0	0	0	0	4	0	0	0	0	0	0	0	0	40	1	5	65	115
OTH	0	0	0	0	0	0	30	145	0	10	0	12	1	0	13	0	0	0	212
SAR	0	0	2	222	0	0	0	29	0	0	110	2	108	38	0	17	27	131	685
Grand total	53	2	56	227	300	59	47	336	15	239	444	26	169	105	192	218	221	421	3,129

Annual Table 8: WBG Energy Efficiency Commitments (US$ millions) by Region

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Grand total
AFR	0	0	0	0	0	4	0	1	1	0	0	0	0	0	4	30	79	40
EAP	0	54	10	10	8	0	33	121	0	193	5	1	32	11	77	72	24	648
ECA	265	0	0	33	140	374	14	229	9	62	183	65	131	41	79	292	97	2,015
LCR	0	0	0	14	0	0	6	0	1	15	0	0	6	15	61	38	24	180
MNA	0	0	0	2	0	0	0	0	0	0	0	0	0	0	9	6	16	17
OTH	0	0	0	0	0	2	3	0	15	0	0	0	0	0	0	1	0	20
SAR	0	0	0	0	0	0	0	6	0	25	5	1	0	0	13	8	21	79
Grand total	265	54	10	59	148	380	56	356	26	295	193	67	168	67	243	447	262	3,094

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

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Grand total
AFR	125	55	200	0	0	0	0	196	0	0	0	62	0	0	51	77	636	1,402
EAP	0	67	400	0	310	400	0	0	0	320	0	105	145	0	163	57	26	1,993
ECA	25	0	0	0	0	0	0	0	0	0	0	10	8	51	170	11	7	282
LCR	0	39	338	186	7	0	15	186	0	0	0	4	37	15	16	47	10	898
MNA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	40
SAR	0	0	0	0	0	419	0	79	0	0	0	0	47	15	47	0	32	638
Grand total	150	161	938	186	317	819	15	461	-	320	-	181	237	81	447	192	751	5,253

Annex 3: FY07 Renewable Energy and Energy Efficiency Projects (millions of U.S. dollars)

No.	Country	Project name	Energy type	Financing sources	RE or EE component financing
		Africa Region			
1	Congo/Africa	Regional & Domestic Power Market Development Project	Hydro > 10 MW	IDA	272.97
2	Ghana	Urban Transport Project	EE (urban transport)	GEF	7.00
3	Kenya	Olkaria II Geothermal Expansion Project	Geothermal	Carbon Finance	8.70
4	Madagascar	Power/Water Sector Recovery and Restructuring Project	Small hydro	IDA	3.00
5	Nigeria	Aba Cogeneration Project	EE (Cogeneration)	Carbon Finance	9.00
6	Senegal	Felou Hydro Project	Hydro > 10 MW	Carbon Finance	3.11
7	Senegal	Vicat-SOCOCIM	EE	IFC	17.53
8	South Africa	Renewable Energy Market Transformation Project	Biomass, solar, small-scale hydro	GEF	6.00
9	Uganda	Private Power Generation (Bujagali) Project	Hydro > 10 MW	MIGA IFC IDA Guarantees	115.00 130.00 115.00
10	Uganda	Power Sector Development Project	EE	IDA	6.00
11	Uganda	Umeme Limited (Globeleq ConCo)	EE (Transmission & Distribution)	MIGA	39.60
12	Uganda	West Nile Electrification Project	Solar PV and other new renewables	Carbon Finance	2.55
		East Asia and Pacific Region			
13	China	Bank of Beijing (CHUEE)	EE	IFC	18.00
14	China	CDCF Hubei Guangrun Hydropower Project	Hydro > 10 MW	Carbon Finance	4.61
15	China	Huitengxile Wind Farm	Wind	Carbon Finance	15.20
16	China	Tianjin Shuangko	Waste energy	Carbon Finance	1.16
17	China	Tinarui Cement	EE	IFC	1.97
18	China	Yunnan Hydropower Project	Hydro > 10 MW	Carbon Finance	19.25
19	Lao PDR	GMS Power Trade Project	Hydro > 10 MW	IDA	2.10
20	Mongolia	Renewable Energy for Rural Access Project	Solar PV, wind	GEF	3.50
21	Mongolia	Renewable Energy for Rural Access Project	Solar Home Systems, wind, renewable-diesel hybrid system	IDA	3.15
22	Pacific Islands	Sustainable Energy Finance Project	Solar PV, pico-hydro and bio-diesel	GEF	9.48
23	Philippines	MWC III	EE	IFC	4.39
24	Philippines	Northern Negros Geothermal Power Project	Geothermal	Carbon Finance	9.36
25	Philippines	PNOC-EDC	Geothermal	IFC	49.30
26	Timor-Leste	Energy Services Delivery Project	RE, including wind	IDA	1.63

(*continuous from previous section*)

Europe and Central Asia Region

27	Europe and Central Asia	GeoFund 1	Geothermal	GEF	4.53
28	Bosnia	EKI	EE	IFC	0.77
29	Macedonia, Former Yugoslav Republic	Sustainable Energy Project	New renewables, including solar, hydro, biomass, EE	GEF	5.00
30	Poland	Puck Wind Farm Project	Wind	Carbon Finance	2.44
31	Russian Federation	MDM Bank	EE	IFC	50.00
32	Serbia	Energy Efficiency Additional Financing Project	EE	IBRD	27.16
33	Serbia	Pro-Credit Serbia	EE	IFC	19.10
34	Ukraine	Hydropower Rehabilitation – Proto Carbon Finance Project	Hydro > 10 MW	Carbon Finance	7.15
35	Ukraine	Sandora II	EE	IFC	0.40

Latin America & Caribbean Region

36	Brazil	Bauducco	EE	IFC	1.08
37	Brazil	Bertin LTD	EE Cattle waste fat bio-diesel	IFC IFC	1.62 1.62
38	Brazil	Lages Cogen Facility	Biomass Cogeneration	Carbon Finance	7.50
39	Brazil	Vale do Parana	Bagasse Cogeneration	IFC	5.95
40	Chile	Hidromaule	20 MW	IFC	9.70
41	Colombia	Furatena Energy Efficiency Project	EE	Carbon Finance	0.66
42	Mexico	CFE Wind Farm Project	Wind	Carbon Finance	1.22
43	Mexico	Hybrid Solar Thermal Integrated Cycle Project	Solar Thermal	GEF	49.35
44	Mexico	Umbrella Waste Management Project	Waste energy	Carbon Finance	1.56
45	Mexico	Wind Umbrella Project	Wind	Carbon Finance	16.73
46	Nicaragua	Nicaragua Sugar	Bagasse cogeneration	IFC	3.25
47	Peru	BBVA Continental	New renewable energy credit-line to bank EE	IFC IFC	8.40 19.60
48	Peru	Laredo Expansion	EE	IFC	0.84
49	Uruguay	Orion	Pulp and paper biomass cogeneration	IFC	4.20

Middle East and North Africa Region

50	Iraq	Dokan & Derbankdikhan Emergency Hydropower Project	Hydro > 10 MW	IDA	40.00
51	Morocco	Integrated Solar Combined Cycle Power Project	Solar Thermal	GEF	43.20
52	Morocco	Energy Sector Development Policy Loan	Solar, wind EE	IBRD IBRD	22.00 16.00

(*continuous from previous section*)

South Asia Region

53	India	Allain Duhangan Hydro Project	Hydro > 10 MW	Carbon Finance	31.73
54	India	Balrampur II	Biomass cogeneration	IFC	10.40
55	India	BHSL	Biomass cogeneration + ethanol	IFC	15.30
56	India	CCIL II	EE	IFC	3.91
57	India	CF IHDC	Small hydro	IFC-Carbon	7.40
58	India	Electrotherm	EE	IFC	2.60
59	India	Moser Baer Photovoltaic Ltd. (MBPV)	Export-oriented solar PV manufacturing plant investment with 80 MW p.a. production capacity	IFC	22.50
60	India	MSPL	Two wind projects of 37 MW	IFC	33.00
61	India	West Coast Paper	EE	IFC	14.60
62	Nepal	Nepal Village Micro Hydro Carbon Offset Project	Micro-hydro	Carbon Finance	1.96
63	Sri Lanka	Technical Assistance to the Ministry of Public Works	Small hydro, solar home systems, bio-energy	IDA	40.00

Notes: RE stands for renewable energy, and EE stands for energy efficiency.
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/.

Fuel cells are categorized as RE by IFC regardless of whether the energy resource used to generating the hydrogen has been a fossil fuel or renewable energy resource. For the World Bank and *for this report*, fuel cells are only filed as renewable energy of the energy resource used to generating hydrogen is a renewable energy resource.

Hydropower rehabilitation projects, which do not result in greater output, are classified as EE by the WBG.

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