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AN INVESTMENT FRAMEWORK FOR CLEAN ENERGY AND DEVELOPMENT:

A PROGRESS REPORT

Attached for the September 18, 2006, Development Committee Meeting is a paper entitled "An Investment Framework for Clean Energy and Development: A Progress Report," prepared by the staff of the World Bank.

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AN INVESTMENT FRAMEWORK FOR CLEAN ENERGY AND DEVELOPMENT: A PROGRESS REPORT

VICE PRESIDENCY FOR SUSTAINABLE DEVELOPMENT

September 1, 2006

ACRONYMS

AAA	Analytic and Advisory Assistance
AAU	Assigned Amount Unit
AfDB	African Development Bank
APL	Adaptable Program Loan
AsDB	Asian Development Bank
CARICOM	Caribbean Community
CAS	Country Assistance Strategy
CCGT	Combined Cycle Gas Turbine
CCS	Carbon Capture and Storage
CDM	Clean Development Mechanism
CEFV	Clean Energy Financing Vehicle
CER	Carbon Emission Reduction
CESF	Clean Energy Support Fund
CMI	Carbon Market Initiative
CO2	Carbon Dioxide
DPL	Development Policy Loan
DMC	Developing Member Country
EBRD	European Bank for Reconstruction and Development
ECA	Export Credit Agency
EIB	European Investment Bank
ESMAP	Energy Sector Management Assistance Program
FY	Fiscal Year
GDP	Gross Domestic Product
GEF	Global Environment Facility
GGFR	Global Gas Flaring Reduction Partnership
GIIF	Global Index Insurance Facility
GW	Gigawatt
HFC-23	Trifluoromethane
IADB	Inter-American Development Bank
IBRD	International Bank for Reconstruction and Development
IDA	International Development Agency
IEA	International Energy Agency
IFC	International Finance Corporation
IFI	International Financial Institution
IGCC	Integrated Gasification Combined Cycle
IPCC	Inter-governmental Panel on Climate Change
ISDR	International Strategy for Disaster Reduction
JI	Joint Implementation
LDCF	Least Developed Countries Fund
LED	Light Emitting Diode
LPG	Liquefied Petroleum Gas
MDG	Millennium Development Goal
MIGA	Multilateral Investment Guarantee Agency
MW	Megawatt
NAPA	National Action Plans for Adaptation
NEPAD	New Partnership for Africa's Development
NGO	Non-governmental Organization
ODA	Official Development Assistance
OECD	Organization for Economic Cooperation and Development
PRSC	Poverty Reduction Support Credit
PRSP	Poverty Reduction Support Paper
PV	Photovoltaic
PWC	Price Waterhouse Coopers
SADC	Southern Africa Development Community
SCCF	Special Climate Change Fund
SEI	Sustainable Energy Initiative
SSA	Sub-Saharan Africa
SWAp	Sector-wide Approach
TF	Trust Fund
UNFCCC	United Nations Framework Convention on Climate Change
VARG	Vulnerability and Adaptation Resource Group
WB	World Bank
WBG	World Bank Group

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EXECUTIVE SUMMARY

- This paper responds to the Development Committee Communiqué of April 2006 requesting the World Bank to (a) review, in close coordination with other partners, existing financial instruments, taking into account the role of the private sector, and (b) explore the potential value of new financial instruments to accelerate investment in clean energy; so as to report on progress towards an investment framework by their next meeting.
- This paper builds on the report "Clean Energy and Development: Towards an Investment Framework" that was presented to the Development Committee at the April 2006 Spring Meeting and concludes:
- The major financing gap for the energy for development and energy access agendas can be met by deepening and broadening energy sector policy reform to attract private sector investments and additional public sector financing. Additional concessional support will be required to meet the energy access challenge in Sub-Saharan Africa.
- Current International Financial Institution, public, and private resources cannot lead to a meaningful transition to a low carbon economy. A long-term stable global regulatory framework, with differentiated responsibilities, is needed to stimulate private investments and provide predictability. The Bank proposes the development of a number of options to accelerate the transition.
- Progress in fighting poverty is under threat from increasingly severe weather events and climate variability. Risks of weather-related disasters, including droughts and floods, need to be integrated into poverty and sustainable development strategies with a combination of public and private sector resources.
- Clean energy will address the following issues that affect poor people and undermine progress on many of the Millennium Development Goals:
  - Pollution at the household level, especially indoor air pollution, which adversely affects human health;
  - Environmental impacts at the local, national and regional level, including urban air pollution and acid deposition, which affects human health and ecological systems; and
  - The adverse impacts of greenhouse gas emissions from the production of energy on agricultural productivity, water resources, human health, human settlements and ecological systems.

1. ***This paper reports on progress in developing an Investment Framework for Clean Energy and Development.*** The Investment Framework is intended to be a vehicle to accelerate investments to address developing country energy needs for growth and access for the poor; mitigate greenhouse gas emissions by moving to a low-carbon economy; and support developing countries in adapting to climate variability and risk**.** This paper presents progress since the April 2006 Development Committee meeting where an earlier paper "Clean Energy and Development: Towards an Investment Framework" was considered. Responding to the request from Development Committee members, this Progress Report analyzes the strengths, weaknesses, complementarities, and utilization of existing World Bank Group and other International Financial Institution (IFI) instruments to address these challenges. This is a progress report that seeks to

provide elements to support the Development Committee going forward. In doing so, it offers the World Bank Group's knowledge of sector and market reforms, regulatory issues, strategies for increasing financing, including the removal of market barriers so as to increase private sector investment. It makes proposals to utilize more effectively existing instruments and, where there are gaps, to introduce new strategies and financing vehicles. The Appendix to this Executive Summary shows, in tabular form, the available instruments, improvements required, proposed new instruments, and issues and constraints.

A. Pillar 1: Energy for Development and Access for the Poor

2. ***There is currently a large financing gap in the energy sector — about $80 billion per year, or about 50 percent of the actual needs for electricity generation***. It is estimated that developing countries need an annual investment for electricity supply of US$165 billion through 2010, increasing at about 3 percent per annum through to 2030. Out of the US$165 billion, the investment needed for electricity access for the poor is in the order of approximately US$34 billion per annum. Of the US$165 billion investment needs, financing for half of this is readily identifiable. The under-investment in energy is estimated to reduce GDP growth in some countries by as much as 1 to 4 percent per annum, depending on the severity of the problem. The financial health of the energy sector is an important component of meeting the energy needs of poor people. And poor people without access to modern energy suffer from health effects of indoor air pollution; are constrained from engaging in productive activities; and suffer from poor health and education services.

3. ***Decreasing the electricity sector financing gap is primarily an issue of getting the sector policy framework right.*** Good governance and transparency at the state and corporate level are the keys to attracting foreign and domestic investors. Sector sustainability results only when the rule of law prevails, property rights are respected and contract obligations are enforced. Effective pricing policies can support internal generation of sufficient cash (after meeting all operational expenses and debt service) adequate to meet at least the equity requirements of the system expansion projects. Utilities that achieve a self-financing capability of at least 30 percent generally manage to meet the remaining investment needs through debt, or through the purchase of services from private suppliers and keep demand and supply in balance. Case studies commissioned as part of the development of this paper highlight how good policies can contribute. For example, Vietnam managed to meet a rapid 16 percent per annum electricity demand growth rate over 10 years through a combination of public and private participation, enabled by a financially healthy sector. However, increasing electrification rates often remain a challenge for low-income countries, especially in regard to reaching the poor. If subsidies are needed, they should be transparent, targeted and focused on the demand side, with a defined time frame and with specific results expected. Ensuring accountability systems are in place so that beneficiaries can oversee the utilization of resources will also be important, as will working to put in place the enabling conditions for public-private partnerships and to attract private investment.

4. ***Demand management, optimal generation planning, electricity trade across countries and joint investments in regional projects can significantly reduce the volume of incremental investment needs.*** Increased support for energy efficiency is essential to meet growing demands in a sustainable manner. Efficiency improvements, demand management, improved planning and operation and increased electricity trade could be used to moderate the volume of investments needed and thus help bridge the supply-demand gap. This includes energy efficiency actions at the household level; in the building, industrial and agricultural sectors; in power generation and transmission; and in transportation.

5. ***A review of existing instruments carried out for this Progress Report concluded that they are adequate to meet the energy financing needs.*** The IFIs have a broad range of knowledge, lending and risk mitigation instruments available to address energy sector investment needs. These, together with private sector participation with possible support from existing risk mitigation instruments, are adequate to meet the funding needs of middle income countries. The independent Price Waterhouse and Coopers review indicated that, if stretched, the current IFI instruments could mobilize an additional US$10 to 12 billion per year from IFI, public, and private capital. More could be mobilized if countries pursued aggressive energy sector reforms. The task is more challenging for low-income countries, where the risk profile is perceived as higher. Additional concessional financing to flow through existing instruments will be required to meet the energy access agenda in these countries. Finally, to provide a satisfactory environment in which to enable the larger financing gap to be bridged, a combination of policy guidance, technical assistance and development policy lending will be important. Capacity building is a critical component for scaling up the energy access program.

6. ***The challenge of providing access to modern energy services to the poor calls for special attention***. The International Energy Agency's World Energy Outlook indicates that, with current policies, roughly 1.4 billion people will not have access to electricity by 2030, marginally less than the current number of 1.6 billion. More than 3 billion people use wood, dung, coal, and other traditional fuels inside their homes to meet cooking and heating needs. The indoor air pollution caused by the use of biomass in inefficient cook stoves is responsible for 1.5 million deaths per year—mostly of young children and mothers. Achievement of the Millennium Development Goals (MDGs) requires the provision of grid- and off-grid solutions to key public facilities such as schools, health clinics, and communications centers.

7. ***Most poor people without energy access live in Sub-Saharan Africa (SSA) and South Asia.*** Government programs are well underway in South Asia, but progress is not sufficient in SSA where concerted action will be needed to bridge the considerable energy access gap. This will require a combined effort from: (a) governments to set a framework that provides opportunities for poor people; (b) utilities, to provide reliable generation and networks and services; and (c) donors and IFIs, to support the funding needs of poor people, as well as to share knowledge to help create the conditions for economic growth.

8. ***An Action Plan for energy access with special emphasis on SSA.*** The Action Plan would include five parallel tracks: (a) access to clean cooking, heating and lighting fuels, coupled with sustainable forest management; (b) scaled up programs of electrification; (c) additional generation capacity to serve newly connected households and enterprises, including through regional projects; (d) provision of energy services for key public facilities such as schools and clinics; and (e) provision of stand-alone lighting packages for households without access to the electricity grid. The Action Plan will be supported by the energy sector reform principles outlined in Para. 3. The Action Plan could increase poor people's access to energy from 23 percent today to 47 percent by 2030, a difficult but achievable goal. To implement this Action Plan, concessional support will need to double to US$4 billion per year. This level of support cannot be accommodated in IDA-14, thus additional concessional financing will need to be mobilized. The Africa Infrastructure Consortium, in close cooperation with the African Development Bank, will be an important vehicle for this.

B. Pillar 2: Transition to a Low Carbon Economy

9. ***Meeting the energy needs of developing countries in an environmentally sustainable manner is an urgent yet difficult challenge.*** Local and regional air pollution and an increasingly variable climate can undermine development and stall progress on many of the MDGs. Mitigating greenhouse gas emissions requires the development and implementation of low-carbon technologies and policies encompassing a wide range of sectors. The demand for primary energy is projected to increase globally by a factor of 1.6 to 3.5 between now and 2050 and in non-OECD countries by a factor of 2.3 to 5.2. During this period, unless the policy framework changes and appropriate instruments are in place to facilitate investments in new technologies, developing countries are expected to follow a carbon intensive development path, similar to that of their developed country counterparts.

10. ***The costs of reducing greenhouse gas emissions can be lowered through international trading and adopting a multi gas/multi sector strategy***. The costs depend on several factors, including: (a) the degree to which projected emissions are reduced; (b) the underlying pathway to development; and (c) the degree to which there is flexibility in where, when and how emissions are reduced. For example, a multi-gas/multi-sector strategy will have considerably lower costs in reducing greenhouse gas emissions (a factor of 2 to 3) than a carbon dioxide (CO_2)-only strategy. Increased end-use energy efficiency is a critical element in a cost-effective strategy to reduce emissions. Given that moving to a low carbon economy is a global benefit, it is in the global interest to buy down the incremental costs in developing countries. For instance, a bottom-up analysis suggests that to significantly de-carbonize power production would require incremental investments of up to US$30 billion per year in non-OECD countries (i.e., beyond the basic needs for electricity generation).

11. ***A review of currently available IFI, public and private sector resources and instruments concluded that they cannot lead to a meaningful transition to a low carbon economy.*** Although currently available IFI, public, and private sector resources and instruments can be strengthened and scaled-up for greater impact in the development of

markets for energy efficient and renewable energy technologies, more needs to be done to make a significant dent in the transition to a low-carbon economy. There are three primary sources of funding for mitigating greenhouse gas emissions (a) international grants (e.g., the Global Environment Facility, GEF); (b) carbon trade; and (c) voluntary actions.

12. ***GEF is the largest source of multilateral grant financing for low carbon technologies, and its work is vital.*** However, it would need increased funding to achieve significant and sustained market penetration of near-commercial energy efficiency and renewable energy technologies. Scaling up the GEF's current focus on removing barriers for such technologies would need increased funding by a factor of 3. In addition, were the GEF to expand its support to the capital investment needs of new, low-greenhouse gas emitting technologies, its resources would have to be scaled up considerably more (by at least a factor of 10).

13. ***Carbon finance can contribute to financing a transition to a low-carbon economy, but the carbon market is currently limited primarily due to regulatory risks.*** Considering the wide range of project and program types that could benefit from carbon finance, opportunities to increase market penetration and make greater use of carbon finance for development purposes are numerous. Existing carbon funds can be scaled up for targeted investments and their applications improved; the establishment of the Umbrella Carbon Facility has demonstrated the potential of such instruments for scaling up and increasing the efficiency of delivery of emission reductions from large projects. However, the lack of a global regulatory framework for emissions reductions after 2012 prevents investments with long lead times and a long term positive impact on a transition to a low-carbon economy. Therefore, a viable carbon market, with the involvement of the private sector, needs a long-term stable global regulatory framework, with differentiated responsibilities. This could stimulate the carbon market with a flow of funds to developing countries of tens of billions of dollars per year. The right incentives need to be created.

14. ***There is potential for growth in the voluntary carbon market, though it is highly uncertain and only for relatively low-priced options.*** The motivational forces include corporate risk management and corporate sustainability management.

15. ***The scale of the financing challenge, the real and perceived technology risks that constrain private sector activities, and carbon market uncertainties mean that current instruments are not sufficient to accelerate the transition to a low carbon economy.*** In response, options for new financial instruments include: the Clean Energy Financing Vehicle (CEFV); the Clean Energy Support Fund (CESF); and under the Bank's proposed Middle Income Country paper, proposals that make the Bank's financial products more attractive for "global public goods" like clean energy.

- CEFV, which would blend public and private sources of financing, could: (a) assist in scaling-up and commercializing low carbon technologies; (b) buy down the incremental costs of low-carbon technologies and related infrastructure; (c) mitigate technology risks; and (d) stimulate continuity in the carbon market. An initial capitalization of US$10 billion, with an annual

disbursement of up to US$2 billion, is suggested. The CEFV could provide low interest loans to cover the incremental capital costs with the carbon credits generated assigned to the CEFV in return. Initial equity could be provided via direct cash contributions from developed countries. The CEFV would be expected to generate a reasonable rate of return, and over time attract private capital. The financial viability of the CEFV is highly sensitive to the carbon price. Thus given market uncertainties, carbon market support options may need to be introduced in parallel to the CEFV to mitigate this risk.

- The CESF would be a subsidy mechanism that supports projects in line with the degree of carbon emission reductions. It would operate on a grant financing basis with funding provided by donors. The CESF would provide a subsidy to the project based on the difference of the project costs with and without the carbon credit flows. Such difference will be calculated using an administratively determined "shadow price" based on the cost of carbon emissions reduction and market indicators. Eligible projects will be competitively selected to ensure lowest subsidy is paid. The projects will be made financially viable by use of the subsidy and would generate carbon credits to be pledged to the CESF.

- Besides the proposed new global financing instruments, the World Bank Group will consider new means and mechanisms to make pricing more transparent and competitive and to develop more flexibility in the terms of its financing packages to provide incentives and resources to countries to pursue clean energy alternatives.

16. The new financial instruments (CEFV and CESF) could be hosted as a separate window or fund in the IFIs. The CEFV and CESF involve the generation of carbon credits through the funded projects and the transfer of such credits to the financial instrument. The instruments' intended scale and product lines would fit IFI capabilities and their normal operational financial activities. The CEFV and CESF could also be housed in the GEF, but would require significant changes in the GEF's governance, operations, staffing and institutional arrangements.

17. The structure and design of the proposed financial instruments should avoid both the crowding out of the private sector as well as potential conflicts of interest among the parties involved. Attention would also be given to the risk management issues arising from an increase in the level of carbon credit activities.

C. Pillar 3: Adaptation

18. ***Failure to effectively address increasingly severe weather patterns and climate variability into development activities is a major threat to poverty alleviation.*** The economic impacts will be significant especially in developing countries - partial estimates of the economic impacts of a 2.5°C temperature increase (mid-range value associated with a doubling of the atmospheric concentration of CO_2) without adequate adaptive efforts range from 0.5 to 2 percent of GDP with higher losses in most developing

countries. Resources that are additional to Official Development Assistance (ODA) will need to be found by donors to compensate for the increased development costs, while developing governments will need to reassess policies and institutional structures to be proactive in reducing climate vulnerability.

19. ***Major changes in both public and private investment strategies are needed.*** Recent analyses (by staff in the World Bank, OECD and IADB) suggest that 20 to 40 percent of ODA and public concessional finance (i.e., US$20 to US$40 billion per year) is subject to climate risk and only a small portion of ODA takes this risk into account in project planning. The incremental costs of activities to address that risk are estimated to be from to 5 to 20 percent of the portfolio at risk. This would suggest that at least US$1 billion per year in funding that is clearly additional to existing ODA and concessional financing will be required.

20. ***While current financial instruments are technically adequate to respond to the challenge of achieving climate-resilient development, the amount of money flowing through these instruments needs to be substantially increased.*** The main financial instruments for adaptation are currently donor contributions to the GEF (anticipated to be up to US$200 million per year), the Adaptation Fund from a 2 percent tax on the Clean Development Mechanism (CDM) (a cumulative maximum of US$500 million by 2012), and ODA and concessional lending in which only a tiny portion (much less than 1 percent) is specifically directed to adaptation. Only the Adaptation Fund is demonstrably additional to existing donor funds.

21. ***A major role for the IFIs is to establish a framework in which public and private investment in developing countries becomes more climate resilient through awareness raising, knowledge sharing and capacity development.*** Issues requiring immediate work include an analysis of institutional barriers to including climate related conditions into development planning and the need for new standards for infrastructure and procedures for planning. New insurance related instruments are likely to play a major role in this, including weather index insurance for activities by farmers, and risk pooling arrangements such as the Global Index Insurance Facility.

D. Role of the World Bank Group

1. Energy for Development and Access for the Poor

22. ***Country support through analytical services and investments will continue to be responsive to demands expressed in Country Assistance Strategies (CASs).*** The Bank has successfully reversed the past declining energy sector lending trend, with past and continued analytical and capacity building services, supported in part by the Energy Sector Management Assistance Program (ESMAP) global partnership, providing a strong platform for growth. Challenges to further increasing energy sector lending include lending limits, the size of IDA envelopes, and fiduciary and risk management concerns, to ensure prudent lending practices. Working to remove barriers to private sector participation will continue to be an important part of the strategy. To further enhance the attractiveness of Bank Group financial products and leverage Bank Group financial

resources, the Bank Group will more aggressively combine existing financing and risk mitigation instruments as a means to leverage its own resources, and in particular to mobilize private sector financing.

23. ***The Bank will support the planning and implementation of the Africa Energy Access Action Plan*** in partnership with regional bodies such as the AU/NEPAD, the regional economic communities, the African Development Bank (AfDB), the Africa Infrastructure Consortium and with partners such as the EU, IFIs and bilateral donors. Within the constraints of IDA-14, lending for the energy sector in Africa has already been considerably increased. Future support will be aligned with the Action Plan. However, new donor financing will need to be mobilized beyond IDA-14.

2. Transition to a Low-Carbon Economy

24. ***Country level analytical and advisory assistance is underway or being planned in consultation with the G+5 countries.*** This support would be related to planning, policy advice, and capacity building for clean energy development, with a particular focus on the transition to a low-carbon economy. This assistance will be offered to other interested countries on demand.

25. ***The Bank will consider supporting new instruments.*** This would include (a) the CEFV; (b) the CESF, and (c) utilization of the new approaches to IBRD financing to be discussed as part of the MIC strategy. It will also work to refine existing instruments, including enhancing the products offered by the Bank Group's carbon business; and introduction of Multilateral Investment Guarantee Agency (MIGA) insurance for Carbon Emissions Reductions (CER)-based project finance. These instruments will be used to promote "quick win" low-carbon projects, including scaled-up energy efficiency and power rehabilitation projects, and possibly pilot integrated gasification combined cycle (IGCC) projects.

26. ***Partnerships.*** Strengthening existing partnerships will be a key element of the Bank Group's efforts. Of particular note are the following: GEF, Carbon Finance and Carbon Finance Assist, ESMAP, and the Global Gas Flaring Reduction Partnership.

3. Adaptation

27. ***Analytical work, capacity building, GEF grants, and limited lending will be used to develop tools and test innovative adaptation approaches.*** Such approaches will help clients understand current and future climate conditions, assess the risks to development, and internalize the risks in development planning and investments. In the near-term, the Bank will:

- Expand analytical work on adaptation as basis for action at the country level;
- Develop screening tools to assess the nature of climate risks to development projects;
- Build capacity of institutions and communities at risk to cope/adapt; and

- Support innovations, including investments and developing and piloting risk management tools (e.g., weather insurance for farmers).

28. ***Over the longer term, as a greater understanding of specific actions is gained, the Bank will undertake a climate risk management approach,*** to assess and, where necessary, act upon the threats and opportunities that result from both existing and future climate variability in project- and country-level activities. This means better management of climate variability and its implications in all relevant sectors.

4. Next Steps

29. ***Pending advice and support from the Development Committee,*** follow-up work to this progress report would be carried out with the IFI's and would include:

- mobilization of donor assistance for the Africa Energy Access Action Plan;

- further development of the financing options to support the transition to a low-carbon economy;

- development of strategies, tools, and finance to meet the challenge of adaptation.

30. The upcoming Second Ministerial Meeting of the Gleneagles Dialogue scheduled for October 3-4, 2006 in Mexico will be another milestone where these activities can be discussed.

An Investment Framework for Clean Energy and Development: A Progress Report
Summary of Financial Instruments

Strategy	*Financial Instruments*			*Issues and Constraints*
	Available Instruments	*Improvements Required, if any*	*Proposed New Instruments*	
Energy for Development and Access for the Poor				
Reforming sector regulatory and investment framework; improving sector financial health	IFI public sector lending instruments, including APLs, DPLs (PRSCs), SWAps and AAA	➢ Scale up AAA ➢ Scale up ESMAP	➢ None	➢ Lack of reform implementation ➢ Limits to AAA as part of IFI portfolio ➢ Lack of cost-covering tariffs ➢ Commercialization of operations and adequate financial management
Increasing energy access	IFI public sector lending instruments (see above)	➢ Scale-up concessional lending for energy access, (South Asia and SSA) ➢ Scale-up AAA	➢ None	➢ Limits to concessional lending for low-income countries (e.g., IDA) ➢ Country-led donor coordination to finance sector-wide investment programs
Mobilizing public sector financing	IFI public sector lending instruments (see above)	➢ Scale-up IFI lending to energy projects; use opportunities to leverage PPPs ➢ Scale up of concessional lending for energy access, (South Asia and SSA)	➢ None	➢ Inadequate sector reform ➢ Sectoral and country lending limits ➢ Limits to concessional lending for low-income countries (e.g., IDA) ➢ Limited demand from MICs for IFI loans
Mobilizing private sector capital	IFI private sector lending and risk mitigation instruments—IBRD/IDA/IFC and MIGA guarantees	➢ Expand use of risk mitigation instruments, with and without counter guarantees	➢ None	➢ Low creditworthiness of public utilities ➢ High regulatory and political risks ➢ Lack of equity capital from OECD private developers ➢ Lack of debt capital from OECD commercial debt markets ➢ Insufficient capacity of nascent local capital markets ➢ Limited risk capital available from IFIs for low-income countries
Energy for Low-Carbon Economy				
Reducing cost of newer, cleaner technologies, including renewables; operationalizing newer technologies	GEF, Carbon Finance, Bilateral CDM/JI projects	➢ Options under MIC strategy ➢ Umbrella Carbon Fund ➢ Coverage of new technology risks ➢ ESMAP window for clean energy project development	➢ Clean Energy Financing Vehicle ➢ Clean Energy Support Facility	➢ Negligible funding available for clean energy projects when compared to requirements ➢ Technical know-how support for operations of new technology based projects is not yet explicitly supported by current instruments
Strengthening carbon markets and mobilizing private sector capital	World Bank managed Carbon Funds IFI risk mitigation and lending instruments for private sector projects	➢ MIGA Insurance for CERs	Continue to explore mechanisms to Support Carbon Markets	➢ Lack of adequate long-term emission reduction commitments ➢ Inadequate cost recovery unless technology buy down is undertaken ➢ Regulatory risk mitigation required for Carbon Finance
Removing barriers for near-commercial energy efficiency and renewable technologies	IFI lending, GEF, Carbon Finance	➢ Make financing from GEF predictable; Align GEF with WB approval processes; Expand use of contingent grants and guarantees ➢ Specialized CDM instruments (bundling, "programmatic CDM") ➢	➢ EBRD Energy Efficiency Facility ➢ IADB Sustainable Energy Initiative ➢ AsDB Asia Pacific Energy Efficiency Fund	➢ Implications for GEF's resource allocation framework ➢ Lack of sufficiently simple CDM methodologies for end-use energy efficiency

Strategy	Financial Instruments			Issues and Constraints
	Available Instruments	*Improvements Required, if any*	*Proposed New Instruments*	
Adaptation				
Mainstreaming adaptation into the development process	Trust Funds, GEF	➢ Scaling up of activity and resources for AAA ➢ "ESMAP equivalent" multi-donor trust fund for mainstreaming adaptation in project development	➢ Multi-donor TF	
Support for addition costs for adaptation	GEF including Least Developed Countries Fund and Special Climate Change Fund; Adaptation Fund, IDA	➢ See issues and constraints	➢ None (until Adaptation Fund management and priorities are resolved)	➢ Lack of agreement on the operational guidelines for the Special Climate Change Fund ➢ Lack of agreement on the management and priorities of the Adaptation Fund ➢ Uncertainty of the resources for the Adaptation Fund
Removing barriers greater use of insurance type instruments	Trust Fund, GEF, IFI risk mitigation and lending instruments for private sector projects		➢ Global Index Insurance Facility	➢ Greater coordination of WB, IFC and private sector activities

AN INVESTMENT FRAMEWORK FOR CLEAN ENERGY AND DEVELOPMENT: A PROGRESS REPORT

BACKGROUND

1. This report was requested in the April 23, 2006 Development Committee communiqué. The communiqué noted broad support for the Bank's approach in addressing (a) developing country energy needs and access to energy services; (b) efforts to control greenhouse gas emissions; and (c) helping developing countries adapt to climate risks, including the two-track work program. The Development Committee asked the Bank to review, in close coordination with other partners, existing financial instruments, taking into account the role of the private sector; and to explore the potential value of new financial instruments to accelerate investment in clean, sustainable, cost effective, and efficient energy, so as to report on progress towards an investment framework by their next meeting. This report has been prepared as a background paper for consideration by the Development Committee at the Annual Meetings in Singapore in September 2006, preceded by consideration by the Bank Board's Committee of the Whole on August 24, 2006.

2. This progress report responds to this mandate. It was developed through a process of analysis and limited consultations with some governments, regional development banks and other International Financial Institutions (IFIs), the private sector, and civil society organizations. The paper takes a global perspective as well as a Bank-centric view. It addresses three major inter-related challenges: (a) meeting the energy needs of developing countries and access for the poor with no carbon constraints; (b) reducing greenhouse gas emissions and the transition to a low-carbon economy; and (c) adapting to climate risks. For each of these challenges, the paper outlines the problem and related policy issues, investment needs, and financing instruments (existing instruments, gaps, and proposed new instruments). Lastly, the paper discusses the role of the World Bank Group in each of these areas. The paper is accompanied by technical annexes, which provide supporting information.

3. While the paper is written in three sections—Energy for Development and Access to the Poor; Mitigating Greenhouse Gas Emissions through the Transition to a Low-Carbon Economy; and Adapting to Climate Change—there are synergies and trade-offs among them. Energy sector reform, which is essential for attracting private sector investment in the energy for the development agenda, is also critical for the transition to a low-carbon economy. It is equally important to consider the climatic implications of depending on a high-carbon energy agenda, i.e., climatic consequences are likely to undermine some of the progress achieved by increasing energy.

4. This report does not address the end-use energy efficiency and transportation issues in detail as the European Bank for Reconstruction and Development and the Asian Development Bank, respectively, are taking lead responsibilities for these two critically important issues. Going forward, their work will inform the Bank's strategy.

I. ENERGY FOR DEVELOPMENT AND ACCESS TO THE POOR

- The existing financial instruments of IFIs are adequate to meet the energy needs for development and access to the poor.
- There is an estimated financing gap of US$80 billion per year in the power sector of developing countries. IFIs, donors and foreign direct investment can close the gap by roughly US$10 billion per year using existing instruments. The remaining gap will be reduced subject to the pace of implementation of sector reforms that will benefit the financial health of the sector. Such reforms would include good governance, adequate prices and demand side management, and, in the case of access in the poorest countries, increases in concessional finance.
- More than three billion people use wood, dung, coal and other traditional fuels inside their homes to meet cooking and heating needs, resulting in 1.5 million deaths per year. Scaling-up supply-side activities (sustainable woodfuel supply, LPG, and kerosene) and demand-side activities (improved cookstoves and interfuel substitution) need to be accelerated.
- There is a need for an action plan for energy access along five parallel tracks: (a) scaled up programs of household electrification; (b) additional generation capacity to serve newly connected households and other demands; (c) access to clean cooking, heating and lighting fuels; (d) provision of energy services for key public facilities, such as schools and clinics; and (e) provision of stand-alone lighting packages for households without electricity service. Economic policy considerations include ensuring that the sector policy framework is robust; when subsidies are needed, ensuring that they are transparent, targeted, focused on the demand side, and with a defined time frame and specific results expected. Accountability systems that include beneficiary oversight of the utilization of resources are also important.
- At current rates of electrification in Sub-Saharan Africa (SSA), the rate of household access to electricity is not increasing appreciably. To meet the challenge of accelerating poor people's access to modern energy fuels in SSA will require a combination of reforms, improved knowledge sharing among governments and utilities facilitated by IFIs and a doubling in concessional and grant funding from about $2 billion per year to $4 billion per year. This level of increase cannot be accommodated under IDA 14. Thus mobilization of additional resources will be required.

A. The Problem and Policy Considerations

5. ***Energy has an important role to play in economic growth and poverty alleviation.*** Meeting the challenge of energy sector development effectively in order to ensure economic growth and poverty reduction, is commonly the primary focus of developing countries' energy policy. Local and regional environmental impacts of the energy sector are typically assigned a lower priority. Readily identifiable financing sources only meet about 50 percent of developing countries' power sector funding needs. This shortfall manifests itself in a myriad of problems depending on circumstances, ranging from poor quality of supply (blackouts/brownouts in middle income countries) to unacceptably low levels of access to modern energy fuels in lower income countries. Economic growth has been estimated to be curtailed by as much as 1 to 4 percent of GDP

per annum in some countries depending on the severity of power outages. During periods in which electricity supply shortfalls are pervasive, local and regional environmental constraints are often relaxed. For example, when electricity shortfalls in China became acute at the beginning of the decade, standards for new plant construction were relaxed to enable an acceleration of supply. Thus bridging the financing gap is an important pre-requisite for meeting the challenges of economic growth, poverty alleviation and environmental impact.

6. ***The International Energy Agency's (IEA) Reference Scenario estimates that energy sector investment needs in developing countries average US$300 billion per year from 2003-2030,*** of which 65 percent is for the electricity sector, 19 percent for oil, 14 percent for natural gas, and 3 percent for coal investments. However, IEA's Reference Scenario assumes that 1.4 billion people will still lack electricity access in 2030: a reduction of only 200 million people from today's level. Two challenging questions emerge from this scenario: (a) what are the actions needed to meet the electricity sector funding requirements of developing countries? and (b) what are the actions needed to accelerate access to modern energy fuels for the poor?

1. Meeting Power Sector Funding Needs Through Strong Sector Policies

7. ***Financing of energy needs of rapidly growing countries is feasible where there is political will to undertake sector reform, and to support good governance, the rule of law, and effective pricing.*** This highlights the catalytic role of IFI assistance and of using such assistance to promote policies to address internal cash generation and to attract substantially higher levels of commercial financing and private investment. Efficiency improvements (both on the supply and demand-sides), demand management, improved planning and operation, and increased electricity trade could be used to moderate the volume of investments needed and thus help bridge the supply-demand gap. There are, however, five broad categories of countries where the supply-demand gap persists: (a) conflict countries; (b) countries experiencing recent natural disasters; (c) countries that are perceived to be high risk due to weak policy agenda; (d) countries whose energy sectors are distorted because of pricing anomalies or barriers to entry; and (e) low-income countries where institutional capacity constrains investment support. The text below focuses on the electricity sector issues associated with the latter three categories of countries.

8. ***A Bank-executed, multi-country study that is nearing completion identifies governance, pricing reform, and efficiency improvements as requirements to fully fund basic energy needs.*** A study of how countries have successfully met this challenge was commissioned by the Bank for the preparation of this Progress Report, building on nine case studies[1] that represent several country typologies. For example, Vietnam managed to meet a rapid 16 percent per annum electricity demand growth rate over 10 years through a combination of public and private participation, enabled by a financially healthy sector. Lessons learned are summarized below.

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[1] Nine country/provincial case studies were undertaken, eight of which were considered to be success cases and one of which was considered a failure despite considerable private sector participation. The countries cover a broad geographic and country typology, and include Brazil, Bulgaria, Dominican Republic, India (Delhi), Lithuania, Turkey, and Vietnam.

- ***The rule of law and enforcement of property and contract rights need to be established.*** Whether the services are provided by the public or private sector, the greatest benefit to society and sustainability of the sector results only when the rule of law prevails, property rights are respected, and contract obligations are enforced.

- ***Internal generation of sufficient cash (after meeting all operational expenses and debt service) adequate to meet at least 30 percent of the investment requirements of the system expansion projects is prudent.*** Utilities that manage to achieve such a target generally manage to meet the remaining investment needs through debt financing or through the purchase of services from private suppliers.

- ***Good governance and transparency are necessary to support public or private investments.*** Good governance and transparency at the State and corporate levels are key to reform efforts to make the sector financially sound and attract foreign and domestic investors to meet sector investment needs. The government must establish effective institutions with clear mandates and resources to implement those mandates.

- ***Third parties can play an important role.*** Third party participation (such as by the European Union or World Trade Organization accession, IFIs, credit rating agencies, and local press) in regional markets can provide reforming countries with the motivation to pursue sector reform, including increased transparency and meaningful disclosure, thus promoting investment. Continuity of third party involvement through the reform process is necessary. IFIs could play a role in low-income countries similar to that of credit rating agencies in middle- and high-income countries, building a standardized risk database to facilitate the use of appropriate instruments and help guide the investment community to provide financing in such countries.

- ***Demand management, optimal generation planning, electricity trade across countries, and joint investments can significantly reduce the volume of investment needs***. Increased support for energy efficiency is essential to meet growing demands in a sustainable manner. Such investments have the three-fold effect of moderating upward pressure on energy prices, improving energy security through the use of flexible demand-size options to mitigate supply risks and decreasing the negative environmental impacts associated with energy supply. Electricity trade can reduce the high cost of electricity in small systems. Enhanced regional planning to accelerate implementation of regional generation and transmission projects is necessary to scale up electricity access and supply.

- ***Increased private sector participation can increase demand for good sector governance.*** The private sector has an important role to play in closing the investment gap in many countries. Private investor participation in the electricity sector often positively influences the quality and sophistication of governance (e.g., demand for contractual and legal rights, etc.). Enhancement

of government capacity to respond to such demands should be the focus of IFI work.

9. ***Decreasing the electricity sector financing gap is primarily an issue of getting the policy framework right.*** The role of the Government is clear: ensuring that the laws are in place to decrease theft and corrupt practices that can dramatically improve liquidity in the sector. Good governance, non-discretional regulatory practices, the introduction of competition, and an appropriate enabling environment to support public-private partnerships and public and private investment are also important. For example, distribution reform has been facilitated by management contracts that engage private investors at the distribution level in some African countries and by privatization of the distribution utility in Delhi, India. However, as experience in the Dominican Republic and Georgia in the 1990s have shown, private sector participation is no panacea: it must be coupled with reforms of the legal and regulatory framework, including enhanced competition, as well. The combination of good billing and collections practices with reasonable pricing policies provides the financial liquidity within the sector and enables both public and privately-owned power companies to gain access to capital to meet investment needs. The combination of an enabling environment that allows non-payers to be disconnected and good governance to implement this policy has consistently been the hallmark of successful power companies and financially healthy power sectors.

10. ***Another demonstrated important component to close the electricity supply gap is from energy efficiency investments and demand-side management measures.*** Brazil reduced the supply-demand gap by about 20 percent during the 2001 drought by implementing such measures. A combination of Government support, establishment of market-based incentives and a strong information dissemination campaign were important components of this success.

11. ***IFIs should facilitate a knowledge-sharing environment with the goal of fostering accelerated reforms.*** Based on lessons learned from successful country experiences, key criteria for success should be compiled and made available in the public domain. A scorecard of country performance, drawing on the lessons learned, could facilitate investment and help guide the use of risk mitigation instruments. The lessons and examples should be accompanied by a toolkit to help guide countries seeking to implement reforms. A reporting system that identifies well-performing countries or sub-national entities could be designed to facilitate private sector participation.

2. Accelerating Access for the Poor

12. ***Accelerating access to affordable, modern energy for the poorest is critical to meeting the Millennium Development Goals (MDGs)*** (see Annex 1). This means moving much more aggressively than the current IEA reference scenario. The access problem is most acute in Sub-Saharan Africa (SSA) and South Asia. There are also large populations without access in the poorer countries of Asia and Latin America, as well as in the rural and peri-urban areas of middle income countries. Although there are more people without electricity access in South Asia (675 million) than in SSA (553 million)

there appears to be more reason for optimism that, under current government programs, household access will increase more rapidly in South Asia than in SSA.

13. ***In Asia large scale electrification programs are currently underway.*** Bangladesh, India, the Philippines, and Sri Lanka are among the countries that have accelerated, in the past few years, the rate of new connections. In 2005, India is reported to have connected 4 million households representing a 1.8 percent increase. Since 2003, Sri Lanka is reported to have increased access from 69 to 73 percent, or by more than 100,000 new connections per annum.

14. ***Unless the currently very low investment levels in the electricity sector of SSA are substantially increased, it will not be possible to achieve universal household electricity access.*** The current annual rate of new connections in SSA (less than 1 percent) is not keeping pace with new household formation (1.9 percent). In addition, many SSA countries are faced with an electricity generation shortfall as investments in generation and transmission have not kept pace with demand. The impact of droughts on decreasing hydropower plant outputs, high oil prices and limited fiscal space have exacerbated the problem.

15. ***In countries where very low household access is compounded by severe supply shortfall:*** the most urgent policy changes required are to implement better planning of investments in emergency thermal generation (including cogeneration), investments in end-use efficiency, loss reduction, and tariff rebalancing. For example, the issue is severe in East Africa where drought conditions have seriously decreased the output from hydropower plants.

16. ***The enabling conditions for rapid scale-up of grid and off-grid electrification exist in some SSA countries.*** A review conducted as part of the preparation for this report indicates that some SSA countries have a conducive policy framework (positive macroeconomic environment, country ownership of a sound strategy for electrification that identifies funding sources, enabling institutional sector framework in place, a national utility that is reasonably well managed, and tariffs recover at least the recurrent costs of service provision) to support rapid scale-up of electrification. Many other SSA countries need support to establish good conditions for scaling-up energy access.

17. ***Electrification programs should support grid, mini-grid and off-grid supply options.*** Country factors such as population density, spatial distribution, topographical characteristics and rural-urban drift will determine the relative proportions of grid and off-grid solutions that are least cost. In SSA and in the countries of Asia where there are large populations of urban dwellers without access, grid extension will be the least cost option for a large share of the households that will be provided with access in the medium term. In countries where rural access rates are already high, mini-grid and off-grid supply will be the least cost option to reach the remaining isolated communities that do not yet have access. If subsidies are needed, they should be transparent, targeted to the poor, focused on the demand side, with a defined time frame and with specific results expected. Ensuring that accountability systems are in place so that beneficiaries can oversee the utilization of resources will also be important, as will working to put in place the enabling conditions for public-private partnerships, and to attract private investment.

18. ***Additional electricity generation capacity will be required to serve newly connected households and other demands in SSA.*** There is just 32 gigawatts (GW) of installed generation capacity in SSA (excluding South Africa) for a population of 680 million. By comparison, Latin America, with 533 million people, has installed capacity of 200 GW. A large proportion of the electricity generation capacity additions that are required in SSA over the next decade to support access and economic growth can best be met through development of projects that serve regional needs (about 20 GW). Large regional hydro and thermal generation plants offer economies of scale that can reduce the current high cost of power supply to distribution utilities in many SSA countries. These generation projects will require associated investments in regional transmission interconnections.

19. ***Indoor air pollution has serious health consequences.*** The World Health Organization estimates that more than 3 billion people use wood, dung, coal, and other traditional fuels inside their homes to meet cooking and heating needs and that the resulting indoor air pollution is responsible for 1.5 million deaths per year—mostly of young children and mothers. Over half of all people relying on biomass live in India and China, but the proportion is largest in SSA. A large proportion of the rural poor in South Asia, SSA, and other poor countries are likely to continue relying on biomass for some time. Therefore, it is urgent to ensure that biomass is sustainably produced and efficiently used, and that access among poor people to cleaner cooking fuels and technologies is increased.

20. ***The immediate challenge is to eliminate the negative health impacts that inadequate use of biomass fuels imposes on poor people***. Sustained high prices of commercial fuels will slow the transition from the use of biomass fuels. Improved cookstoves and interfuel substitution are essential to reduce indoor air pollution. Scale-up of these programs needs an enabling environment, consumer education programs and campaigns, and reliance on the domestic private sector to be effective and sustainable. Parallel efforts on the supply side to support sustainable forest and natural resource management are required. Bank project experiences in Senegal and elsewhere in Africa have demonstrated the feasibility and success of sustainable woodlot management that boosts incomes, while introducing more efficient and cleaner charcoal production methods and improved cookstoves. Similarly, the Dutch and Bank-assisted Biogas Support Program in Nepal has successfully developed and supported scaled-up household biogas use. While such projects are resource intensive to develop and implement, they must be accompanied by improved supply and distribution of liquefied petroleum gas (LPG) and kerosene.

21. ***MDGs in education and health will be difficult to achieve in countries where the majority of schools and health clinics lack electricity and fuel***. Sterilization of equipment, clean water supply, and refrigeration of essential medicines are impaired in health facilities without adequate electricity. Lack of electricity is a disincentive for teachers, doctors, and nurses to reside in rural areas, further undermining the delivery of these services. Education of children is also impaired due to lack of adequate illumination in poor households that rely on candles or simple kerosene lamps. Electricity access strategies should target public facilities, such as schools, health clinics, and communications that benefit the whole population in a rural area. The reason why these

facilities are not properly equipped with energy services is usually because of poor planning and because investment programs in the health and education sectors are often not aligned with those for provision of electricity.

22. ***For households and small businesses that do not have electricity service, provision of a stand- alone modern lighting package can meet basic lighting needs.*** Households and businesses that do not have electricity usually rely on fuel-based lighting or flashlights, which provide poor quality light and have high operating costs. Recent advances in stand-alone lighting systems, including light emitting diodes (LED), offer the possibility of providing stand-alone modern lighting systems that poor people can afford.

23. ***Energy access programs need a pro-poor focus and need to be implemented in ways that do not discriminate against poor people.*** This approach requires good regulatory policies that protect poor people and promote access by poor people to electricity and other forms of modern energy. This includes design of pro-poor subsidy mechanisms. Subsidies should be transparent, linked to the delivery of services to poor people, and where-ever possible focus on demand-side, and provide strong cost-minimization incentives. Subsidy schemes should also be technology neutral to avoid biases against off-grid solutions or non-state providers.

24. ***Delivery arrangements for electricity access should be evaluated and optimized to the needs of consumers so that they maximize contributions to poverty reduction and livelihood improvement.*** Electrification programs need to be well integrated in programs of national and rural development so that investments are prioritized to areas where electrification will bring about the greatest returns (e.g., improved farm productivity in areas where there is potential for electricity to replace diesel driven motors in irrigation).

25. ***Demonstrable country ownership, capacity and effective working partnerships are crucial to realizing the envisioned level of energy access scale-up.*** Partnerships of country governments, regional organizations, donors (bilateral, multilateral, and regional development banks), and global entities will be key to building ownership and ensuring sustainability. Such partnerships would also be used to define, establish, and adopt standards for performance and governance of the sector, utilities, and projects, as well as access targets by country for the next 10 years, within defined resource envelopes. It is critical that all stakeholders engage in country strategy formulation, and that poverty reduction strategies be fully participatory. Finally, capacity building efforts to move forward the sector reform and implement scaled-up programs are crucial.

26. ***The scaling-up of demand-side programs for increased access to clean cooking and modern fuels needs to be based on three key policy elements.*** The first element is the financially viable production and marketing of improved woodfuels stoves, with an emphasis on charcoal stoves for urban and peri-urban distribution. The second element is market-based, interfuel substitution promotion, including the use of various effective subsidy mechanisms and price-related policies to increase access to kerosene and liquefied petroleum gas, and reduce the domestic costs of supply of these products. The third element is effective consumer education programs and campaigns that are directly linked to financially viable and readily available improved stoves and/or substitution fuel options.

27. ***The foregoing diagnosis calls for an Action Plan for Energy Access with special focus on SSA.*** The Action Plan (see Annex 1 for details) would include five parallel tracks (a) scaled-up programs of household electrification (with better integration of mini-grid and off-grid electricity options to complement grid-based approaches); (b) additional generation capacity with associated transmission (including through regional projects) to serve newly connected households and demand from enterprises, public facilities, and other users; (c) access to clean cooking, heating, and lighting fuels (through sustainable forest management, fuel switching, and diffusion of improved charcoal, briquetting, and clean cooking technologies); (d) provision of energy services for key public facilities, such as schools and clinics; and (e) provision of stand-alone lighting packages for households without electricity service. The Action Plan would be supported by the economic principles outlined in the previous paragraphs, including the importance of strong sector reform (para. 15) and where needed, appropriate subsidy policies (para. 23). The Bank will support the implementation of the Action Plan in consultation with partners, regional bodies such as the AU/NEPAD, the regional economic communities, the African Development Bank, the Africa Infrastructure Consortium, and with partners such as the EU, IFIs and bilateral donors.

B. Financing Needs

28. ***Near-term electricity sector investment requirements for developing countries to support and meet the needs of the poor are estimated to be about US$165 billion per year***. Readily identifiable sources of funding are likely to finance about 50 percent of electricity supply needs (generation, transmission and distribution), thus leaving a large investment gap. About US$48 billion per annum is invested by the private sector, IFIs, donors, and Export Credit Agencies (ECAs). The remaining US$32 billion per annum come from internal cash generation of sector agencies. A recent study by Price Waterhousecoopers commissioned by the Bank for this report estimates that stretching the use of existing financial instruments could provide another US$10 to 12 billion of funding from IFIs, bilateral donors and ECAs (US$5 billion) and the private sector (US$6 billion).

29. ***Population growth in developing countries[2] implies that to reach 100 percent electricity access by 2030 approximately 600 million additional households would need to be connected.*** The investments required to serve these households would be on the order of approximately US$34 billion per annum.[3] Table 1 shows the investment requirements to achieve this electricity access objective in all regions.

30. ***In order to achieve 100 percent electricity access in SSA by 2030, the access rates would have to increase by about 3.5 percent per annum***. This would increase the number of households with electricity access from 35 million (in 2005) to approximately 234 million

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2 Excluding Eastern Europe and Central Asia

3 The IEA has estimated that additional investment of US $665 billion is needed to reach 100 percent access by 2030 (or about US$20 billion per annum). This is the investment above the funding requirements for IEA's reference scenario where electrification reaches 78 percent of the population by 2030. The estimates provided here are consistent with the IEA's. However, this paper makes all calculations based on the current electrification access rates, and calculates the investment requirements needed to provide electricity access to all households under the hypothetical 100 percent access scenario.

households in 2030. In other words, an additional 200 million households would need to be connected. This requires not only an investment of US$11 billion per annum (out of the total global estimate of US$34 billion per annum), but also enormous implementation capacity and robust enabling environments. Increases in these areas of the magnitude needed are not likely to materialize in poor SSA countries (where current rural electricity access rates are often less than 10 percent) due to lack of absorptive capacity, lack of sector reform, weak enabling environment, minimum implementation capacity, and funding constraints. As part of the preparation of this report, a variety of scenarios were analyzed to evaluate an achievable path for progress on electrification access in SSA based on current and projected conditions and lessons from successfully scaled-up programs. As part of the planning for the Action Plan, additional analysis will be undertaken by the Bank to estimate the investment requirements for access to clean cooking, heating and lighting fuels, and for the provision of energy services to public facilities.

Table 1. Investment Requirements for 100 Percent Electricity Access in All Regions by 2030

						Investment 2005-2030			
	Year	*Pop (millions)*	*Electicity access level (percent)*	*Number of households with electricity access in 2004 (millions)*	*Additional households that would receive electricity (millions)* [1]	*Distri-bution (billions USD)* [2]	*Generation and trans mis. (billions USD)* [3]	*Total (billions USD)*	*Per Annum (billions USD)*
Sub-Saharan	2005	725.6	23.6	34					
Africa	2030	1,179.2	100.0		200	193	87	280	11
Middle East and	2005	338.2	91.1	59					
North America	2030	525.5	100.0		40	58	20	78	3
South Asia	2005	361.2	48.9	31					
(exluding India)	2030	604.3	100.0		75	83	31	113	5
India	2005	1,096.9	55.2	112					
	2030	1,312.2	100.0		130	71	60	131	5
South Asia	2005	1,458.1	53.7	143					
	2030	1,916.5	100.0		205	154	90	244	10
East Asia and	2005	1,893.0	89.6	341					
Pacific	2030	2,193.8	100.0		100	122	47	169	7
Latin America and	2005	533.1	88.9	105					
the Caribbean	2030	691.7	100.0		50	60	26	86	3
Total	**2005**	**4,948**							
	2030	**6,507**		**682**	**595**	**587**	**271**	**858**	**34**

Notes/Assumptions:

[1] Assumes that household electricity access increases to 100% by 2030 in all regions. In some countries in sub Saharan Africa and South Asia where large scale grid roll out is feasible the increase may be greater (between 2% and 3% per annum).

[2] Assumes that 75% of all households that would be connected through 2030 would be through grid connections. Assumes that the LV distribution unit costs are $500 per household until 35% of households are connected, $800 between 35% and 50%, $1,000 between 50% and 75% and $1,500 thereafter. Assumes that 25% of all households that would be connected through 2030 would be by means of off-grid at an average unit cost of $800 per household.

[3] Additional capacity at system peak required per HH connected (kW) = Consumer Max. Load (kW) * Coincident category (HH) load factor) / factor) / System Losses factor. Assumes Capacity Max. Load of 0.7kW and 0.3 kW for urban and rural households respectively; coincident load factor of 0.7; and losses factor of 0.85. Of households that will be electrified the number that will be urban and rural is assumed to be the same proportion as the urban/rural partition in 2020 according to UN projections. Assumes US$1.5 billion per GW for G&T losses.

31. ***An achievable path for electricity access scale up could result in increases from 24 percent currently to 35 percent by 2015 and to 47 percent by 2030 for SSA as a whole.*** This would require doubling current level of investments to US$4 billion per annum from

the current level of US$2 billion for the necessary additional electricity generation, transmission and distribution infrastructure. This estimate assumes conservative assumptions of demand for newly connected urban and rural households (0.7 kW and 0.3 kW, respectively) reflecting conditions commonly encountered in low-income countries In the case of rural households this level of demand is typically associated with electricity consumption for basic lighting needs, and for a few small appliances. Some countries have conducive conditions (such as stable macroeconomic environment, adequate capacity of energy sector institutions and cost recovery in electricity distribution) for scaled-up energy access programs. This scenario corresponds to 76 million households gaining access to electricity by 2030. This energy access expansion path (that would realize for SSA as a whole about 1 percent annual increase in household electricity access) does not mean that some countries cannot achieve greater increases in access. Indeed, a few countries in SSA that are currently implementing large-scale electrification programs or plan to do so may achieve increases in the order of 2 or 3 percent per annum.[4]

32. ***Financing support for access to clean cooking, heating and lighting fuels includes both scaling-up supply-side activities (sustainable wood-fuel supply management investments) and demand-side programs (improved cook-stoves and inter-fuel substitution).*** The investment needs for supply-side measures in nine SSA countries over the next decade are estimated to be on the order of US$400 million (at an average cost of US$50-$100 per hectare of sustainably managed land). It has also been estimated that about US$100 million would be needed to implement demand-side programs based on the domestic private sector in these SSA countries over 10 years. Consumer and producer credit schemes will be required to achieve greatly increased penetration of improved stoves with grassroots NGOs playing an important role in effective consumer education programs and campaigns, which are directly linked to financially viable and readily available improved stoves and/or substitution fuel options.A comprehensive estimate for other regions and for all SSA requires further country data collection and analysis.

33. ***Financing needs for energy access for MDGs include the provision of grid- and off-grid solutions to key public facilities such as schools, health clinics, and communications centers.*** For example, in Kenya only 5 percent of dispensaries have access to electricity, about 50 percent of health centers are connected to the grid, and about 20 percent of health centers have stand-by generators. The capital cost to provide grid electricity (or cost-effective off-grid solutions) to schools, clinics and community centers for rural Kenya has been estimated to be on the order of US$350 million. In these calculations, it is important to note that the annual cost for power generation expenditures to serve these facilities is about US$32 million. Similar country-level studies that combine education, health and energy information are needed to determine overall funding requirements. Donor support should be mobilized to implement focused country campaigns that would include retrofitting of the majority of facilities over five to seven years. Electrification of these facilities would be by grid and off-grid supply options.

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[4] All access rates quoted take account of population growth i.e., if household access were to increase in SSA by 1 percent per annum from 24 percent currently (of approximately 145 million households) to 47 percent by 2030 (of approximately 234 million households) it implies that 76 million households would be connected in SSA between 2005 and 2030.

34. ***Financing for basic lighting to households without access to electricity should support the conditions for the private sector to provide low-cost lighting through domestic retailers.*** Modern lighting for basic needs can be provided for the poorest households that cannot be rapidly reached through the expansion of the electricity network or that cannot afford solar systems. For example, LED lamps can provide good quality lighting and with market development and supporting consumer credit mechanisms, large volume sales to poor households may be achieved. The delivery of lighting systems to households and small businesses that do not have electricity service should be based on programs that rely on private sector-led market development and on consumer credit mechanisms that are geared to low-income households. Large sales volumes would provide the economies of scale to reduce costs. In parallel, institutions could decrease their energy consumption considerably by adopting an energy-efficient lighting program. For example, a compact fluorescent lighting program in which 600,000 bulbs would be replaced in Uganda is estimated to reduce demand by 25-30 megawatts (MW) in a system with an estimated peak demand of 350 MW.

C. Financial Instruments

1. Existing Instruments for Middle Income Countries

35. ***A review of existing lending instruments commissioned for this report concluded that they are adequate to meet the energy needs of middle income countries*** (see Annex 2). The IFIs have a broad range of lending and risk mitigation instruments available to address energy sector investment needs as outlined in Table 2. IFI financial instruments (e.g., IBRD loans and guarantees for private sector debt and equity), together with private sector investments, with possible support from existing risk mitigation instruments, are adequate to meet the electricity sector funding needs of middle income countries. The establishment of a satisfactory environment would enable commercial debt financing of the remaining gap to be bridged by a combination of policy guidance and technical assistance. Improvements in knowledge sharing on policy issues, and on ways to blend instruments, could help facilitate transitions in countries willing to address the reform agenda.

Table 2. Lending and Risk Mitigation Instruments by IFI for Investment in Energy Sector.

Entity Name	Instruments							
ADB	OCR Loans (public and private sector)	Equity Investments	Guarantees (partial credit or political risk)	ADF concessional loans				
AfDB	Non-Sovereign Guaranteed Loans (Public Sector Entities)	Non-Sovereign Guaranteed Loans (Private Sector Entities)	Sovereign Guaranteed Loans	Guarantees (partial credit or partial risk)	Equity	Risk Management Products - IR & Currency Swaps, Caps, Collars and Commodity	AfDB concessional loans	
EBRD	Public loans - sovereign	Public loans - non-sovereign	Private loans	Equity	Mezzanine financing	Guarantees		
EIB	Credit Insurance (EIF)	Credit Enhancement (Securitization - EIF)	Structured Transactions (Structured Investment Vehicles-EIF)	Individual Loans	Global loans	Venture Capital		
IADB	Debt	Non-reimbursable Grants	Equity					
IsDB	Equity	Leasing	Istisna	Instalment Sale	Concessional Loans			
World Bank (IBRD/IDA)	Investment Loans	Government Policy Loans	Grants	Partial Risk Guarantees	Partial Credit Guarantees	Policy Based Guarantees	Risk Management Products - IR & Currency Swaps, Caps, Collars and Commodity	Carbon Finance
MIGA	Political risk guarantees							
IFC	Loans for IFC's Account (A-loans)	Syndicated Loans (B-loans)	Quasi-Equity Finance (C-loans)	Equity Finance	Equity & Debt Funds	Structured Finance	Municipal Finance (Joint IFC-IBRD)	Carbon Finance
GEF	Grants							

Source: PWC Survey and Annual Reports

2. Existing Instruments for Low-Income Countries

36. ***The review of existing financing instruments indicates that they are adequate to support energy access programs in low income countries.*** The enormous challenge of energy access in SSA and other low-income countries with very low access rates requires, in some instances, an evolution of the way in which existing instruments are applied, particularly in (a) programmatic support and regional projects; (b) effective use of capital subsidies to support scaling-up energy access programs; (c) focused financing of electricity access for public facilities; (d) support to the domestic private sector for the provision of energy services (including cookstoves and lighting); (e) increased support for sustainable woodfuel management; and (f) enhanced analytical support for policy reform and program preparation. When a range of financing mechanisms is used—combining public-sector financing (host government, mulitateral and bilateral donors), private-sector financing (equity, debt, and self-financing from revenues), and community and end users' contributions—electrification programs become viable and can result in large increases in household access. Demonstrable country ownership and harmonized efforts through Poverty Reduction Strategy Papers (PRSPs) will be key to scaling-up energy access programs.

37. ***Worldwide, all rural electrification programs have involved some form of subsidy.*** Subsidy schemes are more sustainable when targetted to the household connection, rather than to operation and maintenance. Delivery of subsidies to support scaled-up energy programs requires innovative delivery mechanisms. Output-based approaches have been successfully applied in some countries as a subsidy mechanism to bring in the private sector to implement energy access programs for the poor. In several countries, subsidies for rural electrification are managed and implemented through Rural Electrification Funds, which provide partial capital subsidies for new electricity connections and require the distribution company to cover the operating costs of service through revenue collection.

38. ***In addition to sector reforms, and increased public and private investments, substantial increases in grant and concessional funding***[5] will be required to achieve significant increases in energy access in countries where electricity access is currently very low, such as those in SSA, Central America, and South and East Asia. Current IFI funding for the energy sector in SSA (US$2 billion per annum) is less than half the financing of approximately US$4 billion per annum that would be required to achieve 35 percent electricity access by 2015 and 47 percent by 2030, as described in the previous section of financing needs. In these countries risk factors limit the amount of private funding that can be mobilized, governments' financial constraints limit the amount of host government funding, and utilities' poor credit-worthiness limits their borrowing. International Development Association (IDA) credits for energy in SSA have increased from US$176 million in fiscal year (FY) 2000 to close to US$600 million in FY06. However, given the IDA-14 envelope, any potential further increase in IDA credits to the energy sector in SSA would crowd out other sectors. Additional support for energy investments through mobilization of additional resources, including through IDA-15, is

[5] IFI funding, such as IDA's interest-free loans and grants, and bilateral funding.

needed to scale up energy access in SSA. The World Bank will work jointly with the African Development Bank and the Africa Infrastructure Consortium to mobilize additional resources.

39. ***Increased levels of bilateral and IFI funding for electricity access will have to be matched by increased funding from within the sector and public funding.*** Increasing access to rural areas involves capital cost subsidies that must be financed either from the public treasury or from within the sector. Funding from the treasury depends on year to year budget allocations that vary with government commitment and financial situation, making it difficult to sustain programs. Funding from within the sector, to the greatest degree possible (e.g., through a surcharge on all customers), is more sustainable and is considered best practice. However, in many low income countries, internal cash generation as a source of investment funds is very limited because of low tariff levels and poor collection that result in utilities not even covering their operation and maintenance costs, much less generating profits that would allow for investment in additional generation capacity and expansion of electricity distribution networks.

40. ***Private sector participation in many forms (including investment, management, leasing, etc.) will be necessary to complement public electrification programs.*** In most countries, private sector debt and equity investment leveraged by IFI guarantee instruments will be critical to developing the large generation projects needed. In countries with already high rates of access, reaching the remaining non-electrified households in rural areas will often be through off grid supply options where ownership is private or nongovernmental. Improving electricity access through off-grid supply options particularly those involving renewable energy will require specialized financing facilities. Overall, the role of the private sector, IFI guarantee instruments, and a solid enabling policy environment are key factors in tackling the energy access challenge. Public funding, focusing on the needs of the poor, would be required to help such countries make the transition to a fully financially sustainable sector. Such financial support would focus on subsidizing incremental capital costs in a long-term, least-cost sustainable manner, addressing the primary energy needs of the poor.

41. ***IFI and bilateral support for electricity access needs to change from individual projects to coordinated country and regional investment programs.*** There is a clear imperative that donor support for electricity access programs moves to a more coordinated country-led approach, which would be funded through sector-wide financing syndications of investment programs. Such an approach would go beyond mere harmonization and coordination of donor efforts; it would entail use of pooled funding that would be pledged to a long-term expenditure program, and would embrace multiple activities in electrification (e.g., grid, off-grid, and stand-alone lighting). Large generation and transmission projects that are more suitable to a project approach would be coordinated with such a sector-wide approach for access. Regional projects require innovative and coordinated support among IFIs, bilaterals and the private sector given very large capital needs. Expanded donor support is needed for project preparation and for the critical need of strengthened capacity building to design and implement such coordinated investment programs

II. THE TRANSITION TO A LOW-CARBON ECONOMY

- Technologies are currently, or will soon be, commercially available to transition to a low-carbon economy.
- The costs of decreasing greenhouse gas emissions can be reduced through international trading and adopting a multi-gas/multi-sector strategy, hence reducing financing needs.
- A transition to a low-carbon energy economy requires annual incremental investments of tens of billions of dollars in the energy sector, particularly in power generation.
- A review of currently available IFIs, public and private sector resources and instruments indicates that existing instruments can be strengthened and scaled-up for greater impact in the development of markets for energy efficient and renewable energy technologies, but cannot make a meaningful reduction in greenhouse gas emissions and a transition to a low-carbon economy.
- A viable carbon market needs a long-term, stable, global regulatory framework, with differentiated responsibilities. This could stimulate the carbon market with a flow of funds to developing countries of tens of billions of dollars per year.
- Since current instruments are not sufficient to respond to shift to low-carbon economy, options for new financial instruments are proposed.

A. The Problem and Policy Considerations

42. ***Meeting the energy needs of developing countries in an environmentally sustainable manner is an urgent yet difficult challenge.*** Local and regional air pollution and a changing climate can undermine development, with adverse consequences for agricultural productivity, water resources, human settlements, human health, and ecological systems. Developing countries and poor people in developing countries are the most vulnerable, which is a major threat to sustainable economic development and poverty alleviation. Addressing climate change will require mitigating greenhouse gas emissions globally in the most cost-effective manner through the development and implementation of low-carbon technologies and policies encompassing a wide range of sectors,[6] which can often simultaneously reduce local and regional air pollution. Among these low-carbon investment options, the energy sector is the primary source of problems and potential solutions.

43. ***The demand for primary energy is projected to increase globally by a factor of 1.6 to 3.5 between now and 2050, and in non-OECD countries by a factor of 2.3 to 5.2***,[7] resulting in significant increases in carbon dioxide (CO_2) emissions in the absence of policies and technologies to transition to a low-carbon economy.[8] While OECD countries will remain the largest per capita emitters of greenhouse gases, the growth of greenhouse gas emissions in the next decades will come primarily from developing

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6 While greenhouse gas emissions are emitted from a wide range of sectors, this paper primarily focuses on emissions arising from the energy sector. World Bank carbon finance projects encompass reductions of CO_2, methane, nitrous oxide and HFC-23 from energy, industry, and land and waste management projects.

7 IPCC (2001) estimate

8 A low-carbon economy refers to an energy production and use sector that utilizes technologies that limit greenhouse gas emissions. IGCC coupled with carbon capture and storage would be an energy technology consistent with a low carbon economy.

countries. During this period, unless the policy framework changes and appropriate instruments are in place to facilitate investments in new technologies, developing countries are expected to follow a carbon-intensive development path similar to that of their developed country counterparts, with the main source of primary energy remaining a combination of fossil fuels (i.e., coal, oil, and gas).

44. ***Reducing greenhouse gas emissions and transitioning to a low-carbon economy requires policy reforms.*** Such reforms include (a) energy sector reforms that promote the efficient production and use of energy; (b) an international policy framework that stimulates investments in climate-friendly technologies and promotes carbon trading; and (c) land-use policies that promote sustainable land management (e.g., reducing the rate of deforestation). It is therefore critical to develop appropriate international and national public policy options to enhance near- and long-term private sector investment in climate-friendly technologies.

45. ***Approaches to addressing energy security are consistent with those needed to transition to a low-carbon economy.*** Diversification of energy supply and improvements in energy efficiency can address both issues simultaneously (see Box 1).

Box 1: Energy Security and Clean Energy

Diversification. Diversification of energy supplies in terms of fuel types and location of the source of supply directly impact energy security. Increasing the diversity of supply will address both energy security and a transition to low-carbon economy.

Efficiency. Energy efficiency investments can reduce the environmental impact of energy and reduce the pressure on energy supply options. Projected economic returns for such investments can be large while the risks can be relatively low.

Risks. By diversifying the energy portfolio, overall investor risks can be reduced, increasing the likelihood of investor participation. This issue is of particular importance to developing country markets where investors are already concerned with other uncertainties. An energy strategy that diversifies supply (including low-carbon technologies) and decreases the upward pressure on primary energy prices helps to encourage investors to allocate equity to energy investments.

46. ***A long-term, stable and predictable global framework and accompanying regulatory system, which could be based upon targets, policies, and/or other measures, and which respects the principle of common but differentiated responsibilities, is required to support an effective greenhouse gas trading system.*** This would provide the global capital markets the incentive to help finance low-carbon investments and generate private sector-led investments. In parallel to a carbon market, efforts to promote research, development, and deployment through government-led incentives may be useful to promote private sector investments with longer time spans or higher levels of risk.

47. ***Technologies are currently, or will soon be, commercially available to reduce greenhouse emissions (see Box 2).*** Such technologies include greater use of natural gas; coal-fired power plants with carbon capture and storage, e.g., integrated gasification combined cycle (IGCC) with carbon capture and storage (CCS); rehabilitation of inefficient power plants; renewable energy technologies (e.g., wind, solar, bio-energy, and geothermal); small- and large-scale hydropower; nuclear; biological sequestration

(e.g., reforestation); reducing the rate of deforestation; waste management (e.g., capture of methane emissions); incineration of process by-product gases (e.g., HFC-23); and highly-efficient end-use technologies (e.g., buildings and vehicles). Renewable technologies, in some cases, are of particular interest for off-grid solutions.

Box 2: The Role of Technology in a Low Carbon Economy

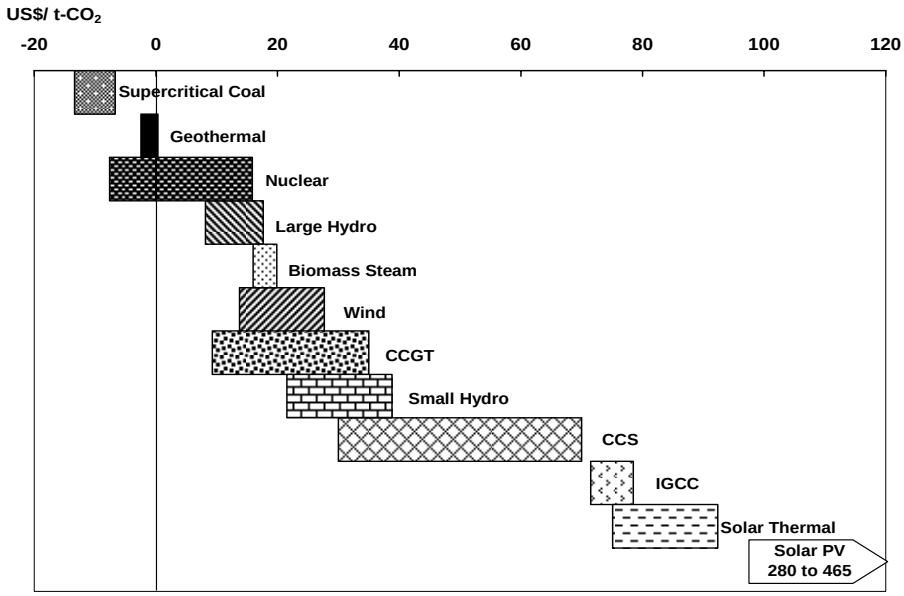
- The transition to a low carbon economy will require a broad range of technical options to be implemented, depending on the resource characteristics of the region concerned:
- Countries with suitable wind, geothermal, solar, bio-energy or hydro resources could be well-served by deploying renewable energy technologies
- Countries with access to economically viable gas resources may consider increased use of gas relative to higher carbon emitting resources like coal
- Where coal is a low cost option, the use of new technologies to burn it more efficiently and to sequester CO_2 emissions should be considered
- Decreased methane, HFC, and N_2O emissions are important components of a greenhouse gas reduction strategy some of which could have considerable near-term impacts
- A focus on land-use/land-use change, aforestation, reforestation and decreased deforestation will help decrease the cost of mitigation
- The incineration of process by-products (e.g., HFC-23)
- More efficient use and production of energy is estimated by the IEA to have the largest impact. Improvements in building efficiency (including appliance use in building), transportation, industries, loss reduction in transmission of energy, and changes in power plant dispatching (see Box 3) are all ways to gain energy efficiencies.

The incremental cost of adopting the above technologies varies by country and resource characteristics, but Figure 1 gives an approximation of relative cost (capital and operating costs) of carbon reduction (estimated for the year 2010).

Hydropower plants appear to be attractive low-carbon candidates without carbon buy-downs. However, their viability is site specific (as is the case for windpower and solar), often depending on social and other environmental considerations. The incremental cost of supercritical coal-fired plants can be relatively easy to justify while wind power and combined cycle gas turbines (CCGTs) become viable under carbon prices experienced in the market in the recent past.

The IEA's reference case forecast of energy supply to 2030 indicates that fossil fuels will supply roughly 80 percent of incremental primary energy needs. Energy use by developing countries accelerates during this period, exceeding that of OECD countries soon after 2020. CO_2 emissions from coal-fired power plants will be a considerable source of greenhouse gas emissions, thus reducing emissions from these plants must be a part of the long-term solution. Higher-efficiency plants (e.g., super-critical and ultra-super-critical) are of limited benefit in this regard as efficient coal-fired plants would still emit more than twice the CO_2 of efficient gas-fired technologies. Thus, carbon capture and storage (CCS) is expected to be an important component of a low carbon economy. Although components of CCS have been implemented, it has, not yet, been tested with coal-fired plants. The earliest pilot is expected to be commissioned in 2012. Therefore, an optimistic date for CCS commercialization is around 2020 given the time required for testing and design modifications. In the interim, coal-fired plants can be designed to be CCS-ready so that the technology can be adopted when it becomes viable. It is expected that OECD countries will play a leadership role in piloting CCS technologies. As nearly all coal-fired plants currently operating in OECD countries are scheduled to be decommissioned by 2030, implementation of cleaner coal options, like IGCC with CCS, could be of increasing importance in both OECD and developing countries.

Figure 1: Illustrative Ranges of Incremental Carbon Reduction Costs for Grid-Based Technologies



(This graph is for illustrative purposes only, actual costs are site specific)

Sources:

*All costs except nuclear and CCS are taken from "Technical and Economic Assessment of Off-Grid, Mini-Grid and Grid Electrification Technologies" Chubu Electric Power Co. Inc et al, Report for World Bank Group/The Energy and Mining Sector Board. September 2006.

*Nuclear Power Plant: Cost Estimates from International Energy Agency/ Nuclear Energy Agency, "Projected Costs of Generating Electricity: 2005 Update", OECD, Paris 2005. Current fuel price data taken from study by Laaperanta University of Technology-2004 (Finland). Efficiency of 33% comes from Nuclear Management Company web site: Nuclear Facts and US Nuclear power plant performance: http://www.nmcco.com/education/facts/business/perform.htm. (Decommissioning costs associated with nuclear power plants are included in the levelized cost estimates and are taken at the end of the operating life of the plant and discounted to current prices. The storage and reprocessing costs for fuel are included in the operating costs).

*For Carbon Capture and Storage (CCS) figures upper & lower bounds are taken from "IPCC Special Report on Carbon Dioxide Capture and Storage", Oct. 10, 2005

Assumptions:

* All figures in the graph are incremental costs (US$ per ton of C02 avoided) in comparison to a Subcritical Coal Plant.

*This scenario assumes $38/tonne Bituminous coal price in 2010 and a $180/thousand cubic meter Natural Gas price and a $16.6/ton Biomass fuel price (probable value).

*Levelized costs for each technology are calculated using 2010 fuel prices, with the exception of nuclear.

*Hydropower Plant cost estimates do not include resettlement or environmental externalities as they are site specific. In addition, methane emissions are not included as it is assumed that vegetation would be removed from reservoirs before they are filled.

Technology	*Subcritical Coal Plant (Baseline)*	*Super-critical Coal Plant*	*IGCC*	*CCGT*	*Nuclear*	*Solar*	*Wind*	*Large Hydro*	*Small Hydro*	*Solar Thermal*	*Geo-thermal*	*Biomass Steam*
Capacity Factor	80%	80%	80%	80%	80%	20%	30%	50%	45%	50%	90%	80%
Efficiency (LHV, net)	38%	40%	42%	55%	33%	N/A	N/A	N/A	N/A	N/A	N/A	80%
Capacity	500MW	500MW	500 MW	300 MW	600 MW	5MW	10 MW	100 MW	5 MW	30MW	50MW	20MW
Unit Investment Cost as of 2010 (in 2005 $)	910-1150	950-1200	1130-1450	490-660	1400-3220	5280-6930	1040-1440	1860-2290	2030-2520	3380-4660	2090-2600	1310-1770

48. ***Incentives are needed to induce technological changes to a low carbon economy, which would in turn accelerate the reduction of greenhouse gas emissions.***[9] This would be facilitated by the large-scale development of new and improved energy production and use technologies. In particular, research and development is needed to further improve certain technologies, including IGCC with CCS,[10] bio-energy, and zero- or low-emission vehicles. This will require sustained private and public sector research and development investments. The cost of implementing such technologies will be reduced if technology policies encourage the development and early adoption of the new energy technologies.

49. ***One particular challenge is to improve the efficient production and use of energy.*** Past experience shows that primary energy use in developing countries can be cut by 30 to 50 percent with the cost of saved energy being a fraction of that needed to increase supply. Therefore, an aggressive uptake of cost-effective energy efficiency improvements must be a priority in increasing useful energy supplies. It will also reduce local and regional pollution, and decrease greenhouse gas emissions. Although energy intensities have started declining gradually in developing countries and in economies in transition, mostly due to structural changes to their economies, much of the technical potential across the supply, transmission, and use of energy remains largely untapped, with only one-third of primary energy being converted into useful energy. Box 3 summarizes these opportunities.

50. ***The cost of decreasing greenhouse gas emissions can be reduced through international trading and adopting a multi-gas / multi-sector strategy.*** The cost depends on several factors, including: (a) the degree to which projected emissions are reduced; (b) the underlying pathway to development; and (c) the degree to which there is flexibility in where, when and how emissions are reduced:

- *Where:* by using international trading, which reduces costs and promotes sustainable development in developing countries through "low-carbon" technologies and financial flows;

- *When:* by timing the introduction of technologies and policies in the most cost-effective manner (e.g., no major premature retirement of existing capital stock);

- *How:* by using mitigation strategies that consider all greenhouse gases from all sectors.

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[9] Weyant, J. P., 2004: EMF 19 alternative technology strategies for climate change policy, *Energy Economics*, 26 (4), pp. 501-755.

[10] If IGCC with CCS proves to be cost-effective, then appropriate sites would need to be identified.

Box 3: Energy Efficiency: Quick Win and High Pay-off for Development and the Environment

As countries invest in infrastructure to support development, it is imperative that investments are energy efficient since such infrastructures have long life spans. For example, by 2015 half of China's urban residential and commercial buildings would have been built since 2000 and this stock will remain in use for another 50 to 100 years. Existing and newly emerging technologies offer many opportunities to reduce energy use with no productivity loss or reduction in comfort. For example:

- **Transportation.** Efficient gasoline/diesel engines, urban mass transport systems, modal shifts to inter- and intra-city rail and water transport, improved fleet usage.
- **Buildings.** Integrated building design and measures such as better insulation, advanced windows, energy efficient lighting, space conditioning, water heating, and refrigeration technologies.
- **Industry.** Cogeneration, waste heat recovery, pre-heating, efficient drives (motor, pump, compressors).
- **Municipalities/Urban Local Bodies.** District heating systems, combined heat and power, efficient street lighting, efficient water supply, pumping, and sewage removal systems.
- **Agricultural.** Efficient irrigation pumping and efficient water use, such as drip irrigation.
- Power Supply:
  - *New thermal power plants:* Combined cycle, supercritical boilers, IGCC, etc.
  - *Existing generation facilities:* Refurbishment and re-powering (including hydro), 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.

However, energy efficiency investments face barriers. There are the classical barriers of non-economic pricing of energy and greater weight given to upfront (first) costs compared to recurring costs. Capital constraints faced by investors favors investment in new production capacities rather than energy efficiency, especially if energy costs are a small proportion of production costs. There is also a higher risk perception due to the lack of awareness and experience among investors and financiers.

As these projects depend on revenues generated through energy savings, the absence of robust systems of measurement, monitoring and verification of energy savings present a challenge. These projects also could have higher transaction costs due to their smaller size. In the case of retrofit projects, there is a risk and potential revenue loss associated with taking a plant out of service during renovation. Consequently, improving energy efficiency require actions on multiple fronts:

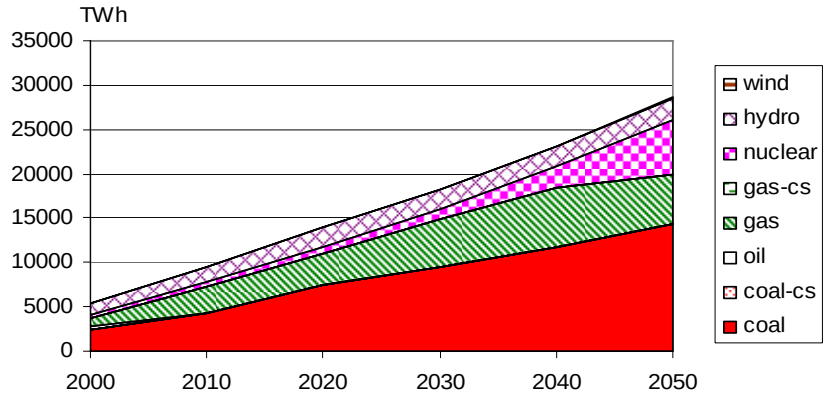
- Increasing access to energy efficient technologies and strengthening design and engineering capabilities.
- Improving the policy and regulatory environment by adopting economic pricing of energy, and adopting and enforcing energy efficiency codes and norms, appliance energy efficiency standards and labeling systems, mandatory industry energy audits, and utility demand side management programs.
- Increasing access to pre-investment and project financing, introducing risk management and credit enhancement instruments, such as guarantees, and encouraging investment decision-making based on lifecycle costs.
- Introducing new business models such as performance contracting and bundling of small projects through Energy Service Companies.
- Building capacity and increasing knowledge among domestic financial sector, industries, municipalities, electric utilities, energy auditors, engineers, architects, builders, and so on.

51. ***A multi-gas strategy can achieve the same climate goal at considerably lower costs than a CO_2-only strategy.***[11] The costs (GDP loss) of meeting a specific climate goal utilizing a multi-gas/multi-sector strategy may amount to only 30 to 40 percent of the GDP losses as compared to a CO_2-only strategy. GDP losses in the first few decades could be significantly reduced because a considerable part of the more expensive CO_2 emission reductions would be replaced by cheaper reductions in non- CO_2 greenhouse gas emissions. The estimated GDP losses increase with increasing levels of de-carbonization (i.e., decreasing stabilization levels) and are also dependent on the assumed business-as-usual baseline.

B. Financing Needs

52. ***The global, incremental, upfront capital cost of de-carbonizing the power sector is estimated to up to US$40 billion per year between now and 2050 depending on the level of de-carbonization and the assumed baseline, with non-OECD countries incurring about 50 to 80 percent of this cost (i.e., up to US$30 billion per year).*** To significantly reduce greenhouse gas emissions and de-carbonize the power sector, the global power generation technology mix will have to change substantially, with a marked decrease in conventional fossil fuel technologies and increased proportions of advanced fossil-fuel technologies (e.g., coal- and gas-fired plants with CCS) and non-fossil fuel technologies (e.g., hydropower, wind and nuclear). Several scenarios were developed with different assumptions regarding both the reference and future de-carbonized energy mixes.[12] Figure 2 shows one possible business-as-usual reference technology mix for non-OECD countries between now and 2050,[13] while Figure 3 shows a possible transformation of that energy mix that is significantly de-carbonized. The incremental capital investment costs in non-OECD

Figure 2. Technology Mix, EPRI Reference Case: Non-OECD Countries



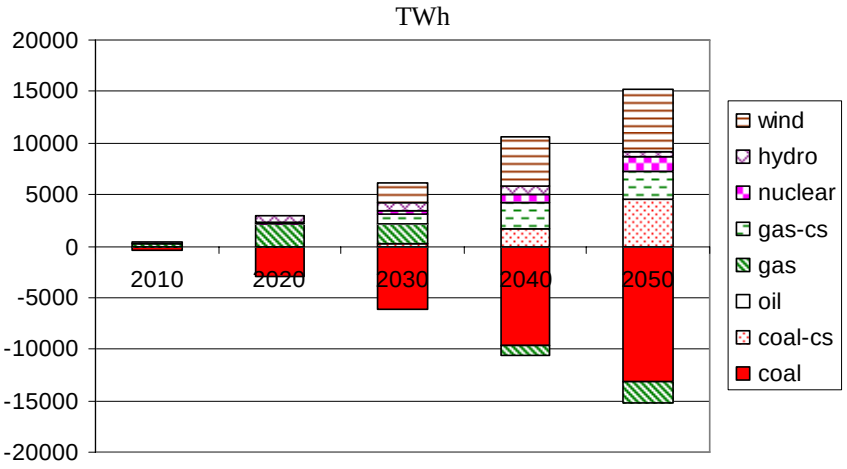
[11] Weyant, J. P., and F. de la Chesnaye, In Press: Overview of EMF 21 multi-gas mitigation and climate change, *Energy Journal*.

[12] Taken from: the US Electric Power Research Institute Model for Evaluating the Regional and Global Effects of GHG Reduction Policies, and the US Pacific Northwest National Laboratory Mini Climate Assessment Model.

[13] This assumes a reference (business-as-usual) scenario that is in the middle of the IPCC scenarios. A higher baseline, i.e., greater demand for energy, or a scenario even more dependent on fossil fuels, would mean that the same degree of de-carbonization would require even higher incremental investments in the power sector.

countries to transition from the business-as-usual scenario (Figure 2) to the highly de-carbonized energy mix (Figure 3) is about US$30 billion per year between now and 2050.[14]

Figure 3. Change of Technology Mix, EPRI de-carbonized case: Non-OECD Countries



C. Existing Financial Instruments

53. ***A review of IFIs, public and private sector instruments indicates that these can be strengthened and scaled-up for greater impact in the development of markets for energy efficient and renewable energy technologies*** (see Annex 2). However, they cannot make a meaningful reduction in greenhouse gas emissions and a transition to a low carbon economy. Existing financial instruments currently used to mitigate greenhouse gas emissions include:

- Grant resources from the public sector, primarily through the GEF;
- Carbon financing from the public and private sector through the carbon market;
- Voluntary actions by the private sector;
- Risk mitigation instruments.

[14] While the up front capital costs are much higher for de-carbonized energy mixes the long term operating costs are normally less, possibly decreasing the need to buy-down all of the incremental capital costs.

1. Global Environment Facility (GEF)

54. ***The GEF[15] can play a significant role in inducing technological change, particularly with respect to removing barriers to the deployment of commercial or near-commercial energy efficiency and renewable energy technologies by the private sector.*** The focus of GEF funding has moved consistently upstream, from supporting individual investments to creating the enabling environment for market transformation, particularly in improving the investment climate - the policy, regulatory, and institutional factors that encourage the private sector to invest. For example, the GEF would support the Investment Framework's objectives by helping countries formulate and implement their policy and regulatory reforms to encourage on-grid renewable energy generation. Similarly, the GEF will focus on ensuring that renewable energy is used wherever it is the least-cost option for providing access to modern energy services, but because of a variety of barriers, it is not considered the default option.

55. ***GEF financing has had the greatest potential for market transformation in cases where technical assistance and the limited provision of financing for incentives has been applied to reform policies, to transfer relatively narrowly defined technologies to a well organized recipient industry, or to create clean energy incentive programs.*** In particular, this has been the case within energy efficiency, where achievements can be observed in energy-efficient products (e.g., lighting, refrigerators), industrial energy efficiency (e.g., boilers), public sector energy efficiency (e.g., street lighting and district heating), and also transforming financing markets for energy efficiency investments. There is also evidence of emerging market transformation toward increased use of renewable energy in certain sectors in specific countries.

56. ***A positive example is the significant scale-up and market transformation operations now being initiated with GEF co-financing in China***. This includes:

- Implementation of a national Mandated Market Policy in which a mandated share of electricity consumed comes from renewable sources and is sold by electricity suppliers at a government determined price.

- Transformation of the urban heating sector from a government-supported welfare system to a market-based commercial operation, and energy-efficient market transformation of the urban housing sector.

- Overcoming barriers to phase-out of small and medium-sized generating units in the short- and long-run, respectively, and creating the conditions for investment in rehabilitation of medium and large-sized coal-fired power plants for improved thermal performance and coal utilization.

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[15] The GEF is the largest source of grant financing for energy efficiency and renewable energy, with cumulative commitments through the World Bank of approximately US$1 billion since 1992 (the average commitment during the last four years has been about US$100 million per year). Total GEF funding through all its implementing/executing agencies for climate change activities has been about US$2 billion since 1992.

- Removing barriers to large-scale, "system-focused," energy efficiency projects in large industry, and expansion of direct energy efficiency lending from banks to large enterprises.

57. ***In contrast to barrier removal for market transformation of commercial or near-commercial technologies, the GEF's track record in reducing the long-term costs of pre-commercial low greenhouse gas-emitting energy technologies has not been encouraging.*** The Bank's experience with its GEF portfolio demonstrates that, in addition to the technology cost and transfer problems, such new, low greenhouse gas-emitting technologies face a significant market barrier. Such new technologies impose not only incremental costs but also incremental risks. These projects were stymied by their complexity, weak or non-existent linkages to similar investment programs in OECD countries, and inadequate legal and regulatory environments. Addressing these "software" aspects takes time, international partnerships for technology development, and a willingness to inject the technology transfer elements into the energy sector policy dialogue, in addition to substantial funding.

58. ***The GEF's resource levels, and accompanying funding strategies, are not sufficient to meet the investment needs to shift to a low-carbon economy.*** It is estimated that Bank-GEF commitments for the operational programs on "Removing Barriers to Energy Efficiency and Energy Conservation" and "Promotion of Renewable Energy by Removing Barriers and Reducing Implementation Costs" would need to be at the level of about US$250 to 300 million per year over the next 10 years (an increase by a factor of 2-3), to achieve significant and sustained market penetration of energy efficiency and renewable energy technologies. Furthermore, the GEF's focus on "barrier removal" has meant that it has limited funding for the investment needs of near-commercial or mature technologies that might be new to a country.

59. ***In addition to this emphasis on the "software" side of market development, GEF resources would have to be scaled-up by a factor of at least 10 to finance a strategic, global program to support the reduction of costs of pre-commercial, low greenhouse gas-emitting technologies*** (e.g., solar thermal, IGCC, or fuel cells), or rehabilitation of inefficient thermal power plants. GEF-4 programming priorities can be used to provide technical assistance support to both the rehabilitation of existing power plants and new clean coal (and CCS) technologies, but investment financing is limited.

60. ***Even if the GEF Trust Fund's financial resources were significantly increased, constraints on the use of such funds by the Bank and other IFIs would remain.*** For example:

- GEF funding would need to be more predictable, with strengthened project pipeline management through replenishment cycles and coordinated access of 10 implementing and executing Agencies, to allow GEF programming to be better aligned with the Bank's country dialogue.

- GEF and Bank project processing would need to be more closely aligned as the review, approval and evaluation procedures are duplicative, adding to the transaction costs and processing times, with limited value-added.

- Implications of the resource allocation framework would need to be considered. The resource allocation framework potentially targets the 6-8 largest greenhouse gas-emitting countries to implement meaningful "market transformation" interventions, but almost all of the African and many Asian and Latin American countries, would be excluded.

Other innovative uses of the GEF include:

- Greater use of contingent grant and partial risk guarantee instruments would be needed to more effectively engage the private sector (currently, guarantee operations comprise less than 5 percent of the GEF climate change portfolio). The GEF Council is expected to approve a policy on non-grant instruments in December 2006, which should also establish financial terms and procedures for reflows to the GEF Trust Fund. This could potentially enhance the GEF's resource base and leverage effect.

- The Bank would need to build on complementarities between carbon finance and the GEF to mobilize both instruments to cofinance projects. As part of the GEF-4 replenishment negotiations, the GEF has proposed a three-fold approach to reducing potential overlap and encouraging synergies with carbon finance and the Kyoto mechanisms. The GEF could (a) demonstrate projects that carbon finance can replicate; (b) support partial-risk guarantees through a revolving carbon facility for projects yielding a carbon stream, to contribute project financing, which could be replenished partially or fully through the stream of payments for emission reductions; and (c) for projects in the Biodiversity or Land Degradation focal areas, support projects qualifying for carbon finance provided the GEF funds are not used to pay for certification, qualification, and auditing functions linked to the issuance of carbon credits.

- Programmatic approaches that aggregate relatively small projects and technical assistance interventions, would need to be scaled-up. The objective would be to integrate global environmental concerns in the policy dialogue and lending programs at a sectoral, rather than project, level, for example, in rural energy access, infrastructure, and urban transport. It is proposed that the Bank and GEF now explore longer-term, country- or region-based strategies to implement the GEF's strategic priorities. Such an approach would focus GEF review on broad program strategies and results, rather than individual projects (which would be subject to Bank due diligence and fiduciary oversight).

2. Carbon Finance

61. ***Carbon finance can contribute to financing a transition to a low-carbon economy.*** Carbon finance[16] can contribute to clean energy financing in three ways: (a) purchasing carbon credits from low-greenhouse gas projects; (b) using carbon finance to leverage additional investments;[17] and (c) supporting the development of the carbon market through capacity building and political engagement.

62. ***However, a viable carbon market needs a long-term, stable global regulatory framework, with differentiated responsibilities.*** This could stimulate the carbon market with a flow of funds to developing countries of tens of billions of dollars per year, depending on the regulatory framework and agreed targets**.** Without a long-term, stable regulatory framework, the carbon market is not viable and could not play a meaningful role in the transition to a low-carbon economy.

63. ***Considering the wide range of project and program types that could benefit from carbon finance, opportunities to increase market penetration and make greater use of carbon finance for development purposes are numerous***. Carbon funds can be scaled up for targeted investments and the use of existing instruments improved. The establishment of the Umbrella Carbon Facility has demonstrated the potential of such an instrument for scaling-up and increasing the efficiency of delivery of carbon finance from large projects.[18] The establishment of the Clean Development Mechanism (CDM) Fund in China is an illustration of how a country can further maximize the utilization of carbon revenues beyond specific projects to finance future climate-friendly investments. Further developments in the form of auctions and the establishment of country-wide sellers' funds are expected to increase the penetration of carbon finance in host countries and generate carbon revenues on a larger scale. Potential opportunities include:

- Special carbon windows, which could be considered to be an expansion or evolution of the current carbon funds in the Bank :

- An end-use energy efficiency fund, which would build on activities within the existing portfolio of carbon projects, to overcome the barriers to the development of such projects;

- An avoided deforestation fund, which would deepen the activities of the bio-carbon fund, could provide incentives and foster activities that would reduced deforestation in developing countries;

- Blending carbon finance with Bank lending instruments: The Bank could explore strengthening its carbon finance operations by linking them with its lending instruments. For instance, the Bank could lend for the construction of a

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16 The Bank Group has 10 years of experience and US$1.8billion of carbon funds under management.

17 Many private investors interviewed expressed the view that carbon credits were not used as much to change decisions on technologies, but generally viewed as a "kicker" in returns on proposed investments

18 The Umbrella Carbon facility has been used once for an HFC-23 project in China.

carbon reducing project, and the loan could be paid back (in part) from the proceeds earned by selling emission reductions from this project. If the Bank signs a loan agreement and a (fixed-price) purchase agreement for the reductions, both agreements could be linked such that the Bank is authorized to make the repayment on the loan when it receives the emission reductions that the project creates.

- Supporting the development of green investment markets.[19] For example, the Bank could assist sellers of Assigned Amount Units (AAUs) in Economies in Transition to develop and implement domestic schemes, conduct pilot transactions, or buy AAUs in its capacity as a trustee on behalf of the participants of Bank carbon funds.

3. Voluntary Carbon Markets and Partnerships

64. ***The voluntary market, unlike the pre-compliance market, is driven by factors that are largely independent of regulation.*** The key motivational forces for participation in the voluntary market include corporate risk management (i.e., in relation to future liabilities, competitiveness, reputation, and cost of capital), corporate sustainability management and brand and loyalty management. Parallels in carbon asset development between the voluntary and mandated markets exist (i.e., shared use of quantification protocols, verification standards, and accreditation of certifiers).

65. ***There is potential for growth in the voluntary market, though it is highly uncertain.*** According to different estimates, the voluntary market had a volume of 3 to 9 million tonnes of CO_2 in 2005, and is projected to grow to 20 to 50 million tonnes in 2006, 100 million tonnes in 2007, and higher by 2015 (assuming low-cost options exist, i.e., a few US$ per tonne of CO_2 avoided—presumably these would be non-Kyoto compliant otherwise they would be traded at a higher price within the CDM compliance regime). The main beneficiaries of this growth are expected to be the small-scale projects that provide energy services in an affordable way, improve the quality of life, reduce local and regional pollution, strengthen energy security for macroeconomic stability, and promote new categories of carbon-sequestration projects (e.g., avoided deforestation). If this growth materializes, new financing mechanisms will be needed to ensure the efficient channeling of investments into small-scale energy projects.

66. ***Numerous fora play a key role in promoting partnerships to reduce greenhouse gas emissions.*** Fora such as the World Business Council for Sustainable Development, the OECD Roundtable on Sustainable Development, the United Nations Environment Program's work on standards, and trade and private sector associations all play an important role. These are complemented by bi-lateral technology agreements (e.g., the Asia-Pacific Partnership on Clean Development and Climate).

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[19] Green investment schemes are infrastructure investment programs financed by the revenues from the sale of the surplus emissions (AAUs) which are linked to verifiable emission reductions

4. Risk Mitigation Instruments

67. ***The Multilateral Investment Guarantee Agency (MIGA) is poised to undertake additional activities with respect to low-carbon energy power projects, i.e., provide insurance for Carbon Emission Reduction (CER)-based project finance.***[20] The coverage would protect an investor and/or lender in a carbon finance project against:

- Breach by the host government of an agreement to transfer AAUs or Emission Reduction Units;
- Actions by the host government which result in the inability of the project to achieve the planned emission reductions, for which CER's are issued;
- Political violence, war, or civil disturbance resulting in cessation of operation and/or damage to facilities that would lead to the inability of the project to achieve the planned emission reductions; and
- Sovereign risks related to technology transfer/intellectual property rights.

D. New Financial Instruments

68. ***Enhancements to the existing instruments outlined above will contribute to the transition to a low-carbon economy, but only to a limited extent.*** Given the relatively small-scale of GEF operations in comparison to the size of the problem, and the uncertainty of the carbon market due to the absence of a long term regulatory framework, more needs to be done.

69. ***The large amounts of financing that will be required for an effective transition to a low carbon economy will only be available via efficient mobilization of private capital.*** Mobilizing private capital for investments in clean energy generation in developing countries will require, from the point of view of private investors, the equalization of clean energy investment costs with the costs of investments in traditional technology (see Box 4).[21] Current global agreements supporting the climate change agenda and the resulting carbon finance mechanisms of recent years can provide financial support to compensate for a portion of such incremental investment costs and foster sustainable development, including that of clean energy alternatives in both developed and developing economies. However, uncertainties regarding the sustainability of the global agreements beyond 2012

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[20] MIGA is currently well capitalized and can significantly increase its exposure to clean energy projects over the foreseeable future. MIGA has built close relationships with key private sector investors and financial institutions involved in clean energy projects. Close to 20 percent of MIGA's current gross exposure, or US$1.4 billion, relates to power projects. MIGA typically insures part of a project. Total investment supported is a multiple of the MIGA's gross exposure.

[21] For example, average incremental investment in clean energy based on a coal-fired power plant is estimated at 40 percent above the costs of conventional sub-critical boiler technology.

and slow implementation of the CDM[22] have so far limited the ability of carbon finance markets to fund the transition to a low carbon economy.

Box 4: Constraints faced by the Private Sector to Finance "Low Carbon Energy"

Higher investment costs mean projects are less financially attractive sometimes dropping returns below their hurdle rate, resulting in relatively little equity and debt capital for cleaner technologies

Long lead times and untested technologies increase project risks, making private markets nervous, limiting the amount of financing available, especially in markets already perceived to be high risk

Current carbon prices for CDM projects are too low to support mobilization of substantial private capital

Uncertainty regarding future carbon regulatory frameworks limits the mobilization of long term capital.

70. ***Since current instruments are not sufficient to facilitate the shift to a low carbon economy on the scale required, options for new financial instruments are proposed***. These include the Clean Energy Financing Vehicle (CEFV); the Clean Energy Support Facility (CESF); and under the Bank's proposed Middle Income Country Strategy, proposals that make the Bank's financial products more attractive for programs like the Clean Energy Investment Framework. Early ideas to support carbon market continuity during a period of uncertainty are explored. Finally, a proposal is made to support project development via ESMAP.

1. Clean Energy Financing Vehicle

71. ***The CEFV[23] offers a new business model for resource mobilization and investment (Annex 3).*** It would complement the GEF's focus on creating an enabling environment for market transformation and technology transfer. The CEFV is proposed as a dedicated financing facility to provide implementing agencies (public and private) with soft, long-term financing to "buy down" the costs of low-carbon energy technology and related infrastructure (including rehabilitation/upgrading of existing facilities). CEFV could also operate a window to provide technical assistance, on a grant basis, to support the piloting of high risk, pre-commercial technologies (this window would require a grant-funded element within the CEFV).

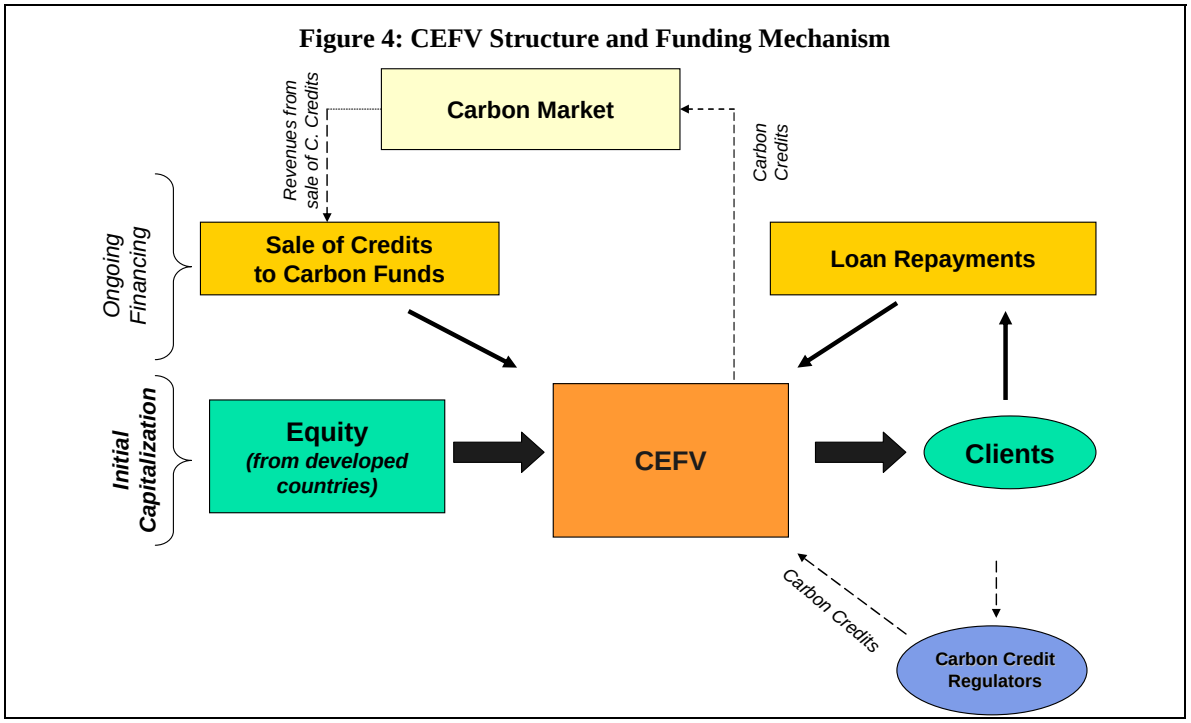
72. ***Implementing agencies receiving loans from the CEFV would pledge carbon credits from investments in low carbon energy to the facility.*** These pledges would allow CEFV to provide loans at soft terms and conditions. The selling of these carbon credits on the market would augment the reflows to CEFV, allowing it to recoup the subsidy embedded in its financial products (see Figure 4). Based on current estimates

[22] It is critical that the CDM review and approval process be expedited and the range of eligible activities expanded (e.g., to include avoided tropical deforestation).

[23] The AsDB supports, in-principle, the establishment of the CEFV on the understanding that details on financing, financial operations, operational procedures and oversight remain to be finalized through inter-agency consultations.

and market absorption capacities, it is proposed that the facility's initial equity be sized at US$10 billion to support average annual disbursements of US$2 billion (see Annex 3).[24]

Figure 4: CEFV Structure and Funding Mechanism



73. ***Equity contributions to the CEFV would be provided by developed country governments.*** The investment made by the shareholders of CEFV would be expected to earn a reasonable rate of return. The financial viability of the CEFV is sensitive to the following key variables: (a) the price of carbon credits in the market; (b) the mix of new technologies in the power sector; and (c) the incremental costs of each of these new technologies over the next several years compared to current technologies. The proposed CEFV would be financially sustainable at an average price of about US$15 per tonne of CO_2 (in constant 2006 dollars).[25] At the end of the life of the CEFV, its equity would be returned (with accumulated earnings) to shareholders. To mitigate the carbon price risk to CEFV and its target rate of return, mechanisms similar to the options described in paragraph 84 might need to be developed.

74. ***CEFV would be governed by its shareholders***, with a small team of dedicated staff assigned to manage the facility. This joint IFI management/coordination team would

[24] The CEFV could finance a significant fraction of the incremental costs of low-carbon energy investments, which have been estimated to be between US$4 to 30 billion per year in the power sector in non-OECD countries between today and 2030. In the medium term, taking into account institutional and technology constraints, it is estimated that developing countries could absorb about US$2 to 3 billion per year in incremental financing for this purpose.

[25] The current average international price of project-based certified carbon credits is about US$9 to 15 per tonne of CO_2, where-as the price of non-certified carbon credits is about US$6 to 9 per tonne of CO_2 for pre-2012 vintages, and less for post-2012 vintages. The current price (mid-July 2006) of carbon in the European Trading System is about €16.5 per tonne of CO_2.

report to all participating IFIs[26] and donors, and would be located in the headquarters of one of the participating IFIs. Task teams in all participating IFIs would be authorized to prepare projects to be funded by the CEFV. A project supported by the CEFV would need to meet certain standards/guidelines, to be developed by the CEFV management team, and would subsequently be sent for approval to the Board of the respective IFI. This vision raises several legal and procedural issues that would need to be resolved.

75. ***By providing long-term concessional financing on a significant scale to cover the incremental cost of low-carbon energy in developing countries, the CEFV would fill a major gap in the range of financing instruments available today***. Once adequately capitalized, and with a strong market, it would not require periodic replenishment by investors. Over time, by producing a fair return for its shareholders, the CEFV would demonstrate to private financiers the viability of a new business model that relies on the future value of carbon credits to buy-down, upfront, the incremental cost of investments in low carbon energy. CEFV would go out of business once the private sector becomes ready to play this role.

2. Clean Energy Support Fund

76. ***Another alternative to consider would be a simple subsidy mechanism that supports projects in line with the degree of carbon emission reduction.***

77. ***Determining a shadow price and subsidy level***. Such a fund will be neutral with regard to technology choice. To achieve this it would use an administratively determined "shadow price" for carbon emissions to signal which projects are eligible for funding. This will be in line with the standard approach of cost-benefit analysis correcting the financials of a project for "externalities". In this case the costs of carbon emissions — based on best possible analysis of the marginal cost of reducing emissions by a unit of carbon. If eligible, the CESF will calculate the difference between the project costs (net present value) with and without the carbon credit cash flows. Such flows will be calculated using the *shadow price*. This difference will constitute the maximum subsidy amount the fund is willing to pay to support the project financial viability.

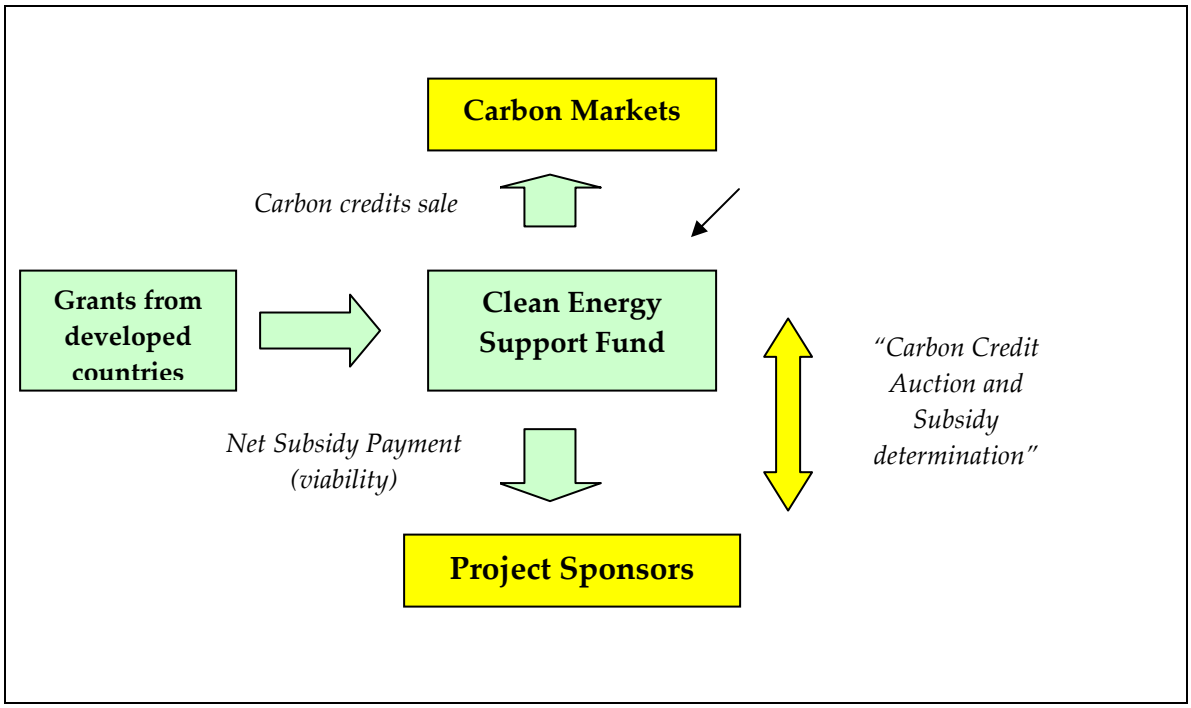
78. ***Buying down the costs of clean technology.*** Eligible projects would be competitively selected so as to ensure that only the lowest required subsidy is paid and to avoid inflating project's profits excessively. Subsidy payments could not exceed the level indicated by the "shadow price" of carbon. De facto the "shadow price" of carbon would act as the reserve price in the competitive process.

79. ***Carbon credit generation***. The projects that are thus chosen and made financially viable by use of the subsidy may generate carbon credits depending on the regulatory system (i.e., certification process) in place. To the extent that carbon credits are generated, the fund will obtain the right to project associated credits in exchange for the subsidy payment. Carbon credits will be traded by the fund in the carbon finance

[26] Participating IFIs refers to international financial institutions accessing the CEFV for their sponsored projects (co-financing and mobilizing private capital).

markets.[27] Net revenues from such trading will be used to replenish the subsidy fund (see Figure 5).

Figure 5: CESF Structure and Funding Mechanisms



80. **Risks.** The fund will take the market price risk of carbon credits as well as the risks associated with the carbon assets creation (i.e., regulatory risks associated with the creation of certified emissions reduction — CERs). If a strong carbon finance market develops after 2012 the trading of carbon credit will ensure the fund continuity (no depletion of funds). Alternatively, if carbon finance markets were not to continue their evolution and further strengthening, the fund will be depleted over time. Such fund will require initial donor contributions and eventual replenishment if carbon finance markets do not develop adequately.

81. **Market evolution**. Such a pure grant fund would ensure that markets are not distorted. The "shadow price" acting as the reserve price in the competitive process will support market continuity in the event of market deterioration due to uncertainties in the post 2012 global regulatory system. Any organization (or consortium of organizations) can develop projects and apply to the fund. Competition for the fund resources should ensure that the subsidies paid out are the minimum required subsidies to achieve emission reductions. This scheme will maximize the effectiveness of grant funds.

3. Strengthening the World Bank's Engagement with IBRD Countries

82. ***The World Bank Group is presenting another paper to the Development Committee ("Strengthening the World Bank's Engagement with IBRD Countries")*** at the same time as the progress report on the Clean Energy Investment Framework. This

[27] Through qualified market operators.

paper highlights the fact that, while middle-income countries have, as a group, performed very well economically in recent years, their access to private capital has been uneven and that infrastructure remains seriously underfinanced in all developing countries.

83. ***Borrowing countries have asked for the MDBs' increased attention to a broad range of financial and risk management instruments*** including (a) local currency financing, (b) non-recourse financing for the private sector, (c) financial instruments appropriate for sectors with weak or delayed financial returns on investment, (d) sub-national lending, (e) refinancing instruments to help improve debt management, (f) pre-approved loans to address countries' immediate liquidity needs in the aftermath of natural disasters, and (g) indexed loans and other products with risk pooling features.

84. ***In that context, the Bank has responded to its members' evolving priorities in a various ways*** including (a) stepping up the relative proportion of its financing delivered as policy support lending, (b) overhauling the terms of its financing, (c) introducing a LIBOR benchmark for floating-rate loans, (d) giving borrowers a choice of currency (including local currency where feasible) and interest rate payment conventions, and (e) making available a number of tools to manage interest rate, currency, and commodity risks in their portfolio.

85. ***The World Bank Group is committed to pursue efforts to better respond to the needs of borrowing countries (in particular within the scope of the Clean Energy Investment Framework) by reducing non-financial transaction costs and making pricing more transparent and competitive.*** In addition, the World Bank Group will consider new means and mechanisms to develop more flexibility in the terms of its financing packages to provide incentives and resources to countries to pursue clean energy alternatives.

4. Other Market Support Options

86. ***Uncertainties surrounding the future of the post-2012 global regulation system could affect the further development of the carbon markets.*** Support will be required to a developing market that has great potential to facilitate investments in clean energy through mobilization of private capital. The main purpose would be to assure sellers of project-based emission reductions about the continuity of a carbon market. Donor based mechanisms could provide risk mitigation support to the carbon market through one of the following options: (a) a carbon market continuity fund for purchasing post-2012 credits, to avoid a gap in trading activity until the global regulatory framework is put in place; (b) implementing a price support mechanism for eligible, project-based carbon credits, to improve the credit quality of project cash flows and stabilize the nascent carbon markets. Each of the options is discussed further below:

- ***Carbon market continuity fund for purchasing post-2012 carbon credits at market prices*** *(including via auctions).* Recognizing that the current commitment period of the Kyoto Protocol ends in 2012, the Bank has recently begun considering options for further engagement in the carbon market beyond this date, with a view to maintaining continuity in the carbon market.

The carbon market continuity fund, aimed primarily at sustaining the market, would support priority projects, such as energy and infrastructure projects with high climate mitigation potential. The fund would be open to operate under any future regime, and participants would be expected to consider their commitments as efforts towards climate mitigation whether formally through the acquisition of emission reductions or informally through recognition in the negotiations. Initial size of funding to be meaningful to support market continuity is about US$1 billion. Additional tranches may be needed the longer uncertainty about the post-2012 regime exists. Although this option would reduce transaction costs, it would only partially protect the CEFV from the risk of low carbon prices (as long as a post-2012 regulatory regime is not in place).

- ***A mechanism to support price levels for post-2012 project-based carbon credits.*** The objective would be to support long term investments in low-carbon energy through price risk mitigation in the carbon market. The mechanism would provide sellers of project-based emission reductions in developing economies a threshold level of revenues for carbon credits beyond 2012. Similar to the CESF option, this mechanism would rely on an administratively determined "shadow price", and offer to buy project based carbon credits at this price from eligible sellers. Eligibility would require, inter alia, advance registration by potential sellers, so the contingent liability can be tracked and limited to the amount that the donors supporting the mechanism are willing to be exposed to. Such a mechanism would act as the reserve price and would support market continuity in the event of market deterioration due to uncertainties post 2012.

87. ***The new financial instruments (CEFV and CESF) could be hosted as a separate window or fund in the IFIs.*** The CEFV and CESF involve the generation of carbon credits through the funded projects and the transfer of such credits to the financial instrument. The instruments' intended scale and product lines would fit IFI capabilities and their normal operational financial activities. The CEFV and CESF could also be housed in the GEF, but would require significant changes in the GEF's governance, operations, staffing and institutional arrangements.

88. ***The proposed instruments and ideas are still in a developmental stage, and further work is needed to determine the best way to increase the quality of revenue flows for the generators of carbon credits (including CEFV and CESF) beyond 2012.*** The design of the instruments would need to ensure that the private sector is supported instead of being crowded out. Consideration of mechanisms to support the carbon markets should include an analysis of their compatibility with proposed financing instruments. Given the complex market environment, and the need to avoid unintended market distortions, broader consultations with private financial markets, development institutions and donor countries would be critical if these types of instruments were to be developed further.

89. ***Design and structuring of any of the proposed options under section D ("New Financial Instruments") should address from the early stages the issues of crowding out the private financial sector from lending to clean energy projects.*** The new financial instruments should be designed so as to help mobilize additional private resources into the capital intensive energy sector. Special attention should also be given to the mitigation of potential conflict of interest between key participants in the proposed new instruments (i.e., CO_2 emitters, project sponsors, financiers, donors, IFIs, etc.) when blending public and private financial resources. Increasing the level of financing of carbon credit based projects would also have an impact on the risk management requirements of dedicated vehicles (such as GEF) and IFIs expanding their activities in the sector. Careful consideration should also be given to these risk implications early on in the development phase of the proposed instruments in this section.

5. Clean Energy Project Development Facility

90. ***A dedicated Clean Energy Program Development Facility (CEPDF) for low-carbon projects could be established as a window within the Energy Sector Management Assistance Program (ESMAP).*** The CEPDF would complement other project preparation facilities, and provide governments with an enhanced program development/pre-investment and sustainable development agenda. The CEPDF would provide pre-investment support at the country-specific and/or sub-regional level to help put in place programs and projects that are intended to accelerate the transition to a low-carbon global economy.

91. ***The CEPDF would focus on program/project development in support of greenhouse gas mitigation and transition to a low-carbon global economy.*** It would assist governments, public utilities, private service providers and other stakeholders in the G5+ countries and selected sub-regional entities to conduct comprehensive assessments to identify viable energy/power sector development strategies to support/facilitate the transition to a low-carbon global economy.

- The CEPDF which could be embedded in ESMAP, would be designed to build a robust pipeline of “bankable” projects needed to support a more rapid scale-up of IFI low-carbon energy operations including, where appropriate, those that would leverage the envisioned new financing instruments. The CEPDF would complement the GEF’s Project Development Facility by focusing on more upstream analytical work, and project development for carbon finance, which the GEF would not support.

III. ADAPTATION

- All countries are vulnerable to climate risks and changes in weather patterns, but the poorest countries and the poorest people within them are most vulnerable. Failure to adequately adapt is a major threat to development goals.
- There has not been enough experience in mainstreaming adaptation to precisely calculate the additional preparation costs and the proportion of new expenditures needed
- The primary financial instruments to support adaptation have been the GEF and Official Development Assistance (ODA). GEF resources include two trust funds for adaptation supported by voluntary donations and the Adaptation Fund, which is resourced by a 2 percent tax on most CDM transactions—this is a new source of funding for adaptation distinct from ODA.
- An assessment of the current financial instruments shows that while they are technically adequate to respond to the challenge of achieving climate-resilient development, the sums of money flowing through these instruments need to be substantially increased.
- The insurance industry faces severe, additional climate risks that might slow the penetration of weather-related insurance into the developing world.
- There is an important work program ahead to provide a stronger basis for advice to developing countries on policy strategies and investment choices in the area of adaptation.

A. The Problem and Policy Considerations

92. ***All countries are exposed to the threat of climate risks and changes in weather patterns, but the poorest countries and the poorest people within them are most vulnerable.*** These people are the most exposed and have the least means to adapt. Higher temperatures, increased variability of temperature and precipitation, and increased incidence of extreme weather events, will result in adverse consequences for agricultural productivity, water resources, human settlements, human health, and ecological systems. In the past decade, almost 300 million people per year in developing countries have been affected by climate-related disasters and each decade the rate increases by 80 million people per year, far outstripping population growth. Floods and droughts affect most people and both are projected to become more frequent under a changing climate. However, it is events such as crop failure from poor rains, late starts to monsoons, and extreme heat that lead to chronic losses and poverty traps.

93. ***Adaptation is a process of anticipating and responding to future climates that must be mainstreamed into development activities.*** The challenge is to increase the resilience of human and natural systems to current climate variability, which is a continuing impediment to development, while taking into account the projected directions of climate change. Many of the actions needed to adapt to future conditions are similar to usual development activities (e.g., comprehensive water management programs, changes in agricultural practices, coastal zone), but with modified options and priorities to take the changing climate into account. In some cases investment requirements will increase, such as the need for increased water storage capacity to account for greater variability in water supply, or for coastal protection against sea-level rise and storm surges.

94. ***Failure to adapt adequately is a major threat to development goals***. Partial estimates of the costs of impacts of a doubling of greenhouse gas concentrations (or about a 2.5°C temperature increase) without adequate adaptive efforts range from 0.5 to 2 percent loss of GDP per year with higher losses in most developing countries arising from lower agricultural production, water supply capacity, coastal damage, and climate-related ill health. Crop production in developing countries has been projected to fall by at least 5 to 10 percent for a 2 to 3°C temperature rise even after allowing for improved crop growth in an atmosphere richer in CO_2. Projections consistently show that, whatever the assumptions about climate scenarios and crop physiology, crop yields in developing countries will fall by about 10 percent relative to developed countries. Higher temperatures and more variable water supply are expected to make the control of human infectious diseases more difficult, especially in SSA. There will be benefits from climate change in some regions (e.g., reduced heating requirements in cold regions, better crop growth in temperate regions), but few of these gains will occur in developing countries. Inadequate response could threaten the attainment and maintenance of some MDGs and may lead to significant forced migrations both within nations and across borders, threatening security at the national, regional, and global levels (i.e., a failure to adapt constitutes a serious development and security risk).

95. ***The best paths towards adaptation are poorly understood at present.*** The extent and timing of climate change is poorly known and will depend on the extent to which mitigation actions are successful. The impacts of a changing climate are difficult to predict, especially as socio-economic circumstances are changing rapidly. Adaptation will be an iterative process and one that has to be targeted to regional and local circumstances.

96. ***The vast majority of investment exposed to climate risk is private and even though much of this is less climate sensitive (e.g., service sectors etc.), the increased costs due to climate change may amount to tens of billions of dollars per year.*** The private sector has a clear economic incentive to reduce these costs by carrying out cost-effective adaptive actions. However, the needs of the private sector must be included in the development of enabling frameworks for adaptation through the provision of information on risks, options, and access to insurance instruments. There is a high awareness of the threats and opportunities of climate change among the international and developed country private sector, but this awareness and skills need to be transferred to developing countries' private sectors.

97. ***Assessment of climate risks needs to become a regular part of the due diligence of development planning.*** For this to occur, awareness of the immediacy of the threats and need for action must be increased; appropriate information and tools for screening for climate risk must be readily available; and new standards for planning and infrastructure must be devised. In the longer term, as a greater understanding of specific actions is gained, a climate risk management approach will be needed at the project and country levels. This means better management of climate variability and its implications in all relevant sectors, including *inter alia:*

- *Infrastructure.* Planning processes need to incorporate exposure to extreme weather events and sea-level rise. The role of infrastructure for protection from storm surges, sea-level rise, and inland flooding in comparison to other adaptation options, such as land-use planning and buffer zones, needs to be considered. In particular, the effect of climate variability on water resources has implications for viability of hydropower and the role of irrigation schemes. The existing vulnerability to natural hazards and current upward trend in weather-related disasters underline the urgency of providing much improved capabilities for early warning systems.

- *Agriculture.* Agricultural practices will be affected by changes in the timing and amount of precipitation, evapo-transpiration, occurrence of extreme weather events, and incidence of pests. In light of growing world population and changing consumption patterns, challenges for adaptation strategies will be to identify and provide incentives for crops better adapted to the changing climatic conditions, improved water management, strengthened access to markets for rain-fed agriculture, and improved soil conservation and rehabilitation techniques.

- *Natural Resources.* While often undervalued economically, ecosystem services have to be recognized for their influence on the climate system, disease control, water quality, and as resource for human well-being. Improved land management (e.g., conservation tillage, construction of micro-catchments) will play an important role for dry-spell mitigation. Efforts to rehabilitate and protect watersheds will become even more crucial in many regions to secure downstream water supply and quality, or to protect from flooding and erosion.

- *Health.* Changes in temperature, precipitation, extreme weather events, and associated environmental effects will have consequences for human health. In particular, adaptation needs include strengthened efforts to monitor and combat vector-borne diseases.

98. ***Major changes in public and private investment strategies will be needed.*** The IFIs and other development agencies can support these changes by leading the development of:

- Comprehensive planning systems to account for current and future climate risks;

- Robust estimates of incremental costs, where they are incurred, and associated compensation schemes;

- Strategies for, and promotion of, insurance related instruments at all levels from rural poor to national catastrophe risk schemes;

- Enabling frameworks to facilitate adaptive actions by governments, communities and the private sector.

B. Financing Needs

99. ***Many countries are poorly adapted to current climate risks and the most effective initial adaptive actions should be directed to overcoming this "adaptation deficit".*** Thus, normal development support and incremental support for adapting to climate change are inextricably linked. Parties to the UNFCCC have agreed to assist developing countries to meet costs of adaptation and the adverse effects of climate change.[28] However, it is not possible to make an accurate direct calculation of the additional costs associated with adaptation. The level of adaptive effort will depend on the effectiveness of mitigation efforts and the consequent degree of climate change and associated impacts. The level of mitigation will be determined largely by the actions of the developed and the Plus-5 countries but the bulk of the effort on adaptation and the residual impact of climate change will be borne in developing countries. Climate risks can also not be readily apportioned to background variability and climate change.

100. ***There has not yet been enough experience in mainstreaming adaptation to precisely calculate the additional preparation costs and the proportion of new expenditures needed.*** Conservative estimates across a wide range of water, infrastructure, and agriculture suggest an increase of about 5 to 20 percent in climate sensitive investment. This includes additional project preparation costs to assess climate risks, costs associated with instigating new activities more appropriate to the changing climate, and some direct costs in modified infrastructure. Discussions over the estimation of the additionality in special adaptation funds managed by the GEF have suggested 20 percent as the minimum default value. The best estimate at this stage of the impact on investment of implementing good practice responses to climate change (sometimes called "climate proofing") suggests that this will increase to several billions of dollars per year across official development assistance (ODA) and concessional lending portfolios (i.e., about 20 to 40 percent of a US$100 billion per year ODA and concessional finance portfolio with an estimated incremental cost of about 5to 20 percent). Despite this challenge, at this stage only a small portion of World Bank projects (around 2 percent) analyze or even mention changing climate risk in project planning.

C. Financial Instruments

1. Existing Instruments

101. ***The primary current financial instruments to support adaptation have been the GEF and ODA.*** The GEF is the main instrument available today. Only a tiny portion (much less than 1 percent) of ODA and concessional lending is specifically directed to adaptation. An Adaptation Fund is a new source of financing.

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[28] UNFCCC Art 4.4 and 4.8].

102. ***GEF resources include two trust funds for adaptation supported by voluntary donations and a small window in the main GEF Trust Fund.*** The Least Developed Countries Fund (LDCF) has supported the preparation of the National Action Plans for Adaptation (NAPAs) and is moving to support implementation of the highest priority activities identified in the NAPAs. The Special Climate Change Fund (SCCF) addresses special needs of developing countries in long-term adaptation, with a priority given to water, agriculture, health, and vulnerable ecosystems (including mountain ecosystems). The SCCF supports the additional costs of adaptation determined by a simple formula based on the size of the project. Neither the LDCF nor the SCCF are required to demonstrate global environmental benefits, nor are they subject to the resource allocation framework of the main GEF trust fund. There are indications that these two funds may receive US$100 million to US$200 million per year in total donations.

103. ***The Adaptation Fund, resourced by a 2 percent tax on most CDM transactions is a new source of funding for adaptation distinct from ODA.*** Its resources are uncertain as it depends on the extent of use of the CDM and carbon prices, but financing is likely to total only US$100M to US$500M though to 2012. The priorities and management of the Adaptation Fund are still subject to negotiation.

104. ***An assessment of the current financial instruments shows that while they are technically adequate to respond to the challenge of achieving climate resilient development, the sums of money flowing through these instruments need to be substantially increased.*** The main financial instruments for financing adaptation through donor contributions to the GEF and from a tax on the CDM through the Adaptation Fund are currently projected to deliver only US$150 million to US$300 million per year compared with an estimated need of roughly 10 times this amount. Only the Adaptation Fund is demonstrably additional to existing donor funding and its sources of finance will need to be expanded through a wider tax or revenue base if it is to be a significant instrument of additional funding.

2 Development of Insurance Instruments

105. ***Climate variability imposes severe additional risks to the insurance industry that might slow the penetration of weather-related insurance into developing countries.*** Currently, few poor farmers in low-income countries have access to such insurance, which is accepted as a norm in farming operations in high-income regions. Access would allow farmers in low-income countries to mitigate the risk of catastrophic losses and thus take higher risks to achieve overall higher incomes. The provision of weather index insurance or weather derivatives is a cost-effective option that is being piloted and implemented in several countries. It is possible that such insurance could provide a disincentive for farmers to move away from agricultural practices that are becoming increasingly non-viable due to either climate or other reasons. Thus, assistance to facilitate such schemes should seek to promote those activities consistent with projected trends in climate and market conditions. The Bank should seek to promote sound underwriting standards, exposure control, and reserving techniques based not only on historical data, but on best practice models of changing exposure.

106. ***The cost of re-insurance to local financial institutions is an impediment to the expansion of insurance facilities in poor areas.*** The Bank Group has proposed the Global Index Insurance Facility (GIIF), with initial resources of US$100 million, to help cover this gap. GIIF would be a risk-taking entity to originate intermediate and underwrite weather, disaster, and commodity price risks in developing countries. The Bank Group is also exploring the use of insurance mechanisms to support governments immediately post-disaster. The Caribbean Catastrophe Risk Insurance Facility would allow CARICOM governments to purchase coverage akin to business interruption insurance that would provide them with immediate payment after a major hazard event. This would help them overcome the typical liquidity crunch that follows a disaster.

3. Moving Forward

107. ***There is significant scope to expand adaptation work with existing instruments and test innovative approaches.*** Activities in support of adaptation are expected to grow as clients begin to recognize its development relevance. Thus, gradually, these activities would be funded as part of country programs. However, for this recognition to emerge, catalytic resources on grant or highly concessional terms will be needed to:

- Expand the analytical work as basis for action at national and local levels;
- Enhance the scientific understanding and tools to assess the nature of climate risks to development projects (e.g., Climate Screening Tool);
- Build capacity of institutions and communities at risk to cope/adapt;
- Support innovations, including investments and piloting of risk management tools (e.g., weather insurance for farmers).

IV. ROLE OF THE WORLD BANK GROUP

A. Energy for Development and Access for the Poor

108. ***The objectives of the Investment Framework for Clean Energy and Development are consistent with the World Bank Group's energy sector strategy.*** However, as noted below, further strengthening its existing activities and expanding its investment and technical assistance will be needed to deliver on the Investment Framework (see Box 5). The Bank Group energy sector goals have been to improve access to modern and affordable energy services for the world's poor, provide energy for economic development, and achieve sustainability in the environmental, financial, and fiscal aspects of the energy sector. The Bank Group's energy strategy and its policy underpinnings have evolved in response to several key events and factors, including recognition of the role of energy in meeting the MDGs; addressing social, local, regional and global environmental concerns; greater demand for Bank assistance, partly as a consequence of rapid fall in private sector participation in energy in most developing countries; and increased relevance of renewable energy and energy efficiency in addressing energy security and environment concerns.

Box 5: Historical World Bank Group Energy Sector Performance

The total WBG commitments in the energy sector were US$58 billion from Fiscal 1990-2006. Bank Group energy sector commitments rose to about US$3 billion in FY05 and US$4.4 billion in FY06 compared to US$2.3 billion in FY99. Clean energy (renewable energy, efficiency and gas) commitments accounted for about 20 to 25 percent of total energy sector commitments. About US$1 billion was from GEF co-financing and carbon finance. From FY03 to FY05, about 17 percent of total energy sector commitments were for improving energy access. Bank lending for energy in Africa has risen to US$598 million in FY06 from US$326 million in FY03. Globally, IDA lending for energy rose to US$1 billion in FY06 compared to US$500 million in FY03. Among the G+5 countries, the majority of Bank energy sector support has been provided to China and India, accounting for 84 percent of the US$14.6 billion committed from 1990-2005, of which, 76 percent has been for power sector investments.

World Bank Group Energy Sector Commitments 1990-2006 (US$ million)

Energy Sector	*FY1990-2005*			*FY05*	*FY06* [c]	*FY90-06*	*Percent*
	IBRD/IDA [a]	*IFC* [a, b]	*MIGA*	*WBG*	*WBG*	*Total*	
Power	24,415	2,406	2,345	1,064	2,453	31,618	55%
Renewable Energy	5,346	961	514	685	387	7,208	12%
Energy Efficiency	2,075	312	5	250	428	2,820	5%
Coal	3,323	15	35	234	103	3,476	6%
Oil & Gas	6,895	2,266	707	462	893	10,760	19%
General energy sector	1,753	0	0	125	170	1,923	3%
Total	**43,807**	**5,960**	**3,606**	2,820	4,434	57,807	100%

[a/] Includes GEF cofinancing and Carbon Finance.
[b/] International Finance Corporation (IFC) FY05 renewable energy and energy efficiency data updated from IFC 2005 Sustainability Report.
[c/] FY06 estimates are preliminary.

The Bank's energy sector AAA serves an essential function in improving the policy environment, building capacity, increasing the sector's ability to attract financing. Nevertheless, the number of energy sector AAA products has steadily declined to 42 in FY06 after peaking in FY03 at 81.

109. ***Energy sector analytical and advisory assistance (AAA) will help create a strong foundation upon which a sustainable energy development program can be built.*** In the next two years, the Bank will expand its energy sector AAA, especially on energy access in SSA and South Asia and on clean energy in the G+5 countries. The latter will be extended to other middle-income countries in response to demand. The Bank will conduct a diagnostic to assess the priority needs with respect to energy access, low-carbon economy, and adaptation, and recommend a plan of action for strengthening the effectiveness of AAA, increasing demand for such services, and more effectively integrating energy sector support within PRSPs and CASs.

110. ***A strong Bank Group investment program and the ability to leverage its resources will be essential.*** The Bank's energy sector investments grew at 54 percent from FY04 to FY05, and at 57 percent from FY05 to FY06, to US$4.4 billion, demonstrating the effectiveness of its 2001 Energy Strategy and 2003 Infrastructure Action Plan. The International Finance Corporation's (IFC) aggressive expansion in energy sector lending from US$592 million in FY04 to US$669 million in FY05 and US$1,147 million in FY06 bodes well for continued support to private sector engagement in energy. Expanding energy lending beyond current levels will require overcoming several challenges, including overall sector, country, and borrower lending limits; the size of IDA envelopes, which could constrain energy sector lending in Africa; and ensuring

prudent lending practices given financial and risk management concerns. Among the options being considered for leveraging Bank financing is the increased use of guarantee instruments. MIGA is well capitalized and is ready to scale-up its energy sector guarantees. Policy-based lending that can support sector reforms could also encourage greater private sector flows to the energy sector.

111. ***Additional leverage will be pursued through joint and/or more flexible use of existing instruments.*** The Bank Group has had some success in combining and sequencing different financial instruments and in expanding the use of instruments in some countries that have seen marked reduction in private sector financial flows to the energy sector. These joint instruments include IDA/IFC financing of generation, blending of MIGA guarantees and IDA financing, and use of carbon credits as part of financing packages. To further enhance the attractiveness of Bank financial products and to leverage Bank Group financial resources, the Bank Group will consider greater use of risk mitigation instruments as a mean to leverage its own resources and, in particular, to mobilize private sector financing. As mentioned above, policy-based lending is also an option.

112. ***Investments for supporting energy access will focus on countries that have the majority of un-served communities and highest dependence on biomass for cooking and heating — SSA and South Asia.*** Principal investment assistance in SSA — where 550 million people are without electricity access and mainly dependent on biomass fuels — will be guided by the Africa Action Plan[29] and the Energy Action Plan proposed in this report.

113. ***The Bank will support the preparation and launching of the Africa Energy Access Plan*** in partnership with the African Development Bank and other members of the Africa Infrastructure Consortium.[30] As proposed in this Progress Report, the Energy Access Action Plan would be part of the program, and would include five tracks: (a) sustainable forest management, access to clean cooking, heating and lighting fuels; (b) scaled-up programs of electrification to the poor; (c) additional generation capacity to serve newly-connected households and enterprises, including through regional generation and transmission projects; (d) energy services for schools and health centers; and | (e) development of low-cost lighting package delivery models for non-electrified poor households. To accelerate implementation of the Action Plan, a program of Country Access Program assessments would be implemented so as to develop fully-costed access scale-up strategies and action plans that could lead to financial prospectus for sector syndication.

114. ***Support in South Asia where 700 million people are without electricity access and dependent on biomass fuels, is likely to be principally for India, where 600 million people lack access to electricity and are dependent of biomass fuels.*** The Bank will discuss with the Government of India areas for potential support, including the Rajiv Gandhi Rural

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[29] The Africa Region, "Meeting the Challenge of Africa's Development: A World Bank Group Action Plan", The World Bank, Washington DC, September 26, 2005

[30] The Africa Infrastructure Consortium is led by the Africa Union and New Partnership for Africa's Development (NEPAD) and includes the African Development Bank and the World Bank Group.

Electrification Program, which proposes extending electricity services to an additional 80 million households by 2012, encompassing the majority of people without access today.

B. Transition to a Low Carbon Economy

115. ***AAA for low-carbon energy will focus on developing programs in support of the low-carbon economy.*** The AAA services will initially focus on the G+5 countries, but can be extended to other countries based on demand. Discussions have been initiated with governments on potential support from the Bank on strengthening policy and institutional frameworks to support national climate change programs, improving the carbon efficiency of economic development, financial intermediation instruments, and other support needed to improve energy efficiency, develop national integrated capacity for long-term research and monitoring of climate change impacts, and prepare methodologies to integrate renewable energy generation into power systems. Support for training and capacity building for clean energy development is also under discussion.

116. ***Where there is demand, AAA could be blended with investment programs.*** Likely interventions include:

- *Brazil.* Discussions are ongoing on support for hydropower; improved efficiency of production, transmission, and use of natural gas; and energy efficiency improvements.

- *China.* The Bank is supporting the implementation of the Renewable Energy Law and China's commitment to increase the power sector share of renewable energy to 15 percent by 2020 from 7 percent in 2005. Investment support to sustainable urban transport program, urban energy infrastructure, thermal power rehabilitation, and coal mine methane and land-fill-gas capture are under discussion.

- *India.* Discussions are ongoing on support for renewable energy, including hydropower, coal-fired plant rehabilitation, grid network loss reduction, and industrial and commercial sector efficiency improvements.

- *Mexico.* Discussions are ongoing on support for large-scale investment in renewable energy, methane capture, introduction of climate friendly measures in transport, and transport corridor investments.

- *South Africa.* Discussions are ongoing on support for helping the country to implement its Energy Efficiency and Renewable Energy Strategy, including greenhouse gas reduction in large enterprises; energy efficient housing; renewable energy power generation, including large hydro; and natural gas projects in neighboring countries with sales to South Africa.

117. ***Depending on the guidance from the shareholders, in cooperation with other IFIs, the Bank will support the detailed design of the preferred new financial instrument alternatives.*** This could include the CEFV, the CESF and options under the

MIC strategy. MIGA Insurance for CER-based Project Finance will also be pursued. MIGA plans to use its insurance product to mitigate risks for investors in CER-based project finance.

118. ***Strengthening Partnerships.*** The Bank Group will further strengthen partnerships needed to support the energy for development and access, and clean energy agenda. These include the Bank's leadership, cooperation and engagement in the GEF, Carbon Finance Operations at the Bank and IFC, Africa Infrastructure Consortium, the Global Gas Flaring Reduction Partnership, ESMAP, and Carbon Finance-Assist Program.

119. ***The Bank will continue to strengthen its cooperation and partnership with GEF.*** The Bank is the largest implementing agency of the GEF. As such, the Bank will engage with the GEF about adopting policies for greater use of contingent grant and partial risk guarantee instruments, blending with carbon finance, and programmatic approaches that aggregate smaller investment and technical assistance interventions. The latter is particularly important for African and smaller nations, which will have small GEF allocations under the resource allocation framework.

120. ***New approaches for making carbon finance more effective in supporting clean energy for development will be explored.*** Among them are new tranches of the Umbrella Carbon Facility, use of auctions and establishment of country-wide sellers' funds, and blending carbon finance with Bank instruments, including GEF resources. The Bank will also explore expanding options for further engagement in the carbon market post 2012.

121. ***The Bank proposes to seek donor support to extend two energy partnerships:***

- ***The Global Gas Flaring Reduction Partnership (GGFR) for another five years to 2012.*** Presently, the Bank leads the GGFR with membership including the 10 major oil companies, the OPEC Secretariat, and 14 countries that contribute a significant share of the world's total flaring (about 70 percent). The majority of partners have endorsed a global standard for gas flaring reduction. GGFR was co-funded by donors with US$ 10 million in support from 2003-2006.

- ***ESMAP could be expanded to cover energy for development and clean energy initiatives more broadly and deeply.*** The current ESMAP business plan defines four areas of work: energy access, energy security (including energy efficiency), renewable energy, and market efficiency and governance. Donors will be asked to consider setting up the Clean Energy Project Development Facility as a pre-investment and project preparation facility to support such interventions. It is expected that the incremental funding needed for preparation of investments and for AAA will flow through ESMAP. The Bank will undertake a detailed proposal for a scaled-up ESMAP as the basis for donor consultations

122. ***The World Bank Institute, in cooperation with Carbon Finance Operations, will expand the Carbon Finance-Assist Program to offer a comprehensive technical***

assistance program, if additional resources are mobilized. The Carbon Finance-Assist Program plans to offer country and regional technical assistance programs for carbon finance project portfolio development and capacity building in 30 countries.

C. Adaptation

123. ***Current projections of finance for adaptation through the GEF adaptation funds and the UNFCCC Adaptation Fund are about US$1 billion to US$2 billion through to 2012.*** Although this falls well short of the estimated amounts needed to cover the incremental costs of climate change in ODA and concessional finance-related activities, it is essential that the Bank Group, along with other IFIs, play a leading role in ensuring that maximum impact is obtained from these funds by mainstreaming appropriate assessment and response to climate risk in the global development portfolio.

124. ***World Bank support on adaptation is nascent (approx. $50 million over about five years) and centers on awareness raising, capacity building, and international coordination.*** Using existing instruments (primarily analytical work, technical assistance, GEF grants, and limited lending), support to clients has focused on improving our understanding of current and future climate conditions, assessing the risks to development, and (in few cases) internalizing the risks into development planning and investments. Approximately US$30 million of the US$50 million (including US$12 million from GEF and other trust funds) has been committed to capacity building, planning, and project design, mostly within the Latin America and Caribbean region. The Bank's Sustainable Development Network, the Africa Region, and the World Bank Institute are initiating a program of activities to expand capacity, information, and resources available to Bank and host country clients to increase direct project support in other regions.

125. ***Country and regional analytical work will be expanded as a basis for action.*** Examples of ongoing work include:

- Climate forecasting for agricultural and livestock production in the Southern Africa Development Community (SADC) within the context of ongoing economic changes influencing vulnerability to both climate variability and change;

- A systematic diagnosis of climate risks and cost effective adaptation measures leading to integration of climate risk into national planning and local decision making in the low-lying Pacific Island nation of Kiribati;

- An assessment of policy interventions that would promote economically prudent farm-level adaptation to climate change in Andrah Pradesh, India;

- Preparation of programs to address expected increases in dengue and malaria incidence and effects on hydropower potential due to changes in high mountain ecosystems in Colombia.

126. ***Additional information and tools are being prepared to facilitate better assessments.*** Of note is a Climate Screening tool, which will encompass agriculture, irrigation, and components of biodiversity for several regions, expected to be ready by the end-FY07. The Bank will continue to develop weather risk management tools, such as weather insurance for farmers

127. ***International Dialogue on Adaptation.*** The Bank has facilitated (and served as Secretariat) for the VARG (Vulnerability and Adaptation Resource Group) that acts as an informal clearinghouse for information exchange, knowledge sharing, and coordination among IFIs, UN agencies, and bilateral agencies. Through VARG, cooperation with the International Strategy for Disaster Reduction (ISDR) System has been strengthened. Equally important is the WBG's participation the technical discussion of the UNFCC regarding adaptation.

D. Immediate Next Steps

128. As noted in the paper presented to the Development Committee during the April 2006 Spring Meetings, the "Investment Framework" work program will cover a two-year period. To maintain momentum, immediate next steps coming out of this Progress Report are to:

- Continue to work with IFIs to develop the Investment Framework. Box 6 provides a brief summary of relevant activities within the IFIs.

- Develop a consensus with donors and IFIs regarding the preferred Clean Energy Financing options to be considered, as a prelude to detailed design.

- Work closely with the G+5 countries to promote quick-win low-carbon projects, including scaled-up energy efficiency and power rehabilitation projects, and possibly pilot IGCC projects.

- Reach agreement with donors on a financing plan to support implementation of the Africa energy access scale-up program.

- Work with donors to secure additional funding for existing partnerships, such as ESMAP and GGFR, in support of analytical work and country capacity building.

- Continue with a strong outreach and communications program. The goal is to increase awareness on the issues raised in the document and facilitate an expanded dialogue and broad engagement among governments, the business community, civil society, and legislators, using existing multi-stakeholder platforms and partnerships. Upcoming activities include a roundtable debate during Annual Meetings in Singapore, participation in the Gleaneagles Dialogue follow-up Ministerial meeting which will take place in Mexico in October 2006, media launches and stakeholder events during the November UNFCCC meeting in Nairobi.

Box 6: IFI Contributions to the Clean Energy and Development Agenda

Energy for Development and Access to the Poor

The **African Development Bank** (AfDB), along with other members of the Africa Infrastructure Consortium and the World Bank, is assisting with the preparation of the Africa Energy Access Plan. The AfDB is also helping to promote regional electricity markets in Africa via investments in transmission infrastructure, to improve energy access. The **European Investment Bank** (EIB) is working in partnership with the EU through a new Trust Fund to promote sustainable energy solutions for Africa.

Mitigating Greenhouse Emissions through the Transition to a Low-Carbon Economy:

The **Asian Development Bank** (AsDB) recently issued a Draft Energy Efficiency Initiative Report (EEI) and an Energy Efficiency in the Transport Sector Report. The AsDB is also developing the Carbon Market Initiative to boost the viability of alternative clean energy projects in its developing member countries (DMCs). Under the EEI, an Investment and Action Plan will be developed in consultation with the DMCs, and will target US$1 billion annual lending for energy efficiency, through a proposed Asia Pacific Fund for Energy Efficiency. The **EIB** is applying a number of instruments designed to mitigate greenhouse gas emissions, including: a €1billion financing facility; technical assistance to encourage development of JI/CDM credits; and the promotion of two carbon funds with IBRD and EBRD. In 2005, the **Inter-American Development Bank** (IADB) adopted an Action Plan for Renewable Energy, Energy Efficiency, Greenhouse Gas Mitigation, and Carbon Finance and is now preparing a Sustainable Energy Initiative, which will expand its activities in energy, housing, transportation and industry. The **AfDB** has initiated the revision of its Energy Sector Policy which will now place greater emphasis on the financing of low carbon projects including renewable energy and energy efficiency projects, and is also developing its own Clean Energy Investment Framework to be submitted to its Board in the 4th quarter of 2006

The **European Bank for Reconstruction and Development** (EBRD) recently launched the Sustainable Energy Initiative (SEI). The EBRD proposes through the SEI to more than double its energy efficiency and cleaner energy investments to €1.5 billion over the next 3 years by: (a) accelerating the pace of direct investment in energy efficiency projects across industrial sectors with the objective to reduce carbon intensity; (b) expanding the development and implementation of energy efficiency and renewable energy financing facilities to small and medium sized enterprises and to the residential sector; (c) contributing to the large investment requirement to develop cleaner energy supply in power and the natural resources sectors; (d) promoting, supporting and investing in the development of renewable energy capacity in its region of operations; (e) investing to reduce municipal infrastructure emissions with a particular focus on district heating and urban transport; and (f) supporting the development of the carbon market in the countries of operations, in addition to establishing the Multilateral Carbon Credit Fund.

In its annual World Energy Outlook 2006, the **International Energy Agency** (IEA) will present an Alternative Policy Scenario (APS) to address energy security and environmental concerns. Developed in co-operation with the World Bank and other IFIs, the APS offers practical guidance to policy makers about the effectiveness and economic consequences of policy options. The IEA recently published "Energy Technology Perspectives", which shows how global CO_2 emissions could be brought back to around their present level by 2050 through accelerated deployment of cleaner energy technology that is either already available or under development. The IEA has a major work program to identify "best practice" policies for promoting lower carbon technologies in all the key areas that have been identified, including energy efficiency. This includes power plant performance, especially for coal plant, and CCS, as well as defining the concept of "CCS capable". The World Bank is co-operating closely with the IEA.

Adaptation to Climate Change:

- The **AfDB** plans to participate in the preparation of adaptation screening tools, led by the WB, including the preparation of proposals for a National Adaptation Program of Action. The AfDB is well placed to implement the NAPA in Africa. The **EIB** is beginning to screen projects for adaptation purposes, and is exploring the need for new financial and analytical approaches in this respect.

ANNEX 1. ENERGY ACCESS FOR THE POOR

Energy has an important role to play in both economic growth and poverty alleviation. Without access to modern and sustainable energy services, the poor are deprived of opportunities for economic development and improved living standards. However, readily identifiable financing sources only reach about $80 billion per annum, or about 50% of the funding needs of developing countries' electricity sector. Many development strategies including PRSPs omit analysis of the role of energy services in poverty reduction and growth and fail to define remedial actions to improve energy services to the poor. Only one third of PRSPs allocate budgetary resources to national energy priorities in mid-term expenditure frameworks.

The IEA's World Energy Outlook suggests that, with current policies roughly 1.4 billion people will not have access to electricity by 2030, marginally less than the current estimate of 1.6 billion. The access problem is most acute in Sub-Saharan Africa (SSA) and South Asia, with 553 million and 680 million people unserved. There are also large populations without access in the poorer countries of Asia and Latin America, as well as in the rural and peri-urban areas of middle income countries. Household access is expected to increase more rapidly in South Asia where there are large-scale electrification programs underway than in SSA.

Unless the low investment levels in the electricity sector of SSA are substantially increased, it will not be possible to achieve meaningful improvements in household electricity access. The annual rate of new connections in SSA (less than 1%) is not keeping pace with new household formation (1.9%). Additional electricity generation and transmission capacity will be required to serve newly connected households and other demands in SSA. Large regional hydro and thermal generation plants offer economies of scale that can reduce the current high cost of power supply in many of the countries of SSA.

WHO estimates that more than three billion people use wood, dung, coal and other traditional fuels inside their homes to meet cooking and heating needs and that the resulting indoor air pollution is responsible for 1.5 million deaths per year—mostly of children and mothers. Over half of all people relying on biomass live in India and China, but the proportion is heaviest in SSA. A large proportion of the rural poor in SSA and China are likely to continue relying on biomass. Therefore it is urgent to ensure that biomass is sustainably produced and efficiently used and that access among the poor to cleaner cooking fuels and technologies is increased.

Although energy is not explicitly mentioned in the Millennium Declaration, the MDGs cannot be met without higher quality and larger quantities of energy services than currently available. MDG goals in education and health will be difficult to achieve in countries where the majority of schools and health clinics lack electricity and fuel, negatively affecting sterilization, clean water supply, and refrigeration of essential medicines. Education of children is also impaired for lack of adequate illumination in poor households that rely on low quality lighting from candles or simple kerosene lamps.

For households and small businesses that do not have electricity service, provision of a stand-alone modern lighting package can meet their essential lighting needs. Households and businesses that do not have electricity usually rely on fuel-based lighting or flashlights that provide poor quality light and have high operating cost. Recent advances in stand alone lighting systems including light emitting diodes (LED), offer the possibility of providing modern stand alone lighting systems that the poor can afford.

The foregoing diagnosis calls for an Action Plan for Energy Access in SSA along five parallel tracks:

- Scaled-up programs of household electrification (with better integration of mini-grid and off-grid electricity options to complement grid-based approaches);
- Additional generation capacity (including regional projects) to serve newly connected households and demand from enterprises, public facilities and other users;
- Provision of energy services for key public facilities such as schools and clinics;
- Provision of stand-alone lighting packages for households without electricity service; and
- Access to clean cooking, heating and lighting fuels.

I. INTRODUCTION

1. ***This annex reviews the challenges of access to electricity, lighting and clean cooking and heating fuels for the poor.*** It also evaluates existing financial instruments, taking into account the role of the private sector and explores ways in which these financial instruments can be enhanced and leveraged. This annex reviews policies that have been shown to support rapid scaling-up of energy access to the poor. Sections 2, 3 and 4 present the challenge, financial aspects, and policies for tracks 1-4 of the Energy Access Action Plan (poor household electrification, increased support for generation, energy access to schools and clinics, lighting packages for unelectrified households). Section 5 reviews track 5 of the Action Plan (clean cooking, heating and lighting fuels). Section 6 presents a summary of regional strategies for scaling up energy access to the poor.

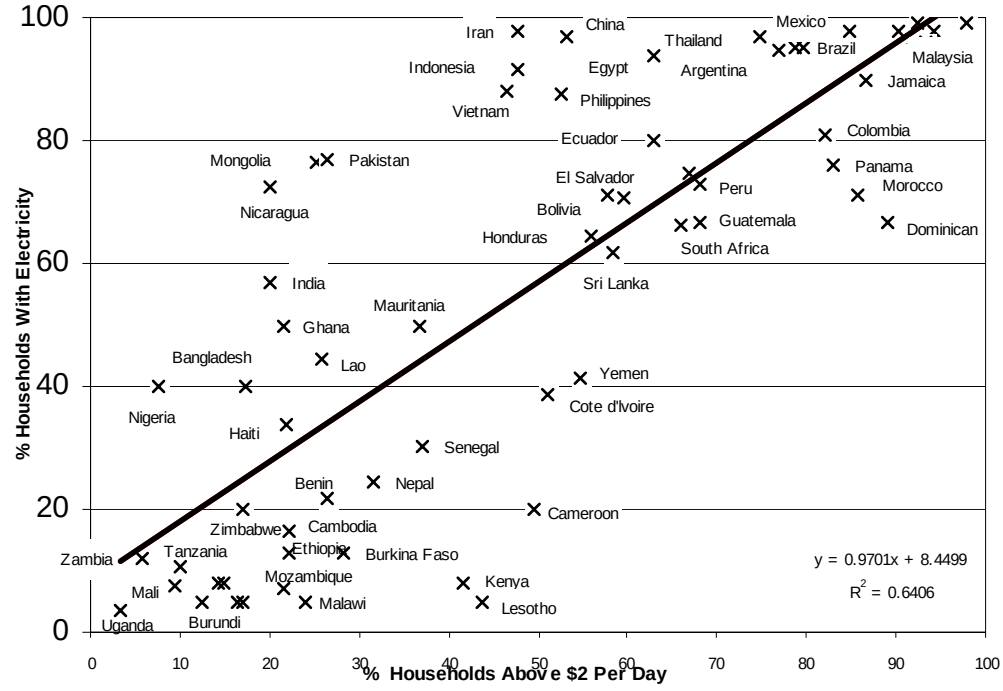
A. Access to Electricity and Lighting for the Poor

2. ***The Challenge.*** IEA's World Energy Outlook suggests that, with current policies roughly 1.4 billion people will not have access to electricity by 2030, marginally less than the current estimate of 1.6 billion. The access problem is most acute in sub-Saharan Africa (SSA) with 553 million people without access, and South Asia with 680 million, respectively.

3. ***The World Health Organization (WHO) estimates that more than three billion people use wood, dung, coal and other traditional fuels*** inside their homes to meet cooking and heating needs and that the resulting indoor air pollution is responsible for 1.5 million deaths per year—mostly of young children and mothers. Over half of all people relying on biomass live in India and China, but the proportion is largest in SSA. A large proportion of the rural poor in India, SSA, and other poor countries are likely to continue relying on biomass for some time. Therefore it is urgent to ensure that biomass is sustainably produced and efficiently used and that access among the poor to cleaner cooking fuels and technologies is increased. This is the focus of Section 5 of this Annex.

4. ***Levels of household electricity access generally mirror income levels.*** As indicated in Figure 1, there is a clear correlation between electrification and development. For countries with high levels of poverty (at left and bottom of the graph) there is remarkable variation in their electrification level. Many if not most of the African countries are well below the regression line, which means that their level of electrification is much lower than countries in other regions with similar levels of income.

Figure 1. Poverty rate and household electricity access



5. ***National averages mask urban-rural, intra-country, and intra-urban differences in household electricity access within countries***. In some Indian states, such as West Bengal and Assam, household-level electricity access is only 20% compared with almost universal access (95%) in the more affluent provinces of Goa and Himachal Pradesh. In Latin America some middle income countries have high levels of electrification but have large segments both in rural as well as peri-urban areas without access. Overall rural electrification is 73% of households in Brazil but varies from 90% in the south to 40% in the north. In Malawi, 35% of urban household are connected but only 2% of rural households. In Lao PDR the urban and rural rates are 44% and 20% respectively. Table 1 shows electricity access differences between cities and informal urban settlements, which have coverage levels of 10-50% lower than cities.

Table 1. Access to Electricity: Citywide and Informal Settlements
(percentage of households with connection)

	Asia and Pacific	*Sub-Saharan Africa*	*North African and Middle East*	*Latin America and Caribbean*	*Developing countries total*
Citywide	94.4	53.9	91.8	91.2	86.5
Informal urban settlements	75.7	20.3	35.9	84.7	59.1

Source: UN Habitat 2003 EAP Flagship study.

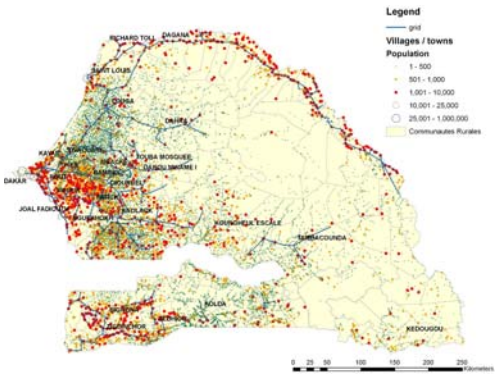
6. ***The challenges in scaling up electricity access are very different in urban and rural areas.*** Rural areas in low-income countries often lack any infrastructure for providing energy services whereas most urban areas have energy providers that already serve better-off populations. Fast population growth and rapid urbanization over the next three decades will intensify the challenge of providing electricity access in cities,

especially in SSA that cannot even serve existing populations. Population growth is projected to be particularly rapid in the urban areas of less developed regions, averaging 2.3% per year during 2000-2030 (ranging from 3.3% in SSA, where there will be 475 million urban dwellers in 2030 compared to 149 millions in 2000, to 2.8% in South Asia and 2.2% in East Asia).

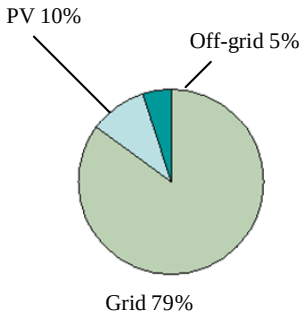
7. ***High capital costs are the chief disincentive to supplying grid electricity to rural areas.*** However, it is often the case that rural populations are much more nucleated than commonly assumed. In some countries spatial analysis reveals that rural households have a nucleated settlement pattern and that the spatial distribution of villages is such that *extension of the national grid would be the least-cost option of providing electricity access to the majority of the unelectrified population.* In the case of Senegal, the analysis showed that grid electrification was the least-cost option for close to 80% of the non-electrified rural population. However, the findings for Senegal cannot be generalized - for example due to the archipelago geography of the Philippines, individual off-grid systems or independent mini-grid solutions are expected to be the least-cost solution for about 30% of the non-electrified and underserved villages.

Figure 2

Population centers and current grid in Senegal (GIS layers)



Rural community access by technology



Source: Columbia University; Institute of Earth Studies

8. ***Recent Trends in Access to Electricity for the Poor.*** Countries that have managed rapid increases in access have done so at a rate of between 1% and 3% per annum above population growth. Tunisia's electrification program expanded access from 6% of the population in 1976 to 88% in 2001 (average 3.3% per annum). South Africa's program expanded access from 44% in 1995 to 66% in 2004 (average 2% per annum). Ghana's program expanded access from 28% in 1989 to 54% in 2004 (average 1.7% per annum).

9. ***In Latin America, East Asia and the Middle East, except for a few low-income countries, universal access is likely within a generation.*** Exceptions include Afghanistan, Myanmar, Cambodia, PNG, Nepal, and Timor Leste. Large scale expansion of household electricity access is underway in Asia, including India, the Philippines, Bangladesh and Sri Lanka. In 2005, India is reported to have connected 4 million households (2% increase). Rural electricity access in Vietnam is reported to have increased from 51% in 1996 to 88% in 2004 (over 4% per annum).

10. ***In SSA the number of people without electricity is either static or increasing because population growth is outstripping the pace at which households are being connected.*** For example, in both Uganda and Mozambique, the national utilities connect about 10,000 new households per year but population growth, at 2.9% and 2.2% per year, respectively, adds 140,000 households in Uganda and 90,000 more new households per year in Mozambique.

11. ***Electricity Service Quality Impacts Economic Growth and Poverty Alleviation.*** Insufficient, unreliable and costly energy services are a constraint to productivity and competitiveness. Large and small enterprises, including informal and home based, depend on adequate and affordable energy services if they are to be the engines of broad based growth that generates jobs and raises incomes. In many developing countries today this is not the case. The estimated percent of sales lost to power outages is about 6% in Nicaragua and Madagascar and 8% in India and Kenya. Many firms have their own generators (30% in Ethiopia, 70% in Kenya and almost 97% of large businesses in Nigeria) despite the fact that the cost of privately supplied power is two to three times as high as that from public grids.

12. ***Power shortfalls are a bottleneck to economic growth.*** In SSA where growth in recent years has been between 3.3 and 4.8%, the increase in electricity supply should be in the order of about 5% per annum (assuming an elasticity of about 1.1), or about 4 GW per annum, while current additions are less than 1 GW per annum. Just 32 GW of generation capacity is installed in SSA (not including South Africa) for a population of 680 million. Latin America with a population of 541 million has an installed capacity of nearly three times (200 GW). Similarly, in order to sustain India's current growth rate of about 8% per annum, about 10 GW of additional power capacity is needed. However new capacity is being installed there at less than 40% of this rate. Recent droughts in SSA are exacerbating the power shortfall. Uganda, Burundi and Rwanda all resorted to load shedding between 2002 and 2005, a period which coincided with severe drought in the region.

13. ***Additional electricity generation capacity will be required to serve newly connected households and other demands in SSA.*** A large proportion of the electricity generation capacity additions that are required in SSA over the next decade to support access and economic growth can best be met through development of projects that serve regional needs (about 20 GW). Large regional hydro and thermal generation plants offer economies of scale that can reduce the current high cost of power supply to distribution utilities in many of the countries of SSA. These generation projects will require associated investments in regional transmission interconnections.

14. ***The cost of producing power in some countries is high due to suboptimal system planning, low operating efficiencies and reliance on high-cost small generating units when regional sources could provide power at lower cost.*** For example the cost of oil based power in some countries in SSA is in the range of 25-30 US cents per kWh reflecting high transportation costs for oil shipments from distant supply points.

15. ***Electricity and Illumination for MDGs.*** In countries with low energy access rates, education and health issues cannot be adequately provided because schools and health clinics lack electricity and fuel. Sterilization of equipment, clean water supply, and refrigeration of essential medicines are impaired in health facilities without adequate electricity. Lack of electricity is a disincentive for teachers, doctors and nurses to reside in those areas further undermining the delivery of these services. For example, in Kenya only about 5% of dispensaries have access to electricity, 50% of the health centers are connected to electrical supply, and 20% have stand-by generators.

16. ***Many poor households in developing countries do not have modern lighting that would facilitate reading, studying and safety after dark.*** Education of children is impaired for lack of adequate illumination in poor households that rely on candles or simple kerosene lamps. In SSA, poor households rely on candles or simple kerosene lamps for lighting that provide low quality lighting for high operating cost and are unsafe in the confined interiors of African homes, despite the fact that they cost less than other alternatives (see Table 2). Emerging technologies such as light emitting diodes (LED) that have low operating costs could offer a viable alternative if they can be retailed at affordable prices. For this to occur the business model will need to rely on existing consumer product distribution systems and will have to achieve large volume sales underpinned by consumer credit mechanisms.

Table 2. Comparison of small single-purpose lighting options preferred by poor households and street traders

Lighting technology	*Useful illumination at work surface (lux)*	*Initial cost ($US)*	*Annual operating cost ($US)*
Candle	1.1	0.1	58.4
Simple wick, kerosene lamp	1.1	1	8.92
0.74 W flashlight (2 batteries)	2.4	5	209.27
5 W fluorescent solar lantern	30	75	2
Pressurized, kerosene lamp	182	10	56.53
White light emitting diode, solar rechargeable battery 1 watt	320	25	4.38

Source: Jones Right Light 2005 Key Determinant; alternatives to fuel based lighting in rural China Jones et al 2003.

17. ***The foregoing diagnosis calls for an Action Plan for Energy Access with special focus in Sub-Saharan Africa along five parallel tracks:*** (a) scaled up programs of household electrification (with better integration of mini-grid and off-grid electricity options to complement grid-based approaches); (b) additional generation capacity with associated transmission (including through regional projects) to serve newly connected households and demand from enterprises, public facilities and other users; (c) provision of energy services for key public facilities such as schools and clinics; (d) provision of stand-alone lighting packages for households without electricity service; and (e) access to clean cooking, heating and lighting fuels (through sustainable forest management, fuel switching, and diffusion of improved charcoal, briquetting, and clean cooking technologies).

B. Financing Needs and Instruments for Electricity and Lighting Access:

18. This section reviews the financing needs of tracks 1-4 of the proposed Energy Access Action Plan.

19. ***Investment Needs for Electricity Access.*** Near-term power sector investment requirements for developing country are estimated to be about $165 billion per year (including about $35 billion for electricity access for the poor). A bottom-up approach to estimate the investment needs on a country by country basis in a way that optimizes the balance between grid and decentralized solutions would be a data intensive exercise. Such an exercise would take years to complete given the scarcity of data. The proportion of the population for whom each technology option is the least-cost varies considerably by country. Country factors such as population density and spatial distribution as well as topographical characteristics and availability of energy resources will determine the relative proportions of grid and off-grid solutions that are least cost.

20. ***In order to estimate the investment levels necessary to reach increased levels of individual household access a simple model was constructed for this paper that took account of country characteristics.*** The unit costs of connecting new households in countries that currently have low levels of access are assumed to be less than for countries where current access rates are high. Grid electrification costs vary between $200 per connection in countries where reticulation is in place and $1,500 per connection in countries where the population remaining to be electrified live in remote communities. The unit cost of mini-grid and off-grid options is in the range of $800 - $1,200 per household connection.[1] Additional generation capacity at system peak will be required to serve newly connected households. Demand of newly connected urban and rural households is usually in the range of 0.7kW to 0.3kW.

21. ***In order to reach 100% electricity access by 2030 in developing countries,[2] approximately 600 million additional households would need to be connected, requiring an investment of about $35 billion per annum[3] (out of the $165 billion for overall electricity supply investment needs).*** Table 3 presents a regional breakdown of the model's results.

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1 Experience provides approximate unit cost of $500 per household connection until 35% of the households are electrified, $800 between 35% and 50%, $1,000 between 50% and 75% and $1,500 thereafter. The average investment cost of rural electrification projects financed under FNDR and FNDR-ER in Chile where 86% of the rural population was electrified in 2004 is around US$1,500 per connection. In India where 44% of the rural population is electrified it is in the range $115 - $230 per connection reflecting the high rate of village electrification (88% in 2002). In Sri Lanka where the overall electrification rate is 75% it is $1,200 per connection.

2 Excluding Eastern Europe and Central Asia

3 The IEA has estimated that additional investment of $665 billion is needed to reach 100% access by 2030 (or by $20 billion per annum). This is the investment above the funding requirements for IEA's reference scenario where electrification reaches 78% of the population by 2030. The estimates provided here are consistent with the IEA's. However, this paper makes all calculations based on the current electrification access rates, and calculates the investment requirements needed to provide electricity access to all households under the hypothetical 100% access scenario.

Table 3. Investment requirements for 100% electricity access in all regions by 2030

	Year	Population[1]	Electrification rate[2]	Number of households with electricity acces in 2004	Additional households that would receive electricity service under 100% access scenario by 2030	Investment 2005-2030			
						Distribution	Generation &Transmis.	Total	Per Annum
		[millions]	[percent]		Millions	[billions USD]	[billions USD]	[billions USD]	[billions USD]
sub-Saharan Africa	2005	725.6	23.6	34					
	2030	1,179.2	100.0		200	193	87	280	11
Middle East and North Africa	2005	338.2	91.1	59					
	2030	525.5	100.0		40	58	20	78	3
South Asia excl. India	2005	361.2	48.9	31					
	2030	604.3	100.0		75	83	31	113	5
India	2005	1,096.9	55.2	112					
	2030	1,312.2	100.0		130	71	60	131	5
South Asia	2005	1,458.1	53.7	143					
	2030	1,916.5	100.0		205	154	90	244	10
East Asia and Pacific	2005	1,893.0	89.6	341					
	2030	2,193.8	100.0		100	122	47	169	7
Latin America & the Caribbean	2005	533.1	88.9	105					
	2030	691.7	100.0		50	60	26	86	3
Total	**2005**	**4,948**							
	2030	**6,507**		**682**	**595**	**587**	**271**	**858**	**34**

Notes/ Assumptions

[1] Assumes that household electricity access increases to 100% by 2030 in all regions. In some countries in sub saharan Africa and South Asia where large scale grid roll out is feasible the increase may be greater (between 2% and 3% per annum).

[1] Assumes that 75% of all households that would be connected through 2030 would be through grid connections. Assumes that the LV distribution unit costs are $500 per household until 35% of households are connected, $800 between 35% and 50%, $1,000 between 50% and 75% and $1,500 thereafter.

[2] Assumes that 25% of all households that would be connected through 2030 would be by means of off-grid at an average unit cost of $800 per household

[4] Additional capacity at system peak required per HH connected (kW) = Consumer Max. Load (kW) * Coincident category (HH) load factor) / System Losses factor. Assumes Capacity Max. Load of 0.7kW and 0.3 kW for urban and rural households respectively; coincident load factor of 0.7; and losses factor of 0.85. Of households that will be electrified the number that will be urban and rural is assumed to be the same proportion as the urban/rural partition in 2020 according to UN projections. Assumes $1.5 billion per GW for G&T costs.

22. ***In order to achieve 100% electricity access in SSA by 2030, the level of access would have to increase by more than 3.5% per annum to connect 200 million additional households***. This requires not only an investment of $11 billion per annum (out of the total global estimate of $35 billion per annum), but also an enormous implementation capacity and a robust enabling environment. Increases of this magnitude are not likely to materialize in poor SSA countries where current rural electricity access rates are often less than 10%, due to lack of absorptive capacity, lack of sector reform, weak enabling environment, minimum implementation capacity, and little funding availability. As part of the preparation of this paper, a variety of scenarios were analyzed to evaluate stretched but achievable paths for progress on electrification access in SSA based on current and projected conditions and lessons from successful scaled-up programs. An achievable stretched path for progress in electricity access in SSA would go from the current level of 24% to 35% by 2015 and to 47% by 2030 (or about 76 million additional households). Such a scenario would require investments in the order of $4 billion per annum (twice the current level of funding for electricity in SSA of $2 billion per annum).

23. ***Financing Electricity Access.*** Electrification programs in middle income countries are often based on an approach that recognizes that the poor are likely to be excluded from accessing modern energy services if such services can only be provided on the basis of full-cost recovery. Where a range of financing mechanisms are used—combining some public-sector financing (equity, debt, or subsidies), private-sector financing (equity, debt, self-financing from revenues), and community and users' contribution—the rate of penetration of service increases and is viable.

Box 1- Brazil Example of Middle Income Approach to Financing Rural Electrification.

Providing electricity to Brazil's rural users will require an investment of about US$2 to 3 billion (depending on the success of cost reduction strategies and on policy decisions regarding rural service quality). As most remaining users cannot afford to pay the full cost of service through tariffs (typical willingness to pay for electricity in the remaining rural areas is under US$5 per month), investments cannot be recovered directly through tariffs, and need to be subsidized.

In November 2003, the "Electricity for All" Program $2.5 billion program was launched. The Program is to be funded at 72% by Federal Government, 14% by State and Municipal Governments and 14% by the utilities. Around 57% (U$1.43 billion) of the federal funding is non refundable. Law 10.438, approved in 2002, was a key step in shaping the legal framework for future electrification efforts in Brazil. This law obliges concessionaires and permissionaires to provide "universal electricity service coverage," without financial contribution by the new consumers toward initial investments (which are to be fully recovered through tariffs).

24. ***In low-income countries—countries such as those in SSA, Central America and South and East Asia where electricity access is low—power sector investments are funded much differently from middle-income countries, due to country risk factors, and financial constraints and credit-worthiness issues.*** In many low income countries, internal cash generation as a source of investment funds is very limited because of low tariff levels and poor collection that result in utilities not covering even their O&M costs, much less generating profits that would allow them to invest in expansion of their networks. IFIs, ECAs and bilateral donors play an important role in financing new investments in these countries. Government support in the form of grants, equity contributions and debt also play an important role in some of these countries depending on the Government's fiscal circumstances. Private sources of funds (both debt and equity) are very limited in these circumstances. In SSA private participation has been extremely limited.

Box 2- Ghana's National Electrification Program

The bulk of resources for the ongoing NEP has come from a wide range of donors, including the World Bank, the European Commission, DANIDA, the Dutch Government (ORET), the Indian Exim Bank, JICA, NDF, SIDA, FINNIDA, the South African Government and many other funding agencies. The assistance include grants, soft/concessionary loans for the NEP, and soft/concessionary loans for the Self-Help Electrification Program (SHEP). As part of the NES, a National Electrification Fund (NEF) was established in 1989. The NEF is managed directly by the Ministry of Energy (MoE) and levies charged on electricity consumption by all classes of consumers serve as the main source of funds for the NEF. The NEF is a complementary financing mechanism to the concessional funds received from donors for the implementation of the national electrification program. Ghana's Self-Help Electrification Program (SHEP) enables communities within 20 km reach of a 33kV or 11kV electrical network, to qualify for electrification earlier if they contribute by providing the low voltage poles required for the electricity network within the community, and the labor for erecting the poles.

Box 3 - The Role of Subsidies in Electricity Access Programs for the Poor

Worldwide, all rural electrification programs have involved some form of subsidy. Subsidy schemes for rural electrification are more sustainable when applied to the capital investment rather than to the on-going operating and maintenance costs. Subsidies should be easy to administer (efficient), have an impact on the desired population (effective), and reach the poorest of society (equitable). Economic policy considerations include ensuring that the sector policy framework is robust; when subsidies are needed, ensuring that they are transparent, targeted, focused on the demand side, and with a defined time frame and specific results expected. Accountability systems that include beneficiary oversight of the utilization of resources are also important.

Subsidies should be transparent, linked to results, and provide strong cost-minimization incentives. Three points to highlight are:

- *Cross-subsidy mechanisms:* For network-type infrastructure, stable long term fund sources are important to construct entire new networks. If economic and financial aspects are assessed on a per-project basis, projects located in areas where demand is relatively small will have a low priority. The internal cross-subsidy mechanism shifts financial benefits from very profitable projects to less profitable ones.
- *Subsidy schemes should be technology neutral:* It is common to find that grid electrification is subsidized while there is no subsidy scheme for off-grid options. Subsidies should set a level playing field for multiple provision options and multiple service providers.
- *Rural Electrification Funds:* In a number of countries, subsidies for rural electrification are managed and implemented through Rural Electrification Funds which provide partial capital subsidies for new electricity connections using funds from government, multi-lateral and bilateral donors, levies on electricity bills, and in some cases the proceeds of utility privatization.
- *Output based aid approaches* have been successfully applied to design subsidy schemes and disbursement schedules for rural electrification projects. In this approach the basic service provision is contracted to a third party (private companies, NGO, community-based organizations) with an explicit performance-based subsidy payment tied to the delivery of previously specified outputs (e.g., per network connection).

25. ***Financing Electricity Access of Public Facilities for MDGs and Household Lighting.*** Electrification of public facilities such as schools and clinics through grid- and off-grid solutions with donor support can be implemented through a focused campaign approach that would see the retrofitting of the majority of facilities in 5-7 year programs. Participation of all key stakeholders, including the private sector, would be needed for these programs to succeed. For example, the capital cost to provide grid electricity (or cost-effective off-grid solutions) to schools, clinics and community centers for rural Kenya has been estimated to be in the order of $350 million. In these calculations, it is important to note that the annual cost for power generation expenditures to serve these facilities is about $32 million. Similar country-level studies that combine education, health and energy access information are needed to determine the overall funding envelope required.

26. ***The delivery of LED lighting systems to households and small businesses that do not have electricity service should be based on programs that rely on private sector led market development as well as on consumer credit mechanisms that are geared to low income households.*** Large sales volumes would provide the economies of scale to reduce costs.

27. ***A Review of Funding Instruments***. As part of the preparation for this report, PricewaterhouseCoopers (PWC) was commissioned by the World Bank to undertake an assessment of existing IFI lending and risk mitigation instruments including those related to initiatives to scale up electricity access. The review of financing instruments commissioned for this paper indicates that the existing instruments are adequate to support energy access programs. However, substantial increases in grant and concessional funding will be required to achieve significant increases in energy access in low income countries—countries such as those SSA, Central America and South and East Asia where electricity access is low. Current IFI funding for the power sector in SSA ($2 billion per annum) is less than half the financing needs (approximately $4 billion per annum needed to achieve 35 % electricity access by 2015 and 47 % by 2030— the energy access expansion path described above.) Though IDA credits for energy in SSA have increased from $176 million in FY00 to nearly $600 million in FY06, further expansion under the IDA-14 envelope is not possible in view of the need in other sectors. Additional support for energy investments through mobilization of additional resources, including through IDA-15, is needed to scale up energy access in SSA. The World Bank will join efforts of the African Development Bank and the Africa Infrastructure Consortium to address this issue.

28. ***Decreasing the investment gap further requires attention to continued reforms.*** A key conclusion of the study is that IFIs can play a pivotal role in scaling energy access in SSA countries by helping develop policies, capabilities and promulgate cohesive financing to initiate and accelerate sustainable energy projects and attract private capital required. Further elaboration of the policy and sector reforms needed to scale up energy access are presented in Section C below.

29. ***Expanded energy access programs in SSA need increased harmonization in the application of IFI instruments.*** The enormous challenge of energy access in SSA and other low-income countries with very low access rates requires, in some instances, an evolution of the way in which existing instruments are applied, particularly in: (i) programmatic support and regional projects; (ii) support to the private sector (especially domestic) for the provision of energy services (including cookstoves and lighting); and (iii) enhanced analytical support for policy reform and program preparation. Specifically:

- ***IFI and bilateral support for electricity access needs to change from individual projects to coordinated investment programs.*** Most donor financing for electricity access is channeled to governments on a project by project basis. Multiple projects do not favor the development of a coherent national energy sector policy and lead to fragmentation, duplication of efforts, unbalanced sectoral development (at geographical and sub-sectoral level), and high transactions costs. There is a clear imperative that donor support for energy access programs move to a more coordinated country led approach that would be funded through sector-wide financing syndications of investment programs. This approach would entail the use of pooled funding that would be pledged to a long term (15 year) expenditure program and would embrace multiple activities in electrification (grid, off-grid, stand alone lighting). Large regional generation and transmission projects that are more suitable to a

project approach would be harmonized with such a sector wide approach for energy access. Regional projects require innovative and coordinated support among IFIs, bilaterals and the private sector given the very large capital needs.

- ***Private sector participation—(investment, management, etc.) will be necessary to complement public electrification programs.*** In most countries private sector debt and equity investment leveraged by guarantee instruments of IFIs will be critical to developing large generation projects needed. In countries with already high rates of access, reaching the remaining non-electrified households in rural areas will often be through off grid supply options where ownership is private or nongovernmental. These projects require specialized financing facilities as they are very capital intensive (with small O&M costs), and have front-loaded cash flows and risk profiles that require long-ranging financing and contractual arrangements (i.e. long-term PPAs). Finally, the delivery of lighting systems to households and small businesses that do not have electricity service should be based on programs that rely on private sector led market development as well as on consumer credit mechanisms that are geared to low income households.

- Meeting the challenges of energy for development and access to the poor requires enhanced analytical support for policy reform and program preparation. A dedicated window for energy access to the poor has been established within the existing Energy Sector Management Assistance Program (ESMAP). With the mobilization of additional resources, this ESMAP window could provide governments with an enhanced program of analytical support, country assessments, and program development in each of the five tracks identified—from household energy access programs to regional generation projects, clean cooking and lighting fuels, energy for MDGs, and basic illumination for households.

C. Policies that Support Scaling-up Electricity and Lighting Access

30. This section discusses policies that have shown to be effective in the scaling-up of energy access programs along tracks 1-4 of the proposed Energy Access Action Plan (poor household electrification, generation, energy access to schools and clinics, lighting packages for unelectrified households).

31. ***Financing of energy needs of rapidly growing countries is feasible where there is political will to undertake sector reforms that support good governance, the rule of law and effective pricing.*** The existence of appropriate structural and regulatory policy frameworks and commitments is the most effective mechanism to scale-up financing for energy access. For example:

32. ***Country-owned policies to support Poverty Reduction***

- Energy access programs need to focus on poverty reduction and be implemented in ways that do not discriminate against the poor. This approach

requires good regulatory policies that protect the poor, promote access to electricity and other forms of modern energies to the poor, and include subsidy mechanisms that target the poor.

- Delivery arrangements for electricity access should be evaluated and optimized to the needs of consumers so that they maximize contributions to poverty reduction and livelihood improvement. The experience of many countries indicates that local incomes may not increase quickly after electrification, particularly in rural areas, because there are other barriers that need to be addressed.

- Demonstrable country ownership and effective working partnerships are crucial to realize the level of energy access scale up envisioned. Partnerships of country governments, regional organizations, donors (bilateral, multilateral and regional banks) and global entities will be key to building ownership and ensuring sustainability. It is critical that all stakeholders be engaged in country strategy formulation and that poverty reduction strategies are fully participatory.

33. ***Governance and Transparency***

- Good governance and transparency at the state level and at the corporate level are the keys to the reform efforts to make the sector financially sound and attract foreign and domestic investors to meet the investment needs. Good governance, strong regulatory practices, the introduction of competition, and an appropriate enabling environment to support public-private partnerships and public and private investment are also important. Political interference in their operations undermines the commercial performance of the publicly owned electricity utilities in SSA and South Asia.

- The private sector has an important role to play in closing the investment gap in many countries, but the involvement of the private sector makes far greater demands on the quality and sophistication of governance. The enhancement of the capacity of the governments in this regard should be the focus of IFIs.

34. ***Financial Viability***

- Internal generation of sufficient cash, after meeting all operational expenses and debt service, adequate to meet at least the equity requirements of the system expansion projects is required. Utilities which manage to achieve such a target generally manage to meet the remaining needs as debt, or through the purchase of services from private suppliers, and manage to keep the demand and supply in balance.

- Tariff levels need to be set at cost recovery levels. At the same time, effective tariff policies need to include the design of subsidy mechanisms that target the poor. Subsidies should be transparent, linked to delivery results to the poor,

and provide strong cost-minimization incentives. Subsidy schemes should also be technology neutral to avoid biases against off-grid solutions or non-state providers.

- Optimal generation planning, electricity trade across the countries and joint investments can significantly reduce the volume of incremental investment needs. Such investments have the three-fold effect of: moderating upward pressure on energy prices; improving energy security through greater diversity in supply options; and decreasing the negative environmental impact associated with energy supply.

- Very high and inflexible technical standards lead to high costs and can be a barrier to serve the poor.

- In remote or inaccessible areas where grid supplies are impractical for cost, technical, or institutional reasons, off-grid solutions are proving to be increasingly competitive on cost and service quality criteria. Among recent off-grid electricity programs, most of the successful ones have involved a fund for providing loans and subsidies to rural communities, private entrepreneurs or non-governmental organizations that develop a viable business plan for providing rural electricity service

35. ***Policies to Ease Barriers to Electricity Access for the Poor***

- Energy supply in isolated locations is often financially nonviable because of low and dispersed demand, and the high costs of either grid extension or small-scale local power generation. Servicing the rural poor requires innovative and proven approaches such as:

- Easing first-cost problems: with first cost-connection to grid electricity ranging up to $1,000 per household and solar home systems ranging from $500 to $1,000 per unit, high costs are a major reason for low connection rates. Financing and credit mechanisms that allow the initial costs to be spread over time are needed to bring these up-front costs within reach of the poor.

- Increasing access to efficient stoves for both biomass and modern fuels: Improved stoves that burn traditional fuels more efficiently, give off less smoke, and vent smoke outside the home are important means for reducing indoor air pollution and its harmful health effects on the poor, and reducing the cost of cooking.

36. ***Regulation and Institutions***

- Improved Regulatory Systems to Support Electrification: Four general principles are recommended to create regulatory systems that will “help” rather than “hurt” electrification: (i) adopt light-handed and simplified regulation; (ii) enable the national or regional regulator to “contract out” or

delegate, either temporarily or permanently, regulatory tasks to other government or non-government entities; (iii) allow the regulator to vary the nature of its regulation depending on the entity that is being regulated and the technology that is used by that entity; and (iv) promote realistic, affordable, monitorable and enforceable quality of service standards.

- Institutional Arrangements for Implementation of Energy Access Scale-up Programs: Experience from countries that have successfully and rapidly scaled up electricity access points to the need for an inter-ministerial and/or interdisciplinary mechanism supported by a dedicated agency that can tackle the local nature of many challenges for delivering electricity services.

- Adapting the institutional model to the local conditions: A review of ten successful rural electrification programs in diverse countries showed that success does not necessarily depend on the nature and form of the dedicated institutional arrangement. In successful countries these arrangements have varied from rural electric cooperatives (Bangladesh, Costa Rica, Philippines), public companies (Mexico, Thailand, Tunisia), private distributors (Chile), and decentralized power companies (China). The cases reveal that success relies more on adhering to strict business principles in distribution company operations than on the specific institutional mechanisms used.

37. ***Mainstream Energy Issues into PRSPs and Poverty Issues into Comprehensive Energy Plans***

- Many PRSPs development strategies treat energy only within the context of large-scale infrastructure projects. They also tend to focus only on electricity while ignoring issues such as fuel availability and energy access which are of greatest importance to the poor. Less than half of all PRSPs in Sub-Saharan Africa, for example, include explicit targets and timelines to meet the energy priorities of the poor. Only one third of the PRSPs actually allocate budgetary resources to national energy priorities in their Mid-Term Expenditure Framework (MTEF).

- The country energy plans, either at the sector or sub-sector level, rarely have a special focus on poverty reduction, even when they are well integrated with national development objectives. Enhanced coordination of energy development programs with social and economic development programs is needed to ensure that the poor benefit fully from greater access to energy services.

38. ***Knowledge for Reform***

- The IFIs should facilitate a knowledge sharing environment with a goal of fostering accelerated reforms. Building on lessons learned from successful countries, key criteria for success should be established and published in the public domain. A scorecard of country performance, drawing on these lessons

learned could facilitate investment and help guide the use of risk mitigation instruments.

39. ***Strengthen Implementation Support***

- The World Bank and IFIs should continuously strive to facilitate effective implementation of projects and programs, including through the streamlining and harmonization of procedures, adequate project preparation and supervision budget, enhanced quality control processes, and expanded in-country capacity building for project and program design and implementation.

D. Access to Clean Cooking, Heating and Lighting Fuels.

40. ***This section reviews the issue of access to clean cooking, heating and lighting fuels,*** which is the focus of track 5 of the Energy Access Action Plan, including an analysis of the challenge, financial needs and policies to support scaling up access. More than 2.4 billion people depend on solid fuels, including biomass (wood, dung and agricultural residues) and coal, to meet their most basic energy needs: cooking, boiling water and heating their homes. The indoor air pollution caused by the use of biomass in inefficient cook stoves is responsible for 1.5 million deaths per year—mostly of young children and mothers.

41. ***The Challenge***. Over half of all people relying on biomass for cooking and heating live in India and China, but the proportion of the population depending on biomass is heaviest in sub-Saharan Africa. About 80% of the overall African population relies primarily on biomass to meet its residential needs. In Kenya, Tanzania, Mozambique and Zambia, nearly all rural households use wood for cooking, and over 90% of urban households use charcoal. In Indonesia, nearly all rural households use wood for cooking. In East Asia, the heaviest biomass use occurs in the Philippines, Thailand, Myanmar and Vietnam. Poor people in many Central American countries, especially Guatemala, Honduras, Nicaragua and Haiti, rely on wood for cooking and heating.

42. ***The IEA World Energy Outlook projects that the share of the world population relying on biomass for cooking and heating is projected to decline through 2030 but the total number of people will rise***, mainly due to increases in the number of people relying on biomass in South Asia and Sub-Saharan Africa. Over 2.6 billion people in developing countries will continue to rely on biomass for cooking and heating in 2030. That is an increase of 238 million people. In China and Indonesia, the number of people using traditional biomass for cooking and heating will decline. A large proportion of the rural poor in India, SSA and other poor countries are likely to continue relying on biomass for some time. It is not the fact that the number of people relying on biomass will remain high that is a cause for concern. It is the way in which biomass is produced and used which links biomass use to environmental degradation and to adverse impacts on health, especially the health of women. There is growing urgency to ensure that biomass is produced sustainably and used efficiently, and that in parallel, access among the poor to cleaner cooking fuels and technologies is increased.

43. ***Kerosene is commonly used for lighting, cooking, and heating in developing countries.*** Kerosene can be sold in very small amounts, which makes it particularly attractive to low-income households who cannot afford more lumpy expenditures. As cooking with kerosene is expensive for the poor, in many countries it has been subsidized. However, given kerosene's ability to be used as a substitute for diesel, diversion of low-price kerosene is widespread in countries with large price differences between the two fuels. For example, In India, a study found that as much as 50% of the subsidized kerosene was diverted.

44. ***Financing Needs and Policies to Support Scaling Up Access to Clean Cooking, Heating and Lighting Fuels.*** Financing support for access to clean cooking, heating and lighting fuels includes both scaling-up supply-side activities (sustainable woodfuel supply management investments) and demand-side programs (improved cookstoves and interfuel substitution).

45. ***Supply-Side Activities — Sustainable Forest and Natural Resource Management.*** Starting in the early 90's, community-based sustainable forest and natural resource management approaches in SSA began to supplant the narrow government run forestry and reforestation programs of the past that had yielded such poor results. Over the last decade these new approaches proved to have good results in Senegal, Burkina Faso, Mali, Madagascar, Ethiopia, Mozambique and other countries. The investment cost of these community-based approaches has ranged from $50 per hectare in Southern Africa up to $100 in the Sahelian region. Within that cost envelope multi-sectoral rural development assistance has been delivered (crop and income diversification, increased local revenues, increased access to potable and process water, increased delivery of health and education services and improved local and sub-national governance). The first phase of the Senegal Sustainable and Participatory Energy Management Project (PROGEDE), for example, resulted in the generation of annual incremental sustainable incomes of US $40,000 per village, for a total of US $12.5 million per year. Under sustainable forest management systems, it takes between 0.3 ha and 0.5 ha to ensure a sustainable supply of woodfuels per household.

46. ***Demand-Side Activities — Improved Stoves Programs.*** The results of improved stoves programs in SSA have been mixed. While some successes are documented (Ethiopia, Madagascar, Senegal, Chad and Mali), achievements have normally fallen below initial program expectations, and most importantly, have been small with respect to the respective population size. Improved stove programs in SSA have achieved at best no more than a 15% penetration rate and, in many cases, those rates have fallen sharply soon after termination of donor support. Furthermore, the majority of government-run improved stoves and inter-fuel substitution programs are non-sustainable due to: (i) unviable financial models with donor subsidized stove production; (ii) inappropriate selection of stoves—i.e., limited or no consumer acceptability; (iii) insurmountable market distortions on woodfuels price/volume relations which prevented consumers to fully appreciate fuel saving from energy efficiency gains; (iv) deviation towards limited higher income groups of embedded fuel and stoves subsidies; and (v) absence of financial intermediation instruments to support follow-up phases. These lessons indicate that new demand side management efforts and supply side interventions in SSA need to be

community or market-based and preferably run by the communities, as in PROGEDE, or by private sector in order to be effective and sustainable. Successful sustainable stove programs, such as the Jiko stove (Kenya), the Diambar Stove (Senegal) and the Injera stove (Ethiopia), included private sector participation from the start and a gradual phasing-out of donor support as commercial sustainability was achieved.

47. ***The scaling-up of programs for increased access to clean cooking and modern fuels needs to be based on three key policy elements.*** First, financially viable production and marketing of improved woodfuels stoves, with an emphasis on distribution of charcoal stoves for urban and peri-urban households. Second, market-based interfuel substitution promotion programs, including the use of various effective subsidy mechanisms and price-related policies to increase access to kerosene and LPG and reduce the domestic costs of supply of products. Third, effective consumer education programs and campaigns directly linked to financially viable and readily available improved stoves and/or substitution fuel options.

E. Summary Regional Strategies for Energy Access Scale-Up

1. Sub-Sahara Africa

48. ***This Annex has presented in detail the elements, financing, and policies for an Energy Access Action Plan for SSA.*** Increasing direct household access from the current level of 23% household access to 35% by 2015 and to 47% by 2030 (or about 76 million new household connected) will be an enormous challenge that will demand greatly increased investment flows and enhanced implementation capacity. Scaling-up energy access in sub-Saharan Africa will require first dealing with the current crisis in electricity supply, a significant ramping-up of generation and transmission infrastructure, and overcoming the old problems of planning and implementing electrification projects. It will require a doubling in resource transfers, delivered via innovative mechanisms. The main elements of the Energy Access Action Plan for SSA are outlined below.

49. ***Energy Access for Households and Growth.*** The goal is to provide electricity services to as many households as possible while balancing affordability to end users and to the government of the capital subsidies required. In the immediate term, the objective would be to bring businesses and households that are currently connected but not served back onto the network by increasing generation capacity through low cost financing and through better performing utilities. Over the short to medium term, anchor loads would be built by providing electricity to unserved households, agricultural use and post harvest processing, and to establish rural nodes with mechanical power and electricity services to unlock local enterprise. Where grid extension is not cost effective, independent small grids or off-grid will be necessary.

50. ***Generation Capacity Expansion and Associated Transmission Interconnections.*** About 25GW of generation capacity will be required in SSA over the next decade to make up the present shortfall in supply and to meet future demand growth including demand from newly connected households and businesses. Approximately 20GW of the additional capacity can come from regional projects including gas-to-power

projects in Nigeria, hydro projects in several countries such as Mali (Manantali), DRC (Inga), Mozambique (Cahora Bassa), Zambia (Lower Kafue) and Ethiopia (Tekeze and Gleigele), coal based generation in Botswana, and geothermal projects in East African countries. Innovative financial structures will be required to enhance the creditworthiness of participating countries and to leverage greater private sector participation. Transmission interconnections for power trade will play an important part in ensuring energy security and mitigating the natural risks such as the drought currently affecting the Lake Victoria States. Many of the protocols needed to establish and operate these networks are in place. Investments are needed to build these "power highways" to inter-link countries and open up trade and exchange for lower cost power and security of supply. Finally, national scale generation projects and smaller renewable energy generation projects are needed to ensure power balance and diversity.

51. ***Energy access for public service delivery.*** The goal will be to guarantee reliable energy services to health and education facilities so that they deliver the services expected of them. The aim will be to retrofit existing facilities and to ensure that all new facilities are equipped with required energy services to enable their proper functioning. This would also cover housing for staff associated with these facilities so that they have incentive to live in areas where these services are needed.

52. ***Markets for Low-Cost Household Illumination.*** Modern LED lighting for basic needs can be provided for the poorest households that cannot be rapidly reached through expansion of the electricity network or cannot afford solar household systems. The knowledge and expertise of the World Bank and the IFC will be leveraged to accelerate development of affordable modern lighting options and market-based delivery mechanisms.

53. ***Clean Cooking, Heating and Lighting Fuels.*** The goal is to develop countrywide or regional markets for the production and distribution of improved stoves, complemented by effective consumer education programs and marketing campaigns. In addition, the program would support market-based interfuel substitution promotion, including the use of various effective subsidy mechanisms and price-related policies to increase access to kerosene and LPG and reduce the domestic costs of supply of products. Sustainable community-driven woodfuel programs will be supported.

54. ***Next steps.*** The World Bank in partnership with SSA countries, regional institutions and donor-partners including the AfDB, proposes to initiate a program of Country Access Program—Sector Syndications, based on country-specific readiness. A quick assessment indicates such readiness could exist in about 10 countries in SSA with favorable conditions including a positive macro-economy and policy framework, strong country ownership of access programs, enabling sector framework for access, a national utility that is reasonably well managed and placed to promote access, and tariffs that at least recover recurrent costs. The assessments to be undertaken in such countries, mainly to develop fully-costed access scale up strategies and action plans, could lead to the early preparation of a "Prospectus for Sector Syndication". Such assessments would include for example, GIS-based spatial analyses to estimate the investments required to achieve country-specific electrification targets. In countries that are not at this level of readiness,

parallel efforts to carry out assessments and address creation of necessary conditions would be actively pursued.

55. ***The World Bank will seek to reinforce and expand three levels of partnerships****:* (a) with countries and African institutions (FEMA, NEPAD, EAC and ECOWAS) to build ownership and ensure sustainability of energy access plans within the available resource envelopes; (b) with development partners (AfDB and bilateral donors) to harmonize strategies and action plans, and strengthen coordinated implementation; and (c) with global entities such as WHO and UNICEF on energy access plans for public health and education facilities.

2. South Asia

56. ***India alone accounts for nearly one third of the 1.6 billion people world wide without electricity.*** 82% of urban households are electrified but only 44% of households in rural areas have grid connections despite an overall village electrification rate of 70%. Household electrification ranges from 5% in Bihar to 94% in Himachal Pradesh. Even where service is available, supply is often unreliable and of poor quality, imposing additional costs on households. Subsidized prices pose a serious financial burden for both state and national government, creating a disincentive to invest in electrification. These factors, combined with political interference and weak incentives for increasing service delivery efficiency, have resulted in a system that is financially unviable and physically unsustainable.

57. ***India's electrification strategy and program.*** The National Rural Electrification Program (RGGVY) was launched in March 2005. The program aims to build on the principles outlined in the 2004 National Policy for Rural Electrification (which includes subsidies for 90% of capital costs of rural electricity service providers, and open access/competition for service provision) and is being implemented by the Rural Electrification Corporation (REC). REC is funded through central government loans and grants, tax free bond issues and bank loans. As of March 2006 REC has disbursed loan assistance of $1.4 billion for projects that will provide access to 7.2 million rural households including 4.7 million below the poverty line. The achievement of GoIs ambitious access target of 100% electrification will require a substantial acceleration of past electrification rates. Since 2005 the connection rate has increased considerably with between 3 and 4 million new connections now being made annually. Increasing the overall access rate to 74% (full access in urban areas and 60% in rural areas) would require $5 billion per annum through 2020 (0.7% of current GDP). Universal access would require $9 billion per annum.

58. ***New mechanisms are required to introduce incentives for sustainable electrification investment.*** Emphasis needs to shift from the current supply-led "construction bias" (of the distribution network and transmission links) to supporting alternative models of service provision. The supporting regulatory environment would ensure: tariffs that cover efficient costs; sufficient bulk power supply is available in rural areas; transparent procurement processes; setting universal service obligations (USOs) for service providers and subsidy mechanisms to fund USOs.

59. ***Dispersed populations, topographical features and low levels of income in Afghanistan (2% electricity access) and Nepal (25%) pose a huge challenge.*** Policy interventions can focus on facilitating off-grid electricity service provision, provision of electricity services for schools and clinics, and on provision of stand-alone lighting for those without electricity service in their homes. In addition policies that encourage fuel switching, safe cooking practices and diffusion of clean cooking technologies are needed.

3. Latin America

60. ***With household rates of electricity access ranging from a low of 34% in Haiti to 99% in Uruguay and Chile, there remain approximately 59 million people without access to electricity.*** In 2002, 96 million people in Latin America (about 20% of the entire population) were relying on traditional biomass for cooking and heating, with highs of around 90% in the rural areas of Haiti, Nicaragua and Peru. Efforts in Latin America to engage the private sector in rural electrification projects have been quite successful and have led to significant gains in efficiency and know-how from the private involvement in the provision of energy services. The strategy to scale up energy access to the poor in Latin America is based on three broad and different approaches that have been implemented in the following countries:

- In ***Nicaragua,*** the PERZA rural electrification project focuses on innovative public/private off-grid electricity delivery mechanisms complemented by rural microfinance and business development services to significantly enhance the development impact of rural electrification.

- In ***Argentina***, the PERMER program includes a concession approach for rural electrification, based on the country's ample experience with concessions for infrastructure services (e.g., telecommunications, water). Concessions are eligible to re-bid competitively against other eligible firms every 15 years up to a total of 45 years, tariffs are renegotiated every two years, and the financial rate of return is about 14%.

- In ***Guatemala***, the PER project uses a new output-based scheme where the rural distribution companies are paid $650 for each new eligible connection achieved (those that are 200 meters or more beyond the existing power grid). The government has tapped proceeds of more than $100 million from the sale of assets for this incentive based program.

4. East Asia and Pacific

61. ***Access to modern energy is a major issue in all but the medium income countries of East Asia***. 95% of households in Myanmar and PNG, 47% of households in Indonesia, 23% in Vietnam and 5% or 70 million people in China do not have access to electricity. Lack of electricity access is not just a rural issue. For East Asia as a whole, 32% of urban dwellers do not have electricity service in their homes. In the poorest countries of the region, over 95% of households cook with traditional fuels. The challenge is greatest in the poorest countries of the region where the situation is more

akin to that of SSA countries described in this paper. For these countries, direct household access is possible, with good policies, to increase at a rate of between 1% and 3% per annum, as was the case of Vietnam where access to electricity in rural areas increased dramatically during 1996-2004 from 51% to 88%, marking one of the most successful recent rural electrification programs in the world.

5. Middle East and North Africa

62. ***Despite very high levels of access generally across the region, there are large groups in peri-urban areas without electricity access***. It is estimated that only 36% of those living in informal settlements on the fringes of cities have electricity access. In addition, large investments are required in Yemen (41%), Djibouti (50%) and Morocco (71%) to provide service to those still without electricity access in their homes. Tunisia exemplifies the approach generally followed in the region of utility led large scale grid electrification programs. As part of a multisectoral approach to the extension of a range of infrastructure and services to rural communities, Tunisia's electrification program expanded services from 6% in 1976 to 88% in 2001, including 35 % in rural areas. The electrification program undertaken by the Tunisia Electricity and Gas Company (STEG) achieved dramatic cost savings, which in turn contributed to a remarkable rate of cost-effective electricity grid expansion. Tunisia has now set rural electrification for all as a minimum standard for public service with a goal of 100 % electrification, through a variety of grid-based and off-grid technologies, by 2010.

6. Eastern Europe and Central Asia

63. ***With nominal rates of household access to electricity and gas supplies in excess of 95% across the region, the focus has been on affordability of services by low income groups and quality of service.*** These have been key issues in the wake of energy sector reform programs undertaken to ensure financial sustainability of the utility service providers, from improved metering and billing systems, improved collections, and tariff levels set to generate adequate internal cash. Poor households coped with the tariff increases by reducing their consumption of energy services (sometimes disconnecting from energy networks), switching to wood-fuel for cooking, or simply not paying. A variety of measures such as lifeline tariffs and direct income support have been implemented in countries across the region to protect low income households.

ANNEX 2. REVIEW OF EXISTING FINANCIAL INSTRUMENTS TO SUPPORT ENERGY AND LOW CARBON INFRASTRUCTURE

1. ***The analysis of the investment needs for developing countries will be divided into two categories, because of their differing characteristics***. Energy needs of developing countries, with specific focus on energy needs of the poor can be met on the basis of fairly straightforward market instruments. However, since the transition to a low carbon energy market revolves around issues of global public goods, the analysis and instruments to meet this challenge are quite different and thus will be treated separately.

2. ***The financing gap for electricity in developing countries is estimated today at $80 billion per year (over the near-term to 2010).*** In addition, the incremental up-front costs for de-carbonizing the electricity sector between now and year 2050 are estimated at up to $30 billion per year depending on the decarbonization level. Our analysis concludes that existing financial instruments are adequate to meet financing needs in developing countries (excluding the incremental costs for de-carbonization) but their level of funding, including stretching their current use, could not cover the complete gap. The remaining gap could be addressed using existing financial instruments in concert with policy reforms. The report also reviewed dedicated financial instruments to support low carbon technologies and concluded that such instruments and their funding would only have a limited impact on financing de-carbonization investments.

A. Financing Energy for Development and Access for the Poor

3. ***Scope of the Problem:*** IEA estimates that the energy needs of developing countries will require an average of about $300 billion per year from 2000-2030. The investment needs are largely for the electricity sector (65%), while 19% is for oil, 14% for natural gas and 3% for coal investments. The following focuses on the financing needs of the electricity sector as: (a) it requires more than three times as much financing as any of the other subsectors; (b) oil and gas development are sufficiently profitable to be fully funded; and (c) air pollution problems are forecast to largely stem from the electricity sector.

4. ***The investment needs of the electricity sector of developing countries in the near-term (to 2010) are estimated to be about $165 billion per annum[1] and increase by about 3% per annum between 2010 and 2030.*** Of the $165 billion investment needs, only about half is funded from readily identifiable sources, as indicated in Figure 1 below.

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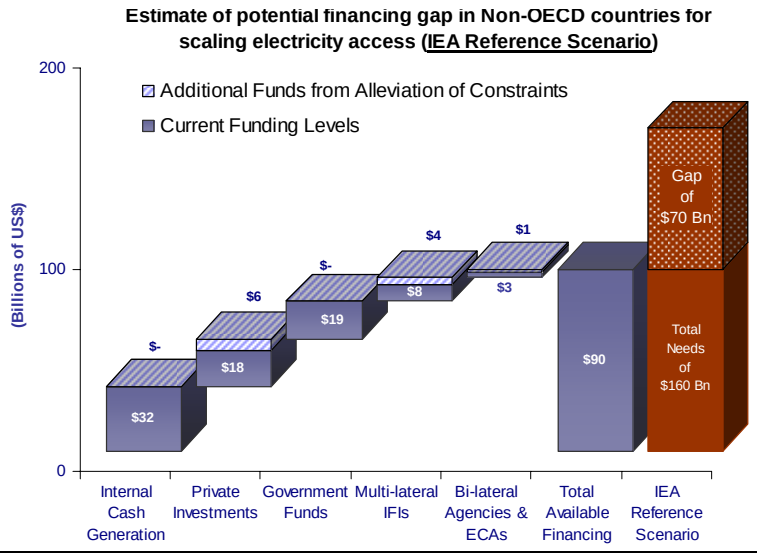
[1] The IEA estimate of electricity sector investment needs in developing countries is roughly $160 billion in 2005 US$. Recent World Bank staff analysis indicates that access to electricity for the poor, particularly in South Asia and sub-Saharan Africa, could be accelerated requiring an addition of roughly $5-7 billion per annum.

Figure 1. Short-term Electricity Financing before and after Scaling up



5. ***Although this gap is large, there are a number of country characteristics that can cause this gap,*** among them: (a) countries that are considered failed states; (b) countries in conflict; (c) countries suffering from natural disasters, spreading limited resources more thinly than normal; (d) countries whose policy framework make it difficult to attract either public or private financing; and (e) countries whose incomes levels and institutional capacity make sustained investments problematic. The primary manifestations of these problems are rolling blackouts and inadequate access for large proportions of the population. Depending on the severity of the problem, it has been estimated that the impacts on economic growth in some countries can be in the range of 1-4% of GDP per annum.

6. ***Addressing the $80 billion Financing Gap***. The single largest impact that can be made to reduce the financing gap is implementation of policy reform. A recently completed study analyzed a broad range of country typologies, focusing primarily on success cases, to determine the feasibility of closing the supply-demand gap in the electricity sector. The study found that governments willing to take on broad-based reforms were able to close, if not eliminate, the financing gap considerably. Vietnam managed to be successful at meeting a staggering 16 percent per annum electricity demand growth over ten years. The power company maintained a sound billings and collection systems, while the Government maintained price levels sufficient to enable the power company to maintain its ability to self-finance 30-50 percent of investments from internally generated cash. The financial health of the sector also enabled the utility to attract private sector financing of Independent Power Plants.

7. ***The characteristics of Vietnam's success were not unique.*** All countries that were successful in bridging the electricity sector financing gap did so through: (a) good governance, both at the policy and corporate level; (b) maintaining a financially healthy power sector characterized by a self-financing capacity for new investments within the sector of at least 30%; (c) a combined focus on both supply and demand-side

opportunities (Brazil particularly in the 2001-2004 period); and (d) facilitating trade to keep the cost of supply low (Botswana's imports of electricity from South Africa).

8. ***The study found that private sector participation was useful in bringing down financing costs and relieving institutional capacity constraints, but was no panacea.*** The experience in the Dominican Republic and Georgia during the 1990s demonstrates that a robust policy framework is necessary for the private sector to be effective. Experience has also shown that the policy reform agenda takes more time to evolve than expected in the 1990s. However, interim measures can be enacted in the absence of private sector participation to reduce the financing gap. Many EU Accession countries have demonstrated this by quickly adopting EU principles in their policy platform. In addition, the active participation of credit rating agencies provided a stimulus for publicly-owned power companies to improve their corporate governance to access capital markets. In doing so, their publicly-owned electricity companies became sufficiently financially viable to be able to attract debt financing from the Eurobond market at attractive terms.

9. ***Earlier studies have shown that a variety of forms of private sector participation can help alleviate the investment gap problem***, across the spectrum from management contracts to full-scale asset divestiture, including leasing and concession options as well. In the early stages of the policy reform, the private sector has demonstrated its reluctance to put its capital at risk but private sector participation can be constructively applied through a management contract. Experience in African countries (e.g. Tanzania) has show that the management contract option can help address the financing problem by increasing liquidity to the sector through improvements in billings and collections. Improved payment discipline and disconnection of nonpayers also helps to reduce financial losses by decreasing theft and corrupt practices.

10. ***The lessons learned from these studies indicate that much of the financing gap can be addressed through policy reforms.*** However, experience also indicates that successful implementation of reforms is a long process, requiring perseverance by all stakeholders: Governments, corporate entities, customers, and the broad donor community. As the reforms often take up to a decade or more to implement, transitional instruments need to be utilized to support change. IFI and donor support both financial and through support for institutional capacity building, is particularly necessary during early stages of the reforms. As the reforms progress, increasing reliance on private sector participation, while addressing risks through use of IFI risk mitigation instruments, are needed to support the latter stages of the reform agenda. Based on evidence collected, it appears that existing financial instruments are adequate to meet the needs of electricity sector financing in developing countries.

11. ***However, some of the financing vehicles need to be stretched to meet this goal.*** A recently completed study by PricewaterhouseCoopers (PWC) estimates that $10-12 billion of the $80 billion financing gap can be bridged by more aggressive financing from public sources ($4 billion from IFIs and $1 Billion from bi-lateral agencies and Export Credit Agencies ($1 billion) and private investments ($6 billion). Although this represents only about 15 percent of the gap, increasing engagement of both public sector

financiers and private investors could also help support governments willing to take on the difficult task of policy reform.

12. ***The PWC report made specific recommendations on actions that could be considered by IFIs to enable this increase in financing which are listed below***:

- Relaxation of IFIs country exposure limits (an additional $1.5 billion p.a.)
- Increase the amount of concessional financing available (an additional $0.5 billion p.a.)
- Bundling of power projects with similar risks, cash flows and timelines so they can be reviewed more economically by IFIs (an additional $1.5 billion p.a.)
- Shift capital to IFIs that can fund sub-sovereign and private sector investments including imaginative use of junior returns such as mezzanine financing and subordinated debt to increase private investment (an additional $2 billion p.a.)
- Increased equity financing by private sector financing arms of IFIs by deepening country and regional risks, providing better risk assessments (an additional $1 billion p.a.)
- Better use of IFI risk mitigation instruments are estimated to decrease the funding gap by $3-3.5 billion per annum by: (a) streamlining IFI structures to target energy investments; (b) broaden the use of partial risk guarantees; and (c) increase awareness of the products and their characteristics

13. ***Access to electricity by the poor deserves separate attention.*** As outlined in Annex 1, access to electricity remains a considerable problem in many countries, particularly in South Asia and sub-Saharan Africa (SSA) which each have over 500 million people without access to electricity. Tackling this problem in South Asia appears to be well in hand in most countries as incomes rise: meeting nearly all demand with current policies and instruments by 2030 appears to be within reach. However, the same is not true for SSA as current levels of electrification are much lower (24% in SSA vs. 54% in South Asia) and income levels and institutional capacity are more limited. Thus, SSA to reach a target of 35% electrification by 2020 and 47% by 2030 would require a doubling of concessional financing from about $2 billion to $4 billion per annum. This means that although the existing instruments are satisfactory from a functional perspective, their level of funding is not adequate.

I. WORLD BANK MANAGED FINANCING INSTRUMENTS FOR LOW CARBON INFRASTRUCTURE

14. ***PWC also reviewed how existing financial instruments could be applied to the challenge of implementing low carbon technologies***. The report came to the conclusion that existing financial instruments would only have a minor impact on the considerable financing gap. The following outlines the existing financial instruments that the World Bank Group can avail of to address these financing needs.

15. ***As previously mentioned, the World Bank Group has been the lead multilateral institution in the design and development of dedicated financial instruments to support transition to a low carbon economy.*** This section assesses how existing World Bank instruments could be used to support developing countries' climate change mitigation activities. Carbon reducing technologies will only be deployed in large scale if the investments are supplemented by carbon finance or receive grant resources in parallel. This review of current instruments focuses on the potential for meeting the incremental costs of greenhouse gas abatement through Global Environment Facility (GEF) concessional financing, the Bank's Carbon Finance Business products and MIGA risk mitigation products to support clean energy investments.

A. Global Environmental Facility (GEF)

16. ***The GEF operates as the entity entrusted with the operation of the financial mechanism of the UN Framework Convention on Climate Change (UNFCCC).*** It has been the largest source of grant financing for energy efficiency and renewable energy in the Bank Group, amounting to nearly $1 billion in Board-approved projects since 1992. The GEF's mission is to develop and transform markets for energy and mobility in developing countries so that over the long term, they will be able to grow and operate efficiently towards a less carbon-intensive path.

17. ***Within its GEF operational program entitled "Removing Barriers to Energy Efficiency and Energy Conservation", the GEF has three strategic objectives:*** (i) Promoting wide-spread adoption of energy efficient buildings and appliances; (ii) Promoting the deployment and diffusion of energy-efficient technologies and practices in industrial production and manufacturing processes; and, (iii) Promoting retrofitting of power plants to improve the efficiency and performance of existing thermal and hydro-based power plants.

18. ***Within the Operational Program entitled "Promotion of Renewable Energy by Removing Barriers and Reducing Implementation Costs", the GEF has two strategic objectives:*** (i) Promoting the supply and demand for grid electricity from renewable sources; and, (ii) Promoting renewable energy for rural energy services. Under the Operational Program "Reducing the Long-Term Costs of Low GHG-Emitting Energy Technologies," the strategic objective is to support the deployment of new, low-GHG-emitting energy technologies by aggregating demand for the technologies in niche applications and facilitating technological access and innovation. GEF-4 support to this strategic objective is expected to be quite limited.

19. ***In the context of Operational Program, "Promoting Sustainable Transport", the strategic objective is to facilitate sustainable mobility in urban areas through:*** (i) Modal shifts to less polluting modes of public (and private) transport; (ii) Public rapid transit; (iii) Non-motorized transport (NMT) facilities; (iv) Transport- and traffic-demand management; and (v) Land-use planning through regulatory measures (zoning laws)

Box 2. Key Results of GEF Financing for Market Transformation (summarized from the Climate Change Program Study, conducted by the GEF Office of Evaluation, 2004)

An example of market transformation within energy efficiency (EE) is the IFC HEECP project, the first loan guarantee program financed by the GEF, which is contributing to the commercialization of EE finance and the growth of a local energy service company (ESCO) industry in Hungary. Other projects in the region, such as in Bulgaria and Romania, may also contribute to promoting more EE through addressing the lack of finance, but with longer time horizons, given the different country circumstances.

The markets for efficient lighting projects in Thailand, Mexico and Poland were dramatically changed toward greater penetration of EE products such as Compact Flourescent Lamps, prices fell, and codes and standards were introduced.

Significant results have been achieved in EE in specific industrial sectors. In the case of the China Boiler Conversion project, an estimated 40% of all coal-fired boilers in Beijing urban districts have been converted to gas, and the costs of gas boilers dropped by 50% due to rapid market development. In Thailand, GEF co-financing helped increase the share of energy-efficient air-conditioners to 38% and single-door efficient refrigerators to 96%.

A frequent strategy within GEF projects has been the development of business infrastructure in the EE sector as a means to promote EE investments, engage the private sector, and overcome several market barriers simultaneously. For example, in the China Energy Conservation project, the development of three pilot energy management companies has demonstrated the potential of an energy performance contracting market.

Full transformation of renewable energy (RE) markets is more difficult considering that many RE technologies remain, in general, more expensive and less accessible than traditional high GHG-emitting energy sources. However, there is evidence of emerging market transformation toward increased use of RE in specific sectors in specific countries, such as for mini-hydro systems in Sri Lanka, the wind market in India, and sugar biomass in Mauritius.

For example, the Sri Lanka ESD project contributed to the commercialization of PV, village mini-hydro and wind energy. The project stimulated private sector participation in PV development by providing consumer credit through microfinance institutions. An enabling environment for private sector participation in grid-connected RE projects was created by facilitating development of small power purchase agreements and by channeling long—term credit through licensed commercial and specialized banks.

GEF support to the Indian Renewable Energy Development Agency's capacity to promote private sector investment in the sector has helped it stimulate finance for RE in India, with about 96% of the total wind capacity of 1700 megawatts coming through commercial projects utilizing private investment. In China, the Renewable Energy Development Project was the largest Solar Home System program in the world. A significant outcome of the project has been the development and institutionalization of standards for PV systems and components and testing centers.

20. ***The GEF's strategic objectives are sufficiently broad to cover most "near commercial" mitigation options, although the emphasis is on technology "deployment" not "development".*** The GEF portfolio comprises several projects that could serve as the basis for replication for a low-carbon economy:

- The China Renewable Energy Scale-Up Project is a 10-12 year, three-phase, $400 million (including $140 million in GEF grants) initiative to support implementation of a national Mandated Market Policy in which a mandated share of electricity consumption comes from renewable sources or electricity suppliers are obligated to buy renewable energy-based electricity at a government determined price. GEF financing for institutional development and capacity building in Phase I ($40 million) will contribute to an increase in renewable electricity from 35 TWh/year to 150 TWh/year and renewable capacity from 7 GW to 29.6 GW.

- The $25 million GEF grant for the Mexico Large-Scale Renewable Energy Development Project will provide targeted GEF tariff support to an initial 101 MW wind energy IPP investment to overcome initial entry risks and stimulate learning, and will support a combination of policy and technical assistance activities to support development of additional renewable energy generation resources on a diversified basis. Based on Phase I project performance, a Phase II $45 million program would continue project replication and cost reduction with both wind and additional renewable energy technologies.

- The China Heat Reform and Building Energy Efficiency Project, with a GEF grant of $18 million, will support transformation of the urban heating sector from a government-supported welfare system to a market-based commercial operation, and energy-efficient market transformation of the urban housing sector. The project will demonstrate on a large scale a comprehensive, fully integrated, and simultaneously implemented program of residential building heat billing and pricing reform; introduction of modern, variable flow heat supply systems; and, construction of energy-efficient new residential building. The project will result in 660,000 TCE/year in coal savings.

- The China Thermal Power Efficiency Project, with GEF co-financing of $20 million, focuses on overcoming barriers to phasing-out of small and medium-sized units in the short and long run, respectively, and creating the conditions for investment in rehabilitation of medium and large-sized coal-fired power plants for improved thermal performance and coal utilization. The project will support enhancement and enforcement of sector regulation on energy efficiency; power sector energy efficiency technical capacity building; and, support identification, preparation and implementation of packaged demonstration solutions to efficiency improvement of targeted coal-fired plants of various unit sizes. The demonstration project will cover about 10-12 units of several sizes, with an estimated capital investment of $80 million, depending on results of screening and technical auditing. Rehabilitation will be targeted to the post-1990 coal-fired units of 200 and 300 MW, where the most potential exists. Capital investments are expected to be financed by power utilities, while the GEF Grant will support preparation of the investment project and knowledge dissemination.

- The China Energy Efficiency Financing Project, with $14 million in GEF co-financing, will remove barriers to large-scale "system-focused" energy efficiency projects in large industry, and expand direct energy efficiency lending from banks to large enterprises. It is envisaged that the proposed GEF program and its associated World Bank financial intermediary lending project will directly mobilize at least US$ 300 million for large scale energy efficiency project financing in the next five years which will result in energy savings of over 3.0 million Tce annually. Assuming the average life span of the energy efficiency projects is 15 years, the total energy saving directly from this project would be 45 million Tce which results in a GHG emission reduction of over 105 million tons.

21. ***However, these projects indicate that Bank-GEF commitments for removing barriers to energy efficiency and renewable energy technologies would need to be at the minimum level of $ 250-300 million per year over the next 10 years (an increase by a factor of 2-3).*** A portfolio of that scale would be necessary to achieve significant and sustained market penetration of energy efficiency and renewable energy technologies in the largest GHG-emitting developing countries. Furthermore, the GEF's focus on "barrier removal" has meant that it has limited funding for the investment needs of near-commercial or mature technologies that might be new to a country.

Box 3. GEF Support for New Technologies

The GEF's experience with solar thermal electricity generation would argue that large projects making use of technologies not yet commercialized stand a greater chance of being successfully transferred if they are under active development in the OECD countries. North-south and south-south partnering with active projects deploying the new technologies holds promise and should be considered a pre-condition for further GEF support in these areas. There have also been problems in the Bank with procurement for such projects due to the fact that it is necessary to bet on specific technologies, there are few or no commercial scale demonstrations, and there are few technology suppliers. The GEF's experience confirms the lesson from the traditional literature on the economics of technology transfer that it is extremely difficult to transfer technologies that are not yet fully commercialized. Such new technologies impose not only incremental costs but also incremental risks that developing countries may be reluctant to bear. In addition to the technology cost and transfer problems, the projects face a significant market barrier.

B. Carbon Finance Business

22. ***Ten years of World Bank experience and $1.8 billion of carbon funds under management have shown that carbon finance can contribute to clean energy financing in three ways:*** (i) by purchasing carbon credits from low-greenhouse gas projects, (ii) by using carbon finance to leverage additional investments, and (iii) by supporting the development of the carbon market through capacity building and political engagement.

23. ***The Bank's carbon funds support a diverse portfolio of projects, including waste management, forestry, energy, chemicals and transport.*** Carbon finance has already had a major impact on improving waste management practices around the globe due to the methane emissions associated with traditional land-fills, waste water and agricultural refuse practices. The carbon finance business has, however, yet to make a

significant difference to reducing the power supply gap in many developing countries due to two main reasons: (i) the initially low price for which emission reductions could be contracted and the associated limited impact of their revenues on the rate of return for (renewable) power projects; and (ii) the uncertainty regarding the continuation of a regulatory framework beyond the first commitment period makes large projects with long lead times particularly unattractive.

24. ***Carbon finance has also had a limited impact on energy efficiency, in particular, end-use energy efficiency.*** The reasons for this include the highly dispersed nature and micro-scale of most individual energy efficiency measures at the household and small enterprise level. In addition, pricing policy issues prevailing in many countries have been a key constraint to the use of carbon finance for demand-side management programs. Furthermore, CDM approaches are not conducive for energy efficiency projects: methodologies are complex due to concerns over monitoring, free riding, rebound effects and general conservativeness. The programmatic approach to the CDM, though still in its early stages of development, may help overcome some of these hurdles and reduce transaction costs.

25. ***Carbon funds could be scaled up for targeted investments and the use of existing instruments improved such as the following examples:***

- ***Scaling up carbon funds and improving the use of existing instruments as well as the utilization of carbon revenues:*** The establishment of the Umbrella Carbon Facility has demonstrated the merits of such instrument for scaling up and increasing the efficiency of delivery of carbon finance from large projects. Further developments in the form of auctions and establishment of country-wide sellers' funds are expected to increase the penetration of carbon finance in host countries and generate carbon revenues on a larger scale. The establishment of the CDM Fund in China is an illustration of how a country can further maximize the utilization of carbon revenues beyond specific projects to finance future climate-friendly investments.

- ***Blending carbon finance with Bank instruments:*** The Bank could explore designing carbon finance loans, possibly as a component of overall Bank lending. Such loans could be paid out directly to the project sponsors—for example, directly from IBRD/IDA—and paid back through the carbon revenue streams. These loans could be serviced directly through payments for emission reductions, based on long-term carbon contracts when emission reductions are obtained for fund participants from the projects (see box 4).

- ***Supporting carbon market continuity*****:** The Bank could scale-up existing carbon finance instruments to support carbon market continuity by helping to sustain the carbon market during the post-2012 negotiation period. This engagement could allow Parties to underscore their long-term interest in sustaining the carbon market and provide a pool of liquidity to buy carbon

credits for post-2012 delivery (see Annex 3 for more details—Market Continuity Fund).

Box 4. Cases of carbon finance leveraging private and public investments in developing economies

A: Monetization of ERPA future receivables in an agribusiness project in Brazil

The project had a long lead time necessary for the trees to mature and for the project to generate cash-flow income (i.e. eight years for full implementation). In addition, three more years would have been required by the project to pay back the investments. Under these conditions, the project could not obtain adequate financing. The anticipated cumulative ERPA revenue streams to be used for amortization of the loan's debt service and the possibility of the payments for the ERs being directly deposited in the lender's account outside Brazil allowed an international commercial lender to advance the nominal value of the ERPA between the World Bank and the project sponsors. The loan amortization was scheduled so as to mirror the annual ERPA payments and the project sponsors were both recipient of the loan in the agreement with the lender and the seller of the ERs in the ERPA with the World Bank.

B: Supplier's finance backed by ERPA receivables in solid waste project in Brazil

The project sponsor did not have the up-front capital required to invest in the equipment and could have tried to obtain a bank loan using the power purchase agreement (PPA) from the sale of energy to the grid as collateral. However, since the energy sector in Brazil was facing serious regulatory problems, energy distributors were highly reluctant to commit themselves through long-term PPAs. Since the project's cash income was risky, its whole viability was doubtful and the project would probably have struggled to obtain financing for the necessary investment. However, due to the ERs generated by the project and the ERPA with the World Bank, the sponsor's technology provider (i.e. an international producer and operator of flaring and energy systems) agreed to lease, operate and maintain the equipment using the ER income as annual payments. The ERs revenue provided the necessary finance to the supplier for the project's implementation. The agreement between the parties has the same period as the ERPA and also requires the ER payments to be made directly into the supplier's account, following a financial structure similar to that described above.

C: The ERPA as an off-take agreement to secure the international finance of a Run-of-River Hydroelectric project in Ecuador

This is the first private investment in hydropower generation in Ecuador. The sponsors who developed the project raised 65 percent of the capital expenditure (i.e. about $30 million) through private equity from several shareholders and sought financing from an IFI for the remaining 35 percent. Although the project had strong fundamentals, the project fell short of the lender's investment criteria (i.e. over 50 percent of sales to be under firm Power Purchase Agreement (PPA) contracts and assigned to the repayment of the loan's debt service in order to mitigate delivery risks). The ERPA provided an off-take agreement similar to a PPA and the proportion of total project revenues (i.e. electricity and ERs) allowed the borrower to reach the threshold for secured sales and comply with the covenant required by the lender. Similarly to the previous cases, the ERPA was structured so that the proceeds accrue directly to a debt reserve account at the lender, which was also able to reduce the loan's interest rate by 100 base points as a consequence of the mitigation of sovereign risk.

C. MIGA Carbon Finance Risk Mitigation Instruments

26. ***Close to 20% of MIGA's current gross exposure,[2] or USD 1.4 billion, relates to power projects.*** MIGA is poised to undertake additional activities with respect to clean

[2] MIGA typically insures part of a project. Total investment supported is a multiple of the Agency's gross exposure.

energy power projects: insurance for Carbon Emission Reduction-based project finance. The coverage would protect an investor and/or lender in a CER based project against:

- Breach by the host government of the letter of approval, in which the host government agrees to release CER's to the project sponsors;

- Actions by the host government which result in the inability of the project to achieve the planned emission reductions, for which CER's are issued;

- Political violence, war or civil disturbance resulting in cessation of operation and/or damage to facilities which would lead to the inability of the project to achieve the planned emission reductions.

27. ***The Agency plans to issue its first contract to cover CER based project finance in June 2006*** for a waste management project in El Salvador, which will lead to a reduction of methane emissions. Building on this first contract, the agency plans to market the product to investors and lenders and expects to further develop it to meet their needs.

ANNEX 3. NEW FINANCING INSTRUMENTS

1. ***With some emerging economies growing at 8-10 percent, their demand for energy is expected to increase 3 to 5 times by 2050***. As carbon intensive energy infrastructure and cities are being rapidly built and expanded, there is little emphasis on cleaner and more efficient technologies. While OECD countries will remain the largest per capita emitters of greenhouse gases, the growth of carbon emissions in the next decades will come primarily from developing countries. In order to bring down the potential growth in greenhouse gas emissions, steps would need to be taken on two fronts:

- Improving energy efficiency on the demand side; and
- Investing in technologies on the supply side (e.g., electricity generation) to increase efficiency and reduce carbon emissions.

2. ***For these investments to take place, regulatory frameworks need to be improved and financial markets need to be engaged***. In particular, the nascent carbon market needs to be stabilized and strengthened. This annex is focused on the issue of supply side investments and their financing sources, especially on the application of new financing instruments.

A. Supply Side Investments in Clean Energy Technologies

3. ***New low carbon technologies are more expensive and in some cases entail higher operational risks.*** As developing countries are trying to minimize the cost of badly needed additional electricity generation capacity, they tend to favor traditional and proven, but carbon intensive technologies over cleaner alternatives. Mobilizing capital for clean energy technologies encounters the challenge of justifying financially the incremental up-front investment costs.

4. ***Electricity utilities in these countries will not voluntarily absorb these incremental costs, and consumers will not be prepared to cover them through payment of higher tariffs.*** Developing country governments are unwilling to introduce compliance-based regulation to impose the use of cleaner technologies. Therefore, the implementation of clean energy investments in developing countries will be contingent on the availability of new financing mechanisms that complement the traditional sources of public and private sector funding.

Table 1: Market Value of Carbon Trading

	Year -end 2005		1Q 2006	
	Volume (MtCO2)	Value (MUS$)	Volume (MtCO2)	Value (MUS$)
Allowance Markets				
EU ETS	322.0	8,220.2	202.5	6,552.2
NSW	6.1	57.2	5.5	86.6
CCX	1.5	2.8	1.3	2.7
UK ETS	0.3	1.3	NA	NA
Total allowance markets	**329.9**	**8,281.5**	**209.3**	**6,641.5**
Project-based Transactions				
Compliance				
CDM	346.2	2,544.3	75.6	886.9
JI	17.8	82.4	3.3	19.3
Other	4.4	38.6	NA	NA
Sub-total Compliance	368.3	2,665.3	78.9	906.1
Voluntary	6.1	43.0	0.1	0.6
Total project-based transactions	**374.4**	**2,708.3**	**79.0**	**906.7**
Total Carbon Trading Markets	**704.2**	**10,989.8**	**288.3**	**7,548.2**

B. Carbon Markets

5. ***The total value of allowance- and project-based carbon transactions was $11.0 billion as of 2005, and $8.0 billion as of 1Q 2006.*** Allowance-based trading is primarily driven by the European Union Emission Trading Scheme (EU ETS) created in 2005, while project-based carbon trading is driven by the Clean Development Mechanism (see Table 1).

6. ***The Kyoto Protocol and other agreements / emission trading schemes listed in Table 2 are behind the bulk of the carbon trading today.*** The types of transactions executed can be grouped in two main categories:

- ***Allowance-based.*** Transactions in which the buyer purchases emission allowances created and allocated (or auctioned) by regulators under cap-and-trade regimes.

- ***Project-based.*** Transactions in which the buyer purchases emission credits from a project that can credibly and verifiably demonstrate that it reduces greenhouse gas emissions compared to what would have happened otherwise. Most project-based transactions are currently executed through the Clean Development Mechanism (CDM) under the Kyoto Protocol, generating Certified Emission Reductions (CERs).

Table 3: Carbon Trading Market Structure

Agreements	*Transactions*	*Purpose for reduction*	*Members*[ab]	*Unit traded*	*Unit issuing entity*
Kyoto Protocol	Allowance based under international emission trading (IET, Art.17 KP)	Compliance	Annex B countries	AAUs	National government, based on 1990 inventories reviewed by international expert teams
Kyoto Protocol	Project-based under JI and CDM (Art. 6 and 12 KP)	Compliance	Annex I countries Non-Annex I countries	ERUs, CERs, VERs	• ERUs issued by host national gov'ts (converted AAUs) • CERs issued by CDM Executive Board • VERs contracted by various companies and institutions (with expectation of their issuance as CERs or ERUs)
EU ETS	Allowance-based under EU ETS directive	Compliance	EU Countries	EUAs	National governments, after European Commission approval of allocation plan
NSW	Allowance-based	Compliance	Members of scheme	ERs	Provincial government
UK ETS	Allowance-based	Compliance	Members of scheme	CCAs	National government
CCX	Allowance-based w/ flexibility	Voluntary	Members of scheme	EUAs, ERUs, CERs, ERs	Corporations, local governments and other institutions

[a] Annex B countries are countries with emission reduction commitments listed in Annex B of the Kyoto Protocol. The list includes most OECD and Eastern European countries in transition. Annex I of the UNFCCC contains the same list plus Belarus and Turkey.
[b] Trading under Kyoto occurs between government parties or by private entities under their government's authority. Trading under the ETS occurs between private sector entities having been allocated or otherwise acquired EAUs.

7. ***Despite the dramatic increase in trading volume from 2004 to 2005, carbon markets are thin and volatile. In the allowance market,*** demand is driven by economic growth, actual output, and the different efficiency measures undertaken to reduce emissions; and supply is determined by the allowances assigned through each scheme to the market participants. Other price determinants include weather, fuel and power prices (about 55 percent of EU allowances are allocated to the heat and power sectors, so allowance-based carbon prices are closely correlated with oil/gas prices and the weather). The market price of European allowances was about $20-25 per tonne of CO2 in the second quarter of 2006. The ETS is currently in its first, experimental phase. The second phase, with new allocations of EUAs currently under preparation, will be concomitant with the first Kyoto commitment period (2008-12).

8. ***In the project-based market, the level of regulatory certainty is a much more significant price determinant.*** For example, prices for CERs—between $7-15 per tonne of CO2 in 2005 and early 2006—are significantly higher than prices for Verified Emission Reductions (VERs). The lower price of VERs, about $5-8 per tonne of CO2 in 2005, reflects buyers' perception of the regulatory risks, which differ between project types.[1]

9. ***Market players can be grouped into three main categories: compliance, voluntary and third parties.*** The main compliance buyers are government buyers interested in Kyoto compliance; European private buyers interested in the EU ETS; Japanese companies anticipating a domestic emissions trading scheme; U.S. multinationals operating in Japan and Europe or preparing in advance for the Regional Greenhouse Gas Initiative (RGGI) in the Northeastern U.S. States; power companies regulated by the New South Wales (NSW) market in Australia. Voluntary buyers are North American companies, local governments and other institutions that have agreed to reduce greenhouse gases voluntarily but are not legally bound to compliance objectives. Third-party buyers are mostly hedge funds and financial intermediaries. Hedge funds are purchasing emissions with the purpose of selling them in the retail / secondary market; and financial intermediaries are purchasing the emission reductions for clients that may or may not be compliance or voluntary buyers.

10. ***The risks*** faced by market participants on the two major markets are presented in Table 3.

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[1] CERs are credits that have been issued by the CDM Executive Board and that are therefore free of regulatory risk.. VERs are credits that have been verified by an independent verifier, but where issuance as CERs or ERUs has not (yet) occurred or may not occur, e.g., because the methodology has not (yet) been approved or the project has not (yet) been validated and registered. The latter involves the risk that none or only a part of the emission reductions will be issued as CERs or ERUs, resulting in a lower contract price.

Table 3: Risk Assessment of Major Carbon Trading Markets

Contract / Units issued	*Risk assessment*
EUAs (EU Allowances)	• Uncertainty of future allocations of EAUs, which may depend on an international regulatory framework beyond 2012 • Uncertainty regarding future emissions of covered sources and associated market demand. • No delivery [project] risks
CERs (Certified Emissions Reductions)	• Regulatory risks due to uncertainty of methodological and project related decisions by the CDM Executive Board • Market risk due to the uncertainty of future CER prices • Project risks (creation of the carbon asset)

11. ***While with time regulatory uncertainty should be decreasing, for the project-based market it is likely to start rising again soon because of the unpredictability of the carbon market regulatory framework post-2012.*** In that year, the first commitment period of the Kyoto Protocol expires and no follow-up arrangements have yet been negotiated. Many power projects, including those with carbon emission reduction effects, require planning and construction periods of several years and debt maturity periods of 10+ and often well beyond 15 years. Since the creditworthy part of the carbon-based revenue stream will end in 2012, new projects with those features, typically large installations with large capacity impact, will not, or only to a very limited extent, be able to use carbon credits as instruments to mobilize upfront investment financing. Experience to date shows that for carbon finance to play a catalytic role in energy and infrastructure project financing, carbon purchases of a minimum of tens years are required. Without an assured market for CDM assets beyond 2012, the incentives for development of greenfield, climate-friendly, CDM-eligible energy investment projects will shortly disappear. Moreover, this would put at risk all the public and private sector investments in capacity and market institutions, know-how and learning on carbon trade regulation as well as the credibility of the carbon market itself.

C. Clean Energy Financing Vehicle

12. ***The large amounts of financing that will be required for an effective transition to a low carbon economy will only be available via efficient mobilization of private capital.*** Mobilizing private capital for investments in clean energy generation in developing countries will require, from the point of view of investors, at least[2] the equalization of clean energy investments costs with the costs of investments in traditional technology. Since current instruments are not sufficient, in terms of scale, to achieve a shift to a low carbon economy, a new financial instrument, which would blend public and private capital, could be considered. The Clean Energy Financing Vehicle (CEFV) would complement the GEF's focus on the enabling environment for market transformation and

[2] Many low carbon technologies have greater technical risks than conventional technologies. These risks will require some form of compensation above the incremental cost of these technologies.

technology transfer. The CEFV would be a dedicated financing facility to provide implementing entities (public and private) with soft long term financing to buy down the costs of low carbon energy technology and related infrastructure, including the rehabilitation/upgrading of existing facilities. CEFV could also operate a window to support with grants and technical assistance the piloting of high risk, pre-commercial technologies (this window would require a grant-funded element within the CEFV).

13. ***Buying Down the Cost of Clean Technology***. The project cost associated equivalent to the business-as-usual (BAU) investment would be funded by standard financial vehicles: internal cash generation, private debt and equity, public debt or Government transfers. The CEFV would be used to finance the difference in cost between BAU investments and low carbon technologies. Committing to low carbon technologies will result in the generation of carbon credits. These carbon credits would be pledged to the CEFV by the implementing agency. The cash flows resulting from the selling of carbon credits on the market would be a source of revenue for CEFV that would be used to maintain its capital base. The sales of these carbon credits enable the CEFV to lend at softer terms, while maintaining a return on its capital.

14. ***CEFV would provide loans to implementing entities for the incremental cost of moving to low-carbon technologies.*** The base investment costs would be financed by standard financing sources for such projects, including the private sector, internal cash generation, host country governments, and/or multi- and bilateral lenders. The use of low-carbon technologies would result in access to carbon credits. Such carbon credits would be transferred to CEFV via pledges by the implementing entities. The risk of carbon asset creation will be shared between the CEFV and the implementing entity. The cash flows resulting from the selling of carbon credits on the market would be a source of revenue for CEFV, and such amounts would be lent again to support new clean energy projects until termination of the facility (see Figure 1). Due to the carbon credits reflows into the CEFV, loans to implementing agencies could be provided under soft terms and conditions.[3]

15. ***Financing Power Rehabilitation.*** By financing the incremental investment and operating cost of power rehabilitation, CEFV could improve the efficiency of existing power plants and reduce greenhouse gas emissions. The rehabilitation program could also include a broader range of activities that could be covered by existing instruments (commercial loans, ECA credits, MDB loans, GEF, carbon Finance, and risk guarantees). The main objectives would be: (a) increased energy efficiency, which would decrease greenhouse gas emissions per unit of energy produced; and (b) avoiding supply interruptions by purchasing replacement power during rehabilitation period. The objectives would also include: (a) life extension, reliability and increased power-output; and (b) retrofit of local and regional environmental control equipment (Flue Gas Desulfurization, improvement of electrostatic precipitation, etc.). Rehabilitation of existing power plants can be financially beneficial where fuel prices and electricity tariff are set appropriately and the investment climate is good. In such cases, rehabilitation projects can attract private investors and commercial loans. However, because these

[3] Building up the financial impact of carbon credits reflows into the loan pricing scheme.

conditions are not met in many developing countries, funds are not available at all, or the limited funds available will be spent only for life extension and increased power-output activities, without any improvements in efficiency and environmental performance. Developing countries suffering from blackouts due to a shortage of power generating capacity are not willing to take existing plants out of service for upgrading despite the apparent financial attractiveness of such investments. The economic costs associated with increasing the levels of blackouts make such options nonviable. Such projects would qualify for support under the CEFV by providing for back-up power.

16. ***Mitigating Technology Risk***. CEFV could also operate a grant window to help implementing entities to enhance their capacity to manage the operations and maintenance risk associated with near-commercial technologies. The grant window would be separately funded by donors. The mitigation of technology risk would require intermediating arrangements for extended warranties by manufacturers as well as technology transfer to some of the key countries. Programs to provide technical assistance would be developed for client countries in partnerships with the private sector as well as IFIs.

17. ***Facility size and disbursements***. The global, incremental, upfront capital cost of de-carbonizing the power sector is estimated to cost up to about US$40 billion per year between now and 2050 depending on the level of de-carbonization and the assumed baseline, with non-OECD countries incurring about 50 to 80 percent of this cost (i.e., up to about US$30 billion per year). These estimates are based on the current assessment of available and developing technologies and their use for power generation between now and 2030. However, there are a number of institutional and technology constraints to large-scale clean energy developments to take place over the next several years. CEFV's client countries are estimated to have an absorptive capacity of $2-3 billion per year in the near term. Therefore, CEFV is proposed to be established with an equity of about $10 billion, enabling it to ramp-up to disbursements of about $2 billion per year to its clients (depending on the value of its carbon credits, see Table 4). The active life span of CEFV would be limited to 20 years.

18. ***Rate of return of the proposed instrument***. Developed country governments are a potential source to finance CEFV's initial equity requirements. Participating governments could invest in CEFV by providing all or a portion of its equity. The investments made by the shareholders of CEFV would be expected to earn a reasonable rate of return (about 6% per annum). At the end of the life of the facility, its equity would be returned, with accumulated earnings, to shareholders.

19. ***The financial viability of the CEFV is sensitive to the following key*** variables: (i) the price of carbon credits in the market; (ii) the mix of new technologies in the energy sector; and (iii) the incremental costs of each of these new technologies over the next several years when compared to current technologies being used. At average annual disbursements of about $2 billion, the CEFV would be financially sustainable at a price of $15 per tonne of carbon dioxide (in 2006 dollars). To mitigate the carbon price risk to CEFV, mechanisms similar to the options described in section E might need to be developed.

Figure 1: CEFV Structure and Funding Mechanism

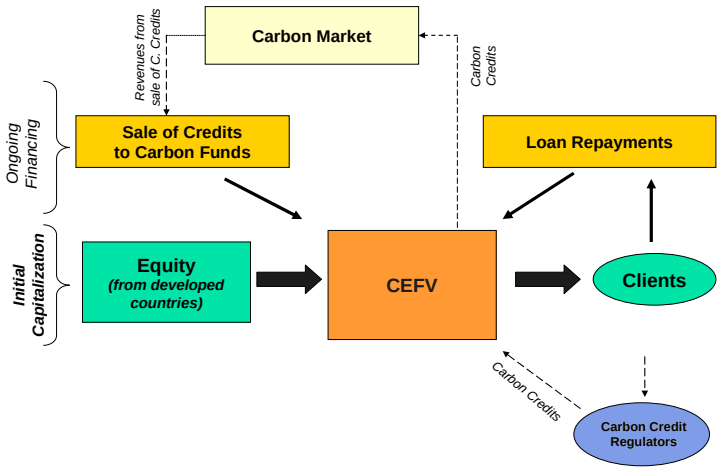


Table 4: CEFV Disbursements Scenarios

Carbon Credit Price	*US$ 10*	*US$ 15*	*US$ 20*
Equity Requirement	US$ 10 Billion	US$ 10 Billion	US$ 10 Billion
Term of the Facility	20 years	20 years	20 years
Average Annual Nominal Disbursements	US$ 1.72	US$ 1.99	US$ 2.20
Rate of Return on Equity	3.2%	6.0%	8.3%

Assumptions

A 5-year ramp up period for disbursements is assumed.
100% of annual disbursements are made in the form of soft loans for investment projects.
45% of annual loans are made for renewable technologies, of which 30% are made for Wind and 70% for Hydro.
55% of annual loans are made for coal technologies, split between Supercritical, Ultra Supercritical, IGCC, and Carbon Capture Technologies.
Loans are provided for 25 years, with 5 year grace period at an interest rate of 0.75% per annum.
Loan Loss provisioning is assumed to be 1.5% of outstanding loans.
A one-time processing fee of 0.75% of loan amount is charged to cover expenses.
An estimate of reduction in costs is incorporated such that costs become 105% of current sub-critical costs for incremental technologies over 30 years.
70% of carbon reduction from projects can be converted to carbon credits, which are monetized for first 10 years of operations.
Carbon prices are assumed to rise by 3% per annum.

20. ***CEFV would be governed by its shareholders***, with a small team of dedicated staff assigned to manage the facility. This joint management/coordination team would report to all participating IFIs and governments, and could be located in the HQ of one of the participating IFIs.[4] Task teams in all participating IFIs would be authorized to prepare projects to be funded by CEFV. A project supported by the CEFV would need to meet certain standards/guidelines, to be ascertained by the CEFV management team, and would subsequently be sent for approval to the Board of the respective IFI. This vision raises a number of legal and procedural issues that would need to be addressed in due course. Other alternative governance mechanisms could consider structures outside the IFIs.

21. ***The main financial product of CEFV would be long-term loans to finance the incremental cost of clean energy investments***. The loans would have a maturity of up to 25 years (to match the asset lives), with five years of grace on repayment of principal amounts. The interest charged would be a fixed rate of 0.75% per annum. The loans

[4] Participating IFIs refer to international financial institutions accessing the CEFV for their sponsored projects (co-financing and mobilizing private capital).

would be available in major and freely convertible currencies, the US$, Euro, and the Japanese Yen.

22. ***As noted above, CEFV could also have a separately funded grant and technical assistance window, to support the mitigation of technology risk and technology transfer***. The operation of this window would be subject to the availability (and the replenishment) of contributions from donors for this purpose.

23. ***Disbursement criteria are proposed to be simple.*** Rather than agreeing on loan amounts on a project-by-project basis, it is proposed that standardized loan amounts for efficiency levels be determined, i.e., the share of investments costs financed by CEFV will be fixed for a given level of carbon and fuel efficiency of a technology. As costs fall for newer technology, absolute amounts of loans for a given technology will fall, thereby allowing the facility to support a larger number of projects. Such a basic criterion for fixing loan amounts will allow the facility to be quick-disbursing leading to immediate impacts on the ground, thus improving access to low-carbon technologies.

24. ***IFIs would continue to focus on their economy-wide mandate and overall development agenda.*** Their ongoing work with clients to improve the sector policy and regulatory environment would complement CEFV's work. A more aggressive approach to risk mitigation and capital market development supported by the IFIs would enable clients to tap progressively into greater local and offshore liquidity for financially viable operations. This, together with a stronger carbon market, would ultimately eliminate the need for CEFV.

D. Clean Energy Support Fund (CESF)

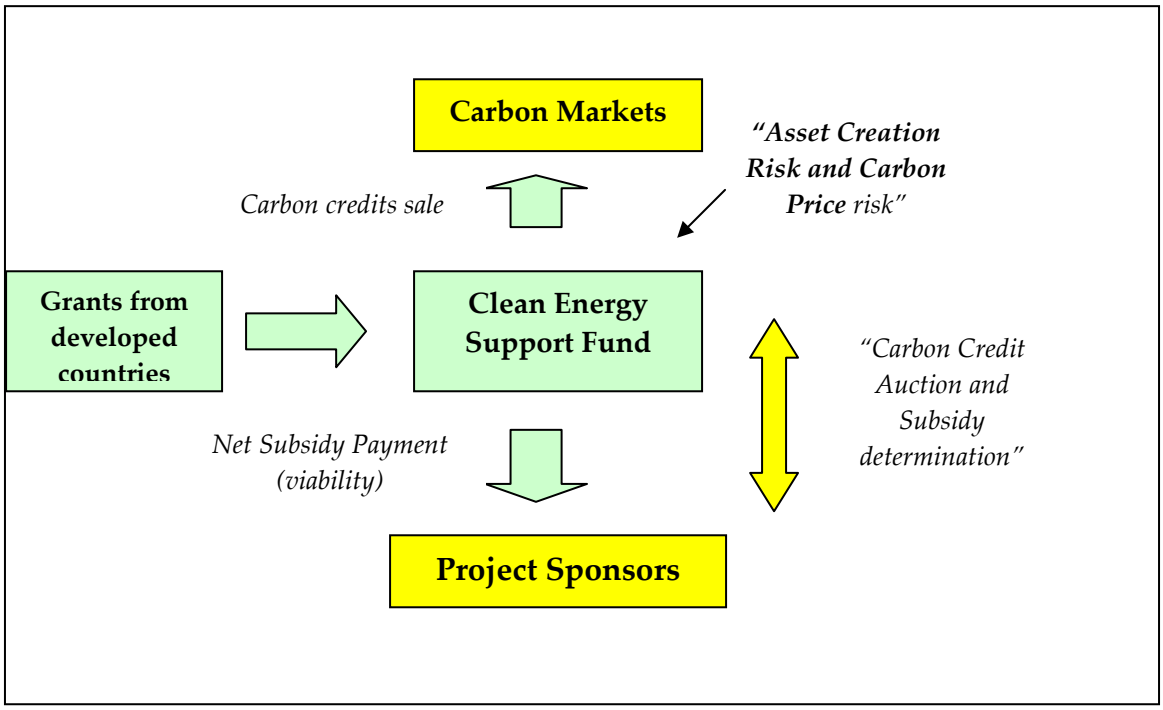
25. ***Another alternative to consider would be a simple subsidy mechanism that supports projects in line with the degree of carbon emission reduction.***

26. ***Determining a Shadow Price and subsidy level***. Such a fund will be neutral with regard to technology choice. To achieve this it would use an administratively determined "shadow price" for carbon emissions to signal which projects are eligible for funding. This will be in line with the standard approach of cost-benefit analysis correcting the financials of a project for "externalities". In this case the costs of carbon emissions – based on best possible analysis of the marginal cost of reducing emissions by a unit of carbon. If eligible, the CESF will calculate the difference between the project costs (net present value) with and without the carbon credit cash flows. Such flows will be calculated using the *shadow price*. This difference will constitute the maximum subsidy amount the fund is willing to pay to support the project financial viability.

27. ***Buying down the costs of clean technology***. Eligible projects would be competitively selected so as to ensure that only the lowest required subsidy is paid and to avoid inflating project's profits excessively. Subsidy payments could not exceed the level indicated by the "shadow price" of carbon. De facto the "shadow price" of carbon would act as the reserve price in the competitive process.

28. ***Carbon credit generation***. The projects that are thus chosen and made financially viable by use of the subsidy may generate carbon credits depending on the regulatory system (i.e., certification process) in place. To the extent that carbon credits are generated, the fund will obtain the right to project associated credits in exchange for the subsidy payment. Carbon credits will be traded by the fund in the carbon finance markets.[5] Net revenues from such trading will be used to replenish the subsidy fund.

29. ***Risks***. The fund will take the market price risk of carbon credits as well as the risks associated with the carbon assets creation (i.e., regulatory risks associated with the creation of certified emissions reduction – CERs). If a strong carbon finance market develops after 2012 the trading of carbon credit will ensure the fund continuity (no depletion of funds). Alternatively, if carbon finance markets were not to continue their evolution and further strengthening, the fund will be depleted over time. Such fund will require initial donor contributions and eventual replenishment if carbon finance markets do not develop adequately.



30. ***Market evolution.*** Such a pure grant fund would ensure that markets are not distorted. The "shadow price" acting as the reserve price in the competitive process will support market continuity in the event of market deterioration due to uncertainties in the post 2012 global regulatory system. Any organization (or consortium of organizations) can develop projects and apply to the fund. Competition for the fund resources should ensure that the subsidies paid out are the minimum required subsidies to achieve emission reductions. This scheme will maximize the effectiveness of grant funds.

[5] Through qualified market operators.

E. Mechanisms to Support the Carbon Market

31. ***Uncertainties surrounding the future of the post-2012 global regulation system could affect the further development of the carbon market.*** Several ideas could be explored which could provide some risk mitigation during this period of market uncertainty. These could provide support to a developing market that has great potential to facilitate investments in clean energy in developing countries through mobilization of private capital. The main purpose would be to assure sellers of project-based emission reductions of the continuity of a carbon market.

32. ***Several mechanisms to approach the problem could be considered,*** including: (i) creation of a continuity fund to provide liquidity for the purchase of carbon assets and (ii) implementation of a reserve price support mechanism for eligible, project-based carbon credits, to improve the credit quality of project cash flows and stabilize the nascent carbon market as described in the CESF (see Box 5). Consideration of these mechanisms should include the analysis of their compatibility with proposed financing instruments. Given the complex market environment, and the need to avoid unintended market distortions, broader consultations with private financial markets, development institutions and donor countries would be critical if these were to be developed further. Conflicts of interest would also need to be carefully assessed.

Box 5: Market Support Mechanisms

Continuity Fund. The fund would provide continuity for the carbon market, while the emission reduction commitments and other regulatory elements of the post-2012 period are being negotiated. The fund would assure sellers of the existence of a pool of liquidity to buy carbon credits and sign emission reduction purchase agreements for post-2012 delivery from projects that could start before any new commitments have been negotiated. Participants in the fund could include large emitters with potentially large compliance gaps and OECD governments. Participants would be able to purchase emission reductions at attractive prices, given market and political uncertainties, and hedge for future compliance commitments or to meet unilateral/national targets. Initial size of the fund would be about $1 billion. Replenishments might be needed to ensure market continuity if there was sustained uncertainty about the post-2012 regime.

A mechanism to support price levels for post-2012 project-based carbon credits. The objective would be to support long term investments in low-carbon energy through price risk mitigation in the carbon market. The mechanism would provide sellers of project-based emission reductions in developing economies a threshold level of revenues for carbon credits beyond 2012 .Similarly to the CESF option, this mechanism would rely on an administratively determined "shadow price", and offer to buy project based carbon credits at this price from eligible sellers. Eligibility would require, inter alia, advance registration by potential sellers, so the contingent liability can be tracked and limited to the amount that the donors supporting the mechanism are willing to be exposed to. Such mechanism would act as the reserve price and would support market continuity in the event of market deterioration due to uncertainties post 2012.