The World Bank Group

Energy Strategy Approach Paper Annexes

Sustainable Development Network

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Abbreviations

AFR	Africa region of the World Bank (Sub-Saharan Africa)
ARPP	Annual Review on Portfolio Performance
BP	Bank Procedure (part of the World Bank Operational Manual)
CAI	Clean Air Initiative
CAS	Country Assistance Strategy
CEIF	Investment Framework for Clean Energy and Development
CIF	Climate Investment Funds
CO_2	carbon dioxide
CTF	Clean Technology Fund
EAP	East Asia and the Pacific
EBRD	European Bank for Reconstruction and Development
ECA	Europe and Central Asia
EI	extractive industries
EITI	Extractive Industries Transparency Initiative
FFT	Fuel for Thought: An Environmental Strategy for the World Bank Group
FY	fiscal year
GDP	gross domestic product
GEF	Global Environment Facility
GHG	greenhouse gas
IBRD	International Bank for Reconstruction and Development
IDA	International Development Association
IEA	International Energy Agency
IEG	Independent Evaluation Group
IFC	International Finance Corporation
INFRA	Infrastructure Recovery and Assets Platform
LCR	Latin America and the Caribbean region
MIGA	Multilateral Investment Guarantee Agency
MNA	Middle East and North Africa
LPG	liquefied petroleum gas
OD	Operational Directive (part of the World Bank Operational Manual)
OECD	Organisation for Economic Co-operation and Development
OMS	Operational Manual Statement (part of the World Bank Operational Manual)
OP	Operational Policy (part of the World Bank Operational Manual)
OPN	Operational Policy Note (previously part of the World Bank Operational Manual)
PPAR	Project Performance Assessment Report
QAG	Quality Assurance Group
QALP	quality assessment of the lending portfolio
QEA	quality at entry
QSA	quality of supervision
RON	research octane number
SAR	South Asia region
SIAP	Sustainable Infrastructure Action Plan
SREP	Scaling-up Renewable Energy Program for Low-Income Countries
SSA	Sub-Saharan Africa
WAPCo	West Africa Gas Pipeline Company Limited
WBG	World Bank Group

Units of Measure

GW	Gigawatts
MW	Megawatts
Toe	tonnes of oil equivalent

Annex 1: Key Energy Sector Issues and Policies for the WBG Client Countries

A survey of WBG energy staff in the six World Bank regional and IFC departments identified a large number of energy sector issues judged to be important for selected countries in the next 10 years. Several issues are thought to be of importance in every region, while some issues are only country-specific. Detailed responses are given in Appendix 1 of the Approach Paper.

A priority seen for every region is the need to increase the amount of power supplied to users, whether by increasing capacity of generation or transmission or by improving the efficiency of utilities. Equally important is the need to increase the efficiency of end-use consumption, which is equivalent to adding more capacity. Many countries, and several regions, mentioned existing and looming power shortages, with their attendant costs of load shedding (intentionally engineered power outage), as an issue that needs urgent attention.

Another concern in every region that is linked to the need to increase capacity in the power sector is financing such investments. How to finance raises a number of issues. The need to improve the financial performance of public utilities (in part through reducing technical and commercial losses) and instituting cost-recovery pricing are considered important for financing the needed investment. Several regions emphasized the importance of the private sector in financing expansion of the sector, and pointed to the challenges presented to this by the current financial crisis, but also to the potential for WBG action in this area.

The staff in every region considered enhancing energy efficiency, through both demand side management and better power sector supply practices, to be of major importance in the coming years. Energy efficiency improvement brings two benefits: it can reduce the need for more capacity and energy generation, and can also reduce GHG emissions with their attendant effects on climate change.

Making further improvements in access to electricity was indicated as a high priority in all regions, except for ECA and MNA (apart from Yemen) where access is nearly 100 percent. This too is linked to the need to increase the capacity of power sectors that are already struggling to meet current demand. The encouragement of off-grid solutions as a method to increase rural access is seen as a priority. The use of off-grid distributed generation is in turn linked to another priority for client countries, that of increased use of renewable energy. Only in ECA was the increased use of renewables not seen as a high regional priority, although judged important in some countries.

Concerns with climate change are reflected very widely, with increased attention to the use of renewables, demand-side energy efficiency, and improved efficiency of utilities, all identified as requiring action. Both the government, through regulations, mandates, and appropriate investment, and the private sector, through well-targeted investments, will be called upon to support these requirements.

Energy security (understood here as ensuring adequate supplies of energy while making modern energy services accessible and affordable to all people) beyond the impacts of inadequate power supply was judged important in all regions. The recent high prices experienced for fuels (especially oil) and the accompanying volatility of prices, are giving considerable impetus to policies designed to improve energy security through fuel diversification as well as energy savings.

These issues require a variety of policy responses depending on country specific circumstances. The nature of these problems and possible approaches to their solution is outlined below.

Shortages of power

A substantial number of countries in all regions are experiencing or expect to experience shortages of power that result in brownouts and blackouts. According to a 2005 study, a number of countries have experienced episodes of substantial blackouts during the last decade. In the 19 countries analyzed, the loss to blackouts ranged between 2 and 10 percent of annual sales (Maurer and others 2005). Any unplanned interruption to the supply of electricity is very expensive for users as well as for suppliers. Power shortages are either due to capacity shortage, energy shortage, or both. A system is energy-constrained if it does not have enough fuel to continue to supply on a long-term basis, even if it could temporarily meet demand. An example is when water levels in a hydro system are too low, or there are fuel shortages, or the utility cannot afford to purchase sufficient fuel due to its weak financial state. A system is capacity-constrained if it has sufficient fuel but does not have enough available generation (or transmission) capacity to supply the demand. A capacity shortage can occur either because there has been too little investment to keep up with growing demand, or an individual generation unit unexpectedly requires maintenance or repair. To account for scheduled maintenance and to avoid the costs associated with a generation unit suddenly failing, countries keep a certain reserve margin, but these have tended to be reduced in recent years (IEA 2005).

The costs of blackouts are very high. For industrial and commercial customers the first hour of a blackout tend to be the most expensive: output is lost, supplies or equipment can be spoiled, or expensive backup generation (usually diesel powered) is utilized. Although costs are country- and situation-specific, it is generally agreed that they will be many times the tariff charged. For residential customers the losses are lower, but still can be substantially higher than the tariff (Annex 2). Where blackouts are relatively frequent, households may ensure that they have access to alternative sources of lighting, cooking, and even heating fuels, but this adds to total costs. Households also can suffer spoiled goods and loss of production. In 2008 the South African power utility evaluated its expansion plan using an average cost to all consumers of unplanned blackouts of 75 South African rands (US$8) per kilowatt-hour (kWh) (ESKOM 2008). Preliminary results from a survey of developing countries worldwide indicated that the value of lost sales from blackouts ranged between 2.3 percent of total sales in the OECD to 7.4 percent in South Asia (Table A1.1)

Table A1.1 Regional power sector performance indicators (recent year averages)

Grouping of countries	*Number of power outages in a typical month*	*Value lost due to power outages (% of sales)*	*Delay in obtaining an electrical connection (days)*
All countries	*10.9*	*4.4*	*29.9*
East Asia & Pacific	14.2	2.8	21.5
Eastern Europe & Central Asia	8.0	3.1	20.2
Latin America & Caribbean	3.0	4.1	34.2
Middle East & North Africa	4.4	4.4	55.4
OECD	Not reported	2.3	9.7
South Asia	101.6	7.4	49.0
Sub-Saharan Africa	13.53	6.0	33.0

Source: IFC 2009.

Policies to cope with existing or looming power shortages depend on the underlying cause. Where there is a capacity constraint, the utility will need to increase capacity or reduce demand. Depending on the circumstances of the country, additional domestic generation, improved transmission, the construction of an interconnector to a neighboring country with excess capacity, or any combination of these measures may need to be evaluated. Where power shortages already exist, and until new plants can come into operation, various rationing schemes that use price signals can be effective in reducing demand. The use of energy efficiency measures can help both reduce the high costs of load shedding and improve energy

security, and, in certain cases, reduce GHG emissions. Because the costs of blackouts are high, the value of energy efficiency improvements is correspondingly high and should be attractive particularly to industrial and commercial users that bear the largest costs of such blackouts.

A different set of policy responses come into play for energy shortages. Water shortages for hydro plants may be cyclical due to droughts—these may be linked to changing precipitation patterns linked to global warming—or to overuse. Countries facing deteriorating hydrological conditions will need to diversify their source of energy in order to maintain a reliable supply of electricity. Other fuel shortages can be due to a variety of reasons; a breakdown in the delivery chain anywhere from the point of import or production can result in loss of supplies. Where domestic stocks are inadequate to cover for such disruptions, the power stations are forced to curtail production. Government policies need to address such weaknesses in the supply chain and the adequacy of stocks. Where the fuel is imported, the possibilities for disruption become greater, and this is particularly true for landlocked countries that rely on the transportation system (pipeline, trucks, or rail) in another country. Source and fuel diversification may be able to reduce the risks of a supply shortage in such a situation.

Table A1.2 summarizes the results of a World Bank energy staff survey which asked where load shedding is an issue today and, where hydro power generation accounted for more than 10 percent of total generation in 2006, and among these countries where there is a serious hydro power shortage as a result of unfavorable hydrology.

Table A1.2 Load Shedding and Status of Hydro Power
(percentage of countries)

Region	*Load shedding is an issue*	*Hydro power more than 10%*[1]	*Hydro power shortage*[2]
Africa	72	62	6
East Asia and the Pacific	25	38	33
Europe and Central Asia	26	70	43
Middle East and North Africa	73	31	0
Latin America and the Caribbean	24	86	28
South Asia	86	86	33
Total	53	62	14

Source: EIA 2009 and World Bank staff survey.
1. Hydro power was more than 10% of total generation in 2006, from EIA 2009.
2. The percentage of countries where hydro power accounted for more than 10% of generation in 2006 where there is a power shortage, from the staff survey.

In the short run, before major new investment can be planned and completed, governments have used a number of coping policies. Countries facing shortages of water have purchased or leased small diesel generators that can be installed very quickly, but this is an expensive solution both in capital and fuel costs. Other countries have imposed rationing schemes in such a way as to make the load shedding more predictable, thus giving consumers a chance to plan around the blackout. Some have also introduced differential prices, so as to persuade large users to reduce demand at peak times. Restrictions on the use of electricity for lighting, air-conditioning, and other power applications in public buildings can also help reduce the demand.

Policies to reduce energy demand primarily involve the market mechanism, but possible adverse effects on social equity require an offsetting mechanism. Governments facing opposition to sudden across-the-board price increases have increasingly looked to find a way to protect low-income households from the full impact of such changes. For electricity, some countries offer lower tariffs to households whose consumption level is below some threshold, on the grounds that the poor consume less energy than the

well-off. Fossil fuel prices affect low-income households directly through fuel purchase and indirectly through purchase of goods and services that use fossil fuels, and often the total impact is greatest in percentage terms for the lowest-income quintiles (Andriamihaja and Vecchi 2007). Two-tier pricing for fossil fuels to protect the poor has been used but is not practical because of significant leakage. The best social protection measures are social safety nets through such devices as cash transfers targeted to low-income groups (Grosh and others 2008). The possibility of future price shocks strengthens the case for ensuring that the necessary steps to implement a safety net policy are in place before such a shock occurs.

For countries with high power consumption and many large users, the use of demand response mechanisms can provide a substantial reduction in peak power demand and hence also in generation and transmission capacity required. Where the appropriate metering system can be installed, utilities can use time-of-day or peak-load pricing to provide incentives to reduce consumption. Smart grid investments are also starting to be introduced in high-income countries in order to permit power to be transmitted more efficiently and hence to reduce the system use of energy and capacity. These technological responses to the higher costs of fuels and to energy and capacity shortages are already commercially proven and will become more economic over time as their use spreads. Developing countries, particularly those with large markets and many large buyers, will be able to benefit from their introduction. Some governments have used policies to mandate a reduction in the use of electricity or petroleum products by commercial businesses and government departments (Bacon and Kojima 2006).

Many developing countries are experiencing large technical and commercial losses in the sale of electricity to consumers. There are several reasons for this but experiences in countries that have managed to reduce losses offer an important lesson. An integrated response designed to reduce these losses can be very effective and financially viable. Ensuring that consumers actually pay for the power they use—through improved billing and collection and the reduction of theft—both improves the financial health of the power utilities (enabling them to make key investments) and at the same time tends to reduce demand as consumers face the true costs of their usage (Antmann 2009).

Demand for power can also be reduced through investing to improve energy efficiency outside of the power supply sector. For example, the lighting sector has already experienced major improvements in efficiency, as compact fluorescent lamps (CFL) have started to replace incandescent light bulbs. The expansion of this market has driven down costs substantially and an increasing number of countries are adopting programs to encourage this switch. Light emitting diodes (LED) are starting to enjoy wider usage with falling prices and technical advances. Opportunities for energy efficiency improvements exist in other activities such as building insulation, heating/ventilation and air-conditioning systems, and use of household appliances such as refrigerators. Governments are working with multilateral and bilateral agencies to develop business models that will catalyze commercial energy efficiency programs that are financially self-sustaining. However, the extent of energy savings resulting from energy efficiency improvements is partially offset by the “rebound effect.” Where efficiency improvements result in a decrease in the cost of a unit of an activity, users are able to use that activity more without increasing the total costs paid. For example, as the cost of home heating or air-conditioning is reduced through energy efficiency improvements, households have been observed to increase the amount of heating or cooling utilized (UK Energy Research Centre 2007). A similar phenomenon has been observed in the transport sector where the choice of a more fuel-efficient car leads to increased driving.

Countries requiring more baseload capacity are facing a particularly difficult choice. In the absence of untapped hydropower or geothermal resources, other energy sources often present difficulties. Absent suitable domestic supply, natural gas is expensive and requires large infrastructure investment (terminals, pipelines, or regasification plants). Nuclear power is technically advanced and requires a large market in

order to be able to exploit economies of scale[1] while not permitting a single plant to dominate the whole power system; there are also unresolved issues of fuel waste disposal and other environmental and safety risks as well as concerns about nuclear proliferation. Coal is often the lowest cost option, but is the largest GHG emitter. The most advanced commercially proven coal burning technologies (supercritical and ultra supercritical) have lower emissions per unit of energy delivered than older coal fired plants, but still emit considerably more CO_2 than almost all other options. Carbon capture and storage (CCS) still needs to be demonstrated on a large scale. CCS is also still at the pilot stage, and, although new coal-fired plants can be made "CCS ready," it is not yet certain how soon this technology could become commercially viable. For these reasons countries looking to increase baseload need to pursue all options for improving efficiency and reducing demand. Countries that can utilize more intermittent plants and reduce the call on baseload plants have a wider range of choices, including several renewable technologies. As costs of wind and solar energy fall these options will become increasingly attractive.

Concerns about supply

The experiences of the last few years have greatly increased concerns about threats to security of energy supply—physical disruptions to supply, energy prices that are markedly higher than what might be broadly considered "affordable," and very large price volatility—in many countries. Energy security has been adversely affected by two major developments: (1) the experience of fossil fuel prices rising to record levels, coupled with great price volatility; and (2) the disappearance of sufficient reserve capacity in the power sector, leading to load shedding and blackouts.

To address increasingly volatile fuel prices and concerns about supply security, governments are increasingly turning to self-sufficiency. Often dubbed energy independence, policies to reduce import dependence have included subsidies and even mandates for domestically-sourced fuels (most prominently biofuels), promotion of domestic exploration and production, setting targets for lowering energy imports, trade restrictions in a handful of exporting countries, and actively encouraging companies—many state-owned—from one's country to gain control of fuel resources in other resource-rich countries. Raising trade barriers through subsidies targeted at domestic production and other means can even diminish rather than enhance security of supply. Careful consideration should be given to policy formulation for supply security before adopting these policies.

High and volatile fossil fuel prices

The causes of the recent high oil prices were global in nature, related to rapid demand growth while surplus capacity to supply oil decreased. In such a situation, anticipated possible shortages led to an extremely rapid rise in prices. The global recession has since led to a fall in demand, the restoration of surplus capacity and the rapid decline of prices to levels last seen in 2004. Gas and (internationally traded) coal[2] prices move in a similar fashion to oil prices. The costs of coping with these high prices has been severe in some cases, with many countries experiencing large increases in the value of the net oil import bill relative to GDP (Table A1.3). The higher oil and other energy prices were especially burdensome for those low-income households that were using modern sources of energy for cooking, heating, lighting, and powering basic appliances (such as radios and fans) and that depended on public transport. The possibility that prices may increase again in the next few years is leading countries to develop policies for restraining demand and a more diversified energy portfolio in order to cope better with a future shock.

[1] The average size of the 436 nuclear reactors operating in January 2009 was 850 megawatts. See www.world-nuclear.org/info/reactors.html.

[2] International spot coal prices move in tandem with oil prices, but a very small percentage of world coal production is internationally traded at spot prices. The vast majority of coal production is domestic coal for power generation which is sold at long-term contract prices, as in such large markets as China, India, South Africa, and the United States.

Table A1.3 Countries Experiencing an Increase in Oil Vulnerability of More than 15 Percentage Points Between 1997 and 2007

Country	*Percent*	*Country*	*Percent*
Burundi	15.0	Antigua and Barbuda	20.6
Belize	15.2	Yemen	21.5
Ghana	15.8	Solomon Islands	22.4
Lebanon	15.9	Sierra Leone	22.7
Saint Lucia	16.1	Congo (Brazzaville)	23.3
Namibia	16.2	Nicaragua	24.1
Kiribati	16.4	Jordan	24.4
Honduras	17.1	Tonga	26.3
Gambia, The	17.2	Maldives	29.6
Kyrgyzstan	17.3	Tajikistan	31.3
Uzbekistan	17.7	Jamaica	34.3
Mauritius	18.2	Guinea-Bissau	39.0
Grenada	18.5	Togo	45.8
Panama	18.5	Seychelles	50.9
Benin	19.8	Guyana	52.7
Liberia	20.1	Djibouti	63.7

Source: World Bank staff calculations updated from Bacon and Kojima (2008b).
Notes: Vulnerability in a year is defined as the ratio of the value of net imports of crude oil and petroleum products to GDP measured in U.S. dollars in that year.

A number of governments have adopted pricing policies either to lower the level of oil prices to domestic consumers, or at least to smooth their volatility. The former approach proved extremely expensive during the recent price run-up and is not a viable long-term solution. Other governments used policies to smooth consumer prices by setting administered prices according to an average of several weeks' or months' past prices. These schemes also proved expensive during the period when international prices were constantly increasing: domestic prices were almost always lagging behind, requiring a constant injection of financing by the government to cover the gap. The lessons of this episode are clear but, in those countries where consumers have become accustomed to smoothed prices, governments may find it politically difficult to allow prices to fluctuate with world oil prices.

Diversification

In the medium term, the power sector has the highest potential for fuel diversification. The bulk of fuel used is for baseload (plants that run most of the time with a high capacity factor; see Annex 3), and these tend to have a high capital cost but low operating cost. Baseload plants include coal, hydro, or nuclear; gas and oil are less commonly used. At the other end of the spectrum are peaking plants, which may be used only for a few hours a day (low capacity factor), but which can respond rapidly to changes in demand without long delays or high start-up costs. Peaking plants have lower capital costs but higher operating costs, and are most commonly gas fueled. Between these two cases are intermittent plants that can supplement the baseload plants but can neither guarantee continuous supply nor "follow demand" as it climbs to a peak and then falls back. Concentrating solar and in most cases wind power are currently in this group. These technical features limit the possibilities for fuel substitution. A few countries (including some island nations) rely heavily on diesel or residual fuel oil—which is used for both baseload and peaking—for the bulk of their generation and for these fuel diversification can be a high priority; for some, the falling costs of solar and wind power are providing a route to diversification.

In the transport sector, which at present relies almost entirely on petroleum products, the options for fuel diversification are at present limited. First-generation biofuels in many cases require a subsidy to be competitive with gasoline and diesel, and can lead to land use changes, adding to GHG emissions in the medium term. Competition for land and water can also lead to food price increases, as seen in 2007 and

2008. Second-generation biofuels are only beginning to be piloted on a commercial scale and face several technical hurdles, and, depending on feedstock sources, there may continue to be competition for land and water (Kojima and others 2007). Improvements in technology (hybrid and plug in hybrid vehicles, as well as improved fuel efficiency for internal combustion engines) can lead to substantial fuel savings and emissions reductions. Even with policies mandating stricter fuel-economy standards for new vehicles, the time to replace a large part of the existing vehicle fleet and to achieve a stabilization of emissions could be lengthy.

Global and local benefits of reduced energy demand

Policies to reduce demand in order to cope with local shortages of supply can have a number of benefits. In addition to sometimes being the least-cost solution to balancing supply and demand and avoiding load shedding which is costly to the economy, these policies contribute to a reduction in the global demand for energy. Were energy demand reduction to be widely implemented, then the pressure on global energy supplies would be reduced, thus reducing the risk of price spikes as seen in recent years. Where energy is more readily available, the risks of regional conflicts over access to energy sources would be correspondingly reduced.

Efficient management of the energy sector and investment

The challenges faced by the power sector include supplying power on a reliable basis, coping with the possibility of high and volatile primary fuel prices, improving access of the community as a whole to electricity, and responding to the urgencies of global warming. Many steps to cope with these problems require investment and, faced with these issues, both public and private utilities need to strengthen their financial and technical performance.

There have been a number of approaches to improving the performance of public utilities, ranging from full-scale vertical and horizontal unbundling and complete privatization, through changing legislation to add independent power producers to the system, to doing nothing except for the government financing directly or indirectly any deficits. Experience has shown that attempts to copy reforms enacted in larger or more sophisticated markets have often not succeeded in meeting expectations in smaller lower-income countries, and that reforms need to be tailored to country-specific situations and circumstances (Besant-Jones 2006, Gratwick and Eberhard 2008).

Reforming the electricity sector may be helpful in meeting the immediate needs to improve the power supply and lower costs, but the very large requirements for investment in all parts of the power sector evident in many developing countries will require a range of policy responses from governments. Even well-run public sector utilities may not be able to simultaneously bear the costs of electricity subsidies while financing investments to meet increasing demand and improve access. Governments can support the power sector by reducing subsidies and by financing them transparently out of the budget, leaving the utilities in a more viable financial position. At the same time utilities need to improve their own financial performance.

A high priority therefore for many utilities is to reduce the scale of technical and commercial losses. These can be so large that loss reduction can lead to a substantial strengthening of the financial position of the utility, thus facilitating investment in new generation and in improving access. At the same time effective programs can reduce the consumption of energy, increasing energy security and reducing overall emissions. Some technical losses from the transmission and distribution system are unavoidable, but good design can help minimize them. Losses in the range of 7 to 10 percent of electricity sent out are experienced in North America and Western Europe, but they are substantially higher in many developing countries. Reducing technical losses can result in more energy available to users with a resulting reduction in energy input or a reduction in rationing. Commercial losses are often even more serious in developing countries (Antmann 2009). In India, combined technical and commercial losses were reported

to exceed 40 percent in some states, a significant fraction being non-technical (Singh 2007). A survey of 22 power utilities in Sub-Saharan Africa showed that 15 experienced total losses of more than 20 percent of power sent out in 2005 (Ouedraogo 2007). Encouraging energy efficiency programs can also save energy and be financially viable if adequate business models are developed. Use of smart grid technologies adapted to the circumstances of developing countries and smart metering can provide incentives to save energy and to use generation capacity more effectively.

An interesting case is the "large for small" policy in China. Implemented now for two years, this policy requires that for every new power generation project—and all pulverized coal-fired power generation units have to be at least 600 megawatts (MW) in size and use super- or ultra-supercritical technology—small units with low efficiency equivalent to 70 percent of the new capacity be retired. This raises the average efficiency of power generation and slows down the growth of CO_2 emissions.

Even where losses are reduced and energy efficiency programs are introduced, countries will still need to invest in new plants, or to rehabilitate old plants, and their financing costs will be substantial. The structure of the power sector will determine the potential sources of financing. A survey in 2006 of 144 developing countries found that a vertically integrated state owned monopolist supplied power in 79 countries, independent power producers sold power to a vertically integrated monopoly in 36 countries, and 35 countries had a more complex ownership structure (Besant-Jones 2006). The survey findings indicate that in most countries the utility itself will have to finance the expansion of distribution and transmission. Where independent power producers are permitted, private sector investment provides an important alternative source of financing.

In the 1990s private sector investment in power increased rapidly but then declined sharply until a major recovery in 2007. Even in peak years the sums invested by the private sector were substantially smaller than those that will be required going forward, and it is clear that public utilities or governments will have to provide much of the financing. Data from PPIAF (2008) show that little private sector finance has gone to transmission or even distribution in the last decade, and that the very large sum required as suggested by IEA for these sub-sectors will have to come almost entirely from the public sector.

At the present time financing for power sector expansion may be difficult to access. Utilities that are not covering their costs are unlikely to be able to self finance or conclude power purchase contracts with independent power producers. These difficulties will be exacerbated by the current global financial crisis in which investors will look for higher and safer returns before investing in markets where there is both country risk and commercial risk to any investment in the power sector. Preliminary data indicate that private sector financing for infrastructure projects in general in developing countries was some 40 percent lower between August and November 2008 than in the corresponding period a year before. Project delays or cancellations have been widespread and other projects under consideration are also in danger. Options with high upfront capital costs (such as coal and nuclear) as well as those that are not least cost (such as new renewables) are finding the current investment climate particularly challenging.

Access to reliable sources of energy

Increasing access to clean and reliable sources of energy contributes to meeting the Millennium Development Goals through a number of channels. The availability of even small amounts of electricity (for lighting) has been linked to better educational performance. Home businesses also require larger amounts of reliable supplies of energy. The use of kerosene or liquefied petroleum gas (LPG) for cooking can replace the use of biomass, which creates levels of indoor air pollution detrimental to health. Even poor households are willing to pay substantial amounts (relative to their income) to purchase a few kWh a month of electricity if it is available.

The availability of affordable clean fuels and electricity, especially in rural areas, is particularly beneficial for women and children. Women are more frequently involved in the collection of firewood and nearly universally engaged in traditional use of solid fuels for cooking. Because women and children spend much time at home, they are more exposed to harmful effects of burning solid fuels. Conversely, they tend to benefit more from the convenience and leisure benefits of access to modern commercial energy. Home businesses tend to be more often engaged in by women, and the availability of reliable lighting can improve their productivity substantially. Children benefit particularly from the increased possibilities that adequate lighting provides for education both at school and in the home.

The challenge is how to accelerate granting access to more than 1 billion people without electricity, many of whom value only a few kWh a month at more than the tariff charged in the country. An important reason why people do not choose to be connected to grid electricity (when available), or utilities choose not to offer to supply them, is the capital cost of providing the connection, wiring, and the meter required. These costs depend on the length of line to be laid, so that extending grid access to a previously unconnected area will be more expensive. Such costs can be shared between those households that choose to connect but are still large. In its reference case scenario IEA assumed that the cost of an urban connection would be US$370 per household and the cost of a rural connection would be US$425 per household (IEA 2008). Even with various schemes to spread out such payments over time, the costs of connection relative to value of the likely demand for electricity for low-income households will be prohibitive. Two approaches to this dilemma are found, sometimes both being utilized in the same country. Utilities may take on some or all of the cost of connections, financing these either through cross-subsidies from larger consumers, or from specially allocated government funds. Where the utility is in poor financial health, its ability to support increased electrification is limited. A second solution aims to fit total costs of supply more closely to households' willingness to pay. Because lighting is the priority application for new users to electricity, finding alternatives to grid electricity (or kerosene) for lighting is attracting wide attention. Portable solar lanterns are dropping in price, and alternative business models for recharging are evolving. Off-grid generation solutions are now appearing that can supply a number of households, without having to carry the costs of a lengthy transmission link from the main grid, and their wider use is allowing cost of equipment to fall. Such solutions include wind, solar photovoltaic, and mini-hydro.

A further factor limiting utilities' interest in grid extension to new customers is the fact that so many are unable to serve their existing customers reliably. The cost of the blackouts to the customers, and loss of potential revenue to the utility, can make their reduction a higher priority than extending the grid to new customers, which is costly and in many cases unprofitable, and whose incremental demand would only make the shortage situation worse.

The rapid urbanization experienced throughout the world has meant that the rate of electrification in many areas is inadequate. The growth of shanty-towns and peri-urban areas presents a number of challenges for utilities. Even where there are low voltage distribution lines laid to an area, many household obtain electricity through illegal connections. Billing and metering legal connections in such areas is often only partial, and the combined effect is large commercial losses. Governments are starting to improve their service of such areas through systematic planning for improving service and loss reduction.

For lower-income groups that may be able to afford connection to a grid supply of electricity, or who rely on kerosene for lighting, the recent energy price increases represented a potentially substantial loss of welfare (although considerably less than that due to the food price increases that occurred during a similar period of time). Governments responded in a number of ways. Many governments declined to allow the full impact of these price increases to be passed through to consumer prices, and controlled domestic prices of electricity and petroleum products. This policy turned out to be fiscally expensive, given the extreme rise in oil prices, and most of the benefit went to better-off households who consumed much more energy. As a way of limiting the fiscal cost while protecting lower-income groups, some

governments have used targeted or conditional cash transfers to compensate the lowest-income groups while allowing retail prices to more fully reflect the costs of energy. As more experience is gathered on how to efficiently operate such schemes, governments may come to prefer this targeted assistance to using general energy subsidies. The recent fall back in prices has provided governments with an opportunity to narrow the gap between domestic prices and international prices, while not imposing too heavy a burden on low-income households. In the power sector it is common practice at all times to use lifeline pricing, in which the first block of consumption—such as often 50 kWh a month—is priced below subsequent blocks. This scheme also benefits all income groups and an alternative scheme exist in which only households whose total consumption is less than 50 kWh receive the lower rate. The application of such a scheme depends on being able to identify such households either through metering or by some other criterion that approximates to low usage (e.g. location).

Climate change and local environmental problems

The growing concern over global warming, and the likelihood that major decisions with respect to the energy sector will emerge from the United Nations Climate Change Conference in Copenhagen, presents a challenge for all countries. Investment decisions taken or planned now will largely shape a country's emissions path in the coming years and decades. Choices of fuel to use for generation and of energy efficiency levels are the key factors. The choice of renewables (including hydro) or nuclear depend to a substantial part on costs and, in the case of nuclear, safety concerns, and here the awareness of latest developments in proven and commercially viable technology, and the likely trends in costs will be of importance in helping governments to make informed choices.

Particularly important for choosing future fuel sources will be the full evaluation of all options to provide more reliable electricity delivery. Many countries have undeveloped gas reserves, and these should be brought into the calculation, since the high thermal efficiency of the latest combined cycle gas turbine plants, coupled with their much lower emissions of CO_2, can make this an attractive fuel source. Depending on resource availability, hydro or geothermal plants offer low lifecycle emissions, but their local environmental impacts need to be carefully evaluated. In cases where there is no feasible alternative to coal-fired power generation, and energy saving policies are being pursued in parallel, choice of an efficient technology for greenfield or refurbished coal generation plants will be crucial. Adoption of supercritical or ultra supercritical technology can reduce emissions relative to older plants or sub-critical technology. New subcritical plants' have efficiency in the range of 33-39 percent (higher heating value, net), new supercritical plants are in the range 38–42 percent and ultra-supercritical are above 42 percent (MIT 2007, Nalbandian 2009). An important factor is plant size since larger plants have a lower cost per megawatt of capacity, and this can limit the choice for small systems that would be dominated by a least-cost coal plant. An additional feature for future coal plants that is already widely under discussion is that such plants should be CCS ready: there should be adequate space and access for plant to capture CO_2, and that there should be an identified storage reservoir with adequate capacity for the life of the plant.

Potential for energy efficiency improvements exists on both the supply side and the demand side. The former would be undertaken by the power utilities themselves, but the latter can be undertaken by both the public and the private sector. Work by IFC has identified several manufacturing sectors, including cement, steel, and glass, that present opportunities for commercially based energy efficiency improvements. The challenge for these sectors will be to scale up initial projects to provide large scale benefits. Utilities could have schemes for distributing or selling CFLs using their knowledge of the customer base. Where energy prices are heavily subsidized, there is little incentive to conserve energy. Rationalizing energy pricing is important for promoting end-use energy efficiency. Other forms of energy efficiency improvements could include governments mandating more energy efficient appliances or cars, and the creation of energy service companies. The performance-based approach utilized by energy service companies—whereby they recoup their upfront costs through energy savings achieved—often requires initial capital injection. In developing countries, where such an approach is relatively new, sources of

initial funding and training can be important in catalyzing the start of an important contributor to a country's energy saving program.

Local pollution will continue to be important. The large and increasing number of households without access to clean fuels for lighting, heating, and cooking will still rely on biomass for these purposes, together with its associated high level of indoor air pollution. If they are not using biomass for cooking and heating, many poor households use kerosene, especially in urban areas. Accordingly, targeting support to protect low-income households against high oil prices in the future is an important policy consideration. Provided an adequate administrative arrangement can be put in place, targeted income support is cheaper and more effective than providing across-the-board subsidies, much of which leak to higher-income households.

The increasing urbanization across the developing world may worsen the adverse public health effects of air pollution. The damage to public health increases with increasing ambient concentrations of pollutants, toxicity, and exposure. Urbanization increases energy demand in urban areas, increasing the amount of fuels burned, and greater combustion in combined with a growing population may elevate pollutants' ambient concentrations, exposure, or both.

The combination of concern over global warming and the need for energy as a necessary ingredient for economic growth requires a new policy focus toward the energy sector in many countries. Some individual policies are already well tested in a country and merely need further government support, while others are proven elsewhere but are yet to make an appearance in that country. A third group of policies revolve around technologies and government policy interventions that are proven or in a pilot stage only in high-income countries. Faced with the important possibility that relevant technologies are rapidly improving and their costs are declining, countries need to adopt a long-run strategy to set themselves on a sustainable and economically viable energy trajectory. A careful prioritization of actions taken now may be able to avoid costly mistakes later on.

Annex 2: Costs of Power Outages

Electricity is planned to be delivered at standard physical conditions. Failures to do so can affect users in various ways. Three types of variations in quality are widely recognized as a concern:

1. Outages (blackouts) occur when the voltage drops to near zero for a period lasting more than a few seconds, and can last several hours or even days. Outages can be unplanned or planned depending on the causes. All electrically-powered equipment ceases to function during a blackout.
2. Smaller voltage fluctuations also occur. Voltage drops produce brownouts and reduce the performance of certain equipment (lights dim) or can even damage other types of equipment (alternating current induction motors and three-phase motors overheat). Voltage swells are much more uncommon.
3. Other variations in power quality (for example harmonics) can also affect certain types of equipment, such as adjustable speed drives.

Causes of unreliability

There are three different groups of causes of unreliability that can be distinguished, but in practice they are often linked together. Equipment failure is the most common cause in high-income countries. If a generator, sub-station, or transmission line fails unexpectedly and the system is unable to compensate for it through the use of reserve power or alternative transmission lines, then some or all users cease to be served. Power systems have a margin of spare capacity built in to ensure that the degree of reliability is maintained at an acceptable level.[3] Equipment failure leads to unplanned outages. Another cause of unreliability is the planned outage, where a utility has to shut down part of its system for maintenance and does not have enough spare capacity in the system to compensate. Planned outages are usually announced in advance, and reduce the costs to users considerably by allowing them to make alternative plans that avoid the worst impacts of loss of power (Maurer 2005).

A shortage of energy can also lead to blackouts. Too low a level of water in a hydro dominated system can force the operator to reduce or ration supply at certain times, in order to conserve water for the future. Interruptions in the supply of fossil fuels, combined with low stock levels, can have the same effect. Shortages of energy are largely predictable on a short-term basis, and so planned and announced blackouts can be used.

Shortages of capacity mean that the system is unable to deliver enough power at certain times. The exact time at which this may happen will depend largely on fluctuations in demand, which are not easily predicted on a minute-by-minute basis. An extra hot day may result in a surge in the use of air-conditioning, or cold weather for extra heating. Where systems have very little reserve margin to cover normal peak demand the chances of blackouts increase. Utilities in some developing countries that have been short of capacity and faced the possibility of experiencing blackouts, have responded by leasing or buying emergency back-up generation capacity (Eberhard and others 2008). This increases the costs for the utility but reduces the risks and costs associated with blackouts.

Magnitude of outage frequency and duration

There are a number of sources of information on the magnitude of outages. The definitions used in these various sources are not always the same so that they cannot be directly compared. LaCommare and Eto (2004) provide a table covering several years for a number of U.S. utilities. They also quote an earlier study which provides an estimate for the United States as a whole, for which the average number of

[3] In developed countries utilities are often said to aim at "three nines" reliability, that is to be able to deliver power 99.9 percent of the time. This corresponds to a downtime for the utility for about 9 hours a year.

interruptions per year is 1.1 per customer, and the average total outage per year per customer is 107 minutes, yielding an average duration per interruption of 97 minutes.

A particularly detailed set of data is provided by the Council of European Energy Regulators (2008) on European countries based on common measures. Table A2.1 below reports the summary statistics for planned and unplanned events.

Table A2.1 Average Frequency and Durations of Power Outages in Europe in 2006

Country	*Unplanned events minutes/year*	*Unplanned events number/year*	*Average duration in minutes per unplanned event*	*Planned events minutes/year*	*Planned events number/year*	*Average duration in minutes per planned event*
Austria	48	0.9	54	22	0.2	118
Denmark	23	0.4	55	3	0.0	100
Estonia	260	1.6	164	124	0.5	247
Finland	147	6.3	23	26	0.6	43
France	86	1.3	65	8	0.1	132
Germany	23	0.5	51	15	0.1	126
Hungary	128	1.8	71	140	0.6	246
Iceland	106	1.6	68	56	0.2	292
Italy	61	2.3	26	54	0.3	158
Lithuania	169	1.7	102	98	0.4	273
Netherlands	36	0.5	79	3	0.0	141
Norway	96	1.8	63	42	0.3	140
Portugal	243	3.8	64	19	0.1	208
Spain	113	2.4	47	10	0.1	120
Sweden	100	1.3	78	24	0.3	95
UK	89	0.8	106	11	0.0	267

Source: Council of European Energy Regulators 2008.

Adding the planned and unplanned average total outage per year per customer values together produces a large range of total outage time, from 26 minutes a year in Denmark to 383 minutes in Estonia. The unweighted average of unplanned outages across countries produces an average number of interruptions per year of 1.8 events a year and average total outage per year per customer of 109 minutes a year for Europe as a whole.

For developing countries published information is generally more scarce. A source with wide coverage is the World Bank Enterprise Survey Database (World Bank 2009a). This provides information from surveys of business enterprises. The resulting information is therefore based on a sample, and omits residential users. The average number of outages experienced a year and the average duration of the outages experienced in the sample are calculated.[4] The survey does not distinguish planned from unplanned outages, nor does it exclude short duration outages. Because the averages are taken across users and will include both those affected and those unaffected by the outages, the measures correspond to the average number of interruptions per year and average duration per interruption. A summary table—

[4] The World Bank's Investment Climate Surveys ask similar questions to the Enterprise Surveys. Three questions are asked: "During how many days last year did your establishment experience service interruptions? How long did they last? What percent of your total sales value was lost last year due to power outages?" It should be noted that the answer to the first question must not be interpreted as the number of days per year lost to outages, but rather that the product of the first two answers is equivalent to this, providing that there were no occasions on which two or more outages occurred on the same day.

based on the most recent survey carried out in each country and taking unweighted averages across countries reporting for each of the World Bank's region—is provided in Table A2.2.

Table A2.2 Average Frequency and Duration of Outages for Enterprises in Developing Countries (recent years)

Region	*Average number of outages per year*	*Average duration of each outage in hours*	*Average time of outages per year in hours*	*Average % downtime of system per year*
Africa	158	7.4	1172	13.4
East Asia and the Pacific	170	5.8	988	11.3
Europe and Central Asia	96	6.2	595	6.8
Latin America and Caribbean	36	8.0	288	3.3
Middle East and North Africa	53	3.9	206	2.4
South Asia	1219	2.4	2926	33.4

Source. World Bank 2009.

Although Table A2.2 is based on samples of firms and covers only a subset of countries in each region, it is clear that outages are much more common and are of longer duration than in developed countries. The percentages of time when power from the grid was not available (downtime in the table) are very high and indicate that enterprises face a major constraint on their business from the unreliability of grid power supply.

A database on large and small blackouts worldwide is assembled by Yu and Pollitt (2009) but it does not provide comparative information on duration and cannot be used to calculate reliability statistics.

Nature of the impacts of power outages

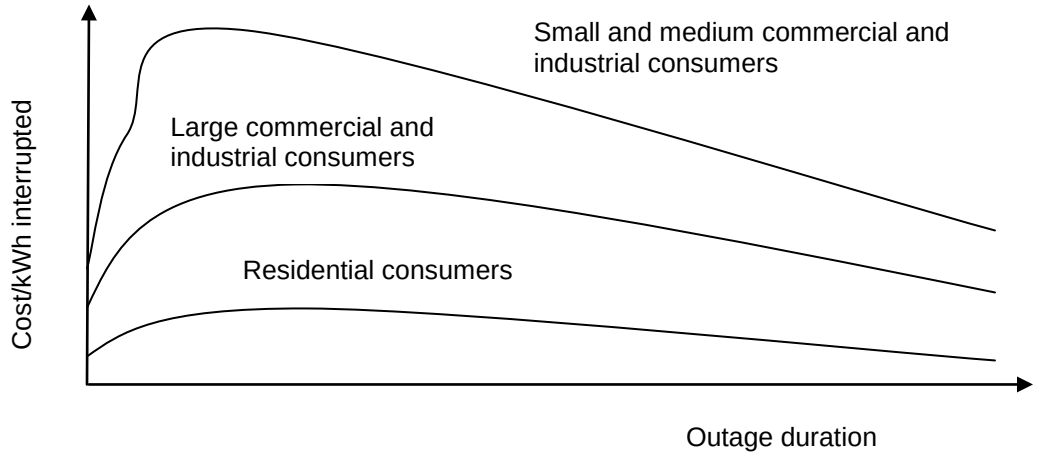
The impacts on non-residential customers arise mainly from lost output. Some output will be lost completely as production is shut down, other products may be damaged, and in more extreme cases equipment may be damaged. Firms may be able to make up some lost output by working extra shifts, but this can constitute an incremental cost. In situations where blackouts are common, firms often have back-up generation (usually powered by diesel) installed to avoid output loss, but the capital, maintenance, and fuel costs constitute an extra financial burden. In certain cases, restoring production takes much longer than the length of the blackout itself and costs are proportional to this downtime. For certain industries reliability is essential, and they cannot afford to be without power for more than a very short period without incurring significant loss of revenue, data, or life. Some particularly sensitive uses include mission-critical computer systems, industrial processing facilities, high tech manufacturing facilities and clean rooms, financial institutions, digital communications facilities, wastewater treatment facilities, hospitals, and healthcare facilities.

Effects on households are different. There can be out-of-pocket costs for back-up supplies such as candles and batteries, or even home generators, and food can be spoiled. Electrical appliances can also be damaged. There are other costs related to inconvenience, changing plans, and the like. Benefits related to power access, such as the use of electricity to read or watch television, will be reduced if blackouts are numerous. Households engaged in domestic production activities can suffer similar effects to firms.

Econometric and other studies have shown several important features of the costs of outages. Costs per customer differ significantly between residential, commercial, and industrial customers. They vary in a non-linaer fashion with the duration of the blackout, with the marginal cost being greatest for the first hour (or period of time) and then declining slowly thereafter. They vary with the size of the enterprise (for businesses), and with the normal use of electricity by the user. They differ by time of day and by season of the year. For households the costs are also found to be proportionate to household income. The

relationship between the duration of the outage and the costs of each extra hour without power is often summarized by a customer damage function which schematically takes the form shown in Figure A2.1.

Figure A2.1 Schematic Marginal Costs of Outages as a Function of Outage Duration



Source: Wikipedia "Value of lost load."

Estimation of outage costs

The methodology of estimating outage costs, known also as the costs of unserved energy or the value of lost load, has generated a large literature. Three broad approaches to estimating the outage costs to users have been developed (for example, see Bose and others 2005). The first is the "production loss method" which relates the value of lost production (including damaged plant) to the loss of power supply. The "captive generation method" estimates the extra cost incurred by the user who uses back-up sources of power, while the "willingness to pay" method obtains a contingent valuation by estimating the user's willingness to pay to have a hypothetical improved power supply. Each method has its own limitations.

The "production loss" method is usually applied by asking a sample of firms for their estimate of lost sales either in a past actual situation or to a hypothetical future situation. Depending on the complexity of the questionnaire, adjustment processes (working extra shifts) may be taken into account. Lawton and others (2003) has an example of such a questionnaire. If loss of sales is calculated as a net cost, then it gives a measure of the loss of GDP to the economy when aggregated over all producing entities. This approach can be used to provide economy-wide estimates of the effects of blackouts.

The captive generation method is typically based on actual cost incurred, but has the obvious drawback that it applies only to users who have installed back-up. It also ignores any other cost involved through the supply disruption.

The willingness-to-pay approach in principle captures all costs incurred by consumers, but the results obtained are known to depend on how the question on willingness to pay is posed. The willingness-to-pay method may undervalue costs of outages if investments to avoid interruptions have already been made, since these would not figure in the user's response to the question asked.

These methods all provide estimates to the cost to specific users of blackouts of varying durations. To obtain a system-wide figure, estimates need to be aggregated over the whole population, including estimates of vulnerability (identifying how many and which users would be affected by a blackout). Econometric methods can be used to relate outage costs to the characteristics of users and of blackouts, thus permitting aggregation across users with different characteristics (household income, normal electricity use, and so on).

Some evidence on the costs of blackouts

To evaluate the aggregate impact of outages two types of information are needed. The first relates to the number and duration of the blackouts, and the number and type of customers affected by each incident. The second relates to the cost to each user of each incident. Utilities have data on the number and durations of incidents, and may also have information on the numbers and types of consumers affected. Individual users know when they have suffered an incident, how long it lasted, and what the costs were.

LaCommare and Eto (2004) carried out a detailed study of costs of outages based on actual data for outages and questionnaires on costs of hypothetical events in the United States. The authors used a regression model to take account of differences in length of duration, type of user, time of day, season, and normal use of electricity. By aggregating over the numbers of actually vulnerable consumers, they arrived at the total costs of various outage events for the various consumer classes. The values for three outage events were calculated: a momentary outage, an outage of one hour, and an outage equal to the average total outage per year per customer for the sample (Table A2.3).

Table A2.3 Estimated Cost per Outage Event per Customer in the USA (2002 dollars)

Duration	*Residential*	*Commercial*	*Industrial*
Momentary	2.2	605	1,893
1 hour	2.7	886	3,253
average total outage per year per customer	3.0	1067	4,227

Source: LaCommare and Eto 2004.

When these costs per event are aggregated over the actual events and user vulnerabilities for 2002, the authors estimated that the commercial sector suffered the largest losses at US$57 billion, industrial consumers accounted for US$26 billion, and residential consumers US$1.5 billion. The much larger number of commercial than industrial users resulted in this sector experiencing the largest costs, despite the much higher cost per event for the industrial sector. Estimates of the marginal cost per hour of duration for each consumer class can be obtained from the regression model estimated.

A study for New Zealand (Castalia 2006) adapted international estimates of the value of lost load to local conditions in 2004. Table A2.4 shows the estimates by customer class, and a weighted average based on the hours consumed by each customer class. The New Zealand data produced much lower costs per kWh of lost load for industry than for commerce and agriculture, indicating that the values are likely to be country-specific. The aggregate value of lost load per kWh of NZ$32 (US$21) can be used for system reliability planning.

Table A2.4 Weighted Average Value of Unserved Energy in New Zealand (NZ$ 2004)

Sector	*Sector VoLL $/kWh*	*Sector share of electricity demand %*	*Weighted VoLL $/kWh*
Residential	4.6	35	1.6
Commercial	75.1	22	16.2
Agriculture	89.2	4	3.3
Industrial	26.6	40	10.7
Total			31.8

Source: Castalia 2006.
VoLL ≡ value of lost load

Bangladesh has suffered high levels of power outages. Wijayatunga and Jayalath (2008) report that in 2000/01 there were 336 unplanned interruptions with average duration of 1.8 hours each, with another 6 planned interruptions of average duration 6.8 hours. A survey of the value of loss of sales for each of the twelve major industries indicated that the cost of unplanned outages averaged US$0.83 per kWh. Planned

interruptions had a much lower cost of lost output of US$0.34 per kWh, but in addition there were fixed costs of avoiding planned outages of US$25.3 per interruption. The authors estimated that 13.6 percent of industrial output demand was unmet due to planned and unplanned outages.

For Africa, where power outages are common, Eberhard and (2008) estimated the loss of GDP to power outages for a number of countries.[5] In some cases a country-specific value of loss of load per kWh was available, and a calculation based on this, and also on a range of common values, was made. Table A2.5 presents the percentage loss of GDP in 2005 to power outages based on these figures.

Table A2.5 Costs of Outages as Percentage of GDP in 2005

Country	*Cost of outages using local VoLL in US$/kWh*	*Cost of outages with VoLL at US$1/kWh*	*Cost of outages with VoLL at US$5/kWh*	*Local VoLL of 1 kWh in US$*
Benin	0.37	0.48	2.40	0.77
Burkina Faso	0.18	0.03	0.14	6.00
Cameroon	0.27	0.08	0.42	3.38
Cape Verde	0.88	0.36	1.81	2.44
Dem. Rep. Congo	NA	1.74	8.68	NA
Ethiopia	NA	0.97	4.83	NA
Kenya	1.79	2.03	10.14	0.88
Lesotho	NA	0.69	3.46	NA
Madagascar	0.96	0.87	4.35	1.10
Malawi	6.40	5.60	27.99	1.14
Mozambique	NA	0.29	1.44	NA
Niger	0.69	0.47	2.33	1.47
Senegal	1.07	0.36	1.82	2.97
South Africa	5.58	0.60	3.00	9.30
Tanzania	4.00	1.99	9.97	2.01
Uganda	3.27	1.08	5.38	3.03

Source. Eberhard and others 2008
VoLL ≡ value of lost load, NA ≡ not available

Several features are evident from the table. In many countries the estimated costs of outages, using local value for loss of load where available, are substantial. In one quarter of the countries the losses are estimated to be equivalent to 3 percent of GDP or more. The local value of 1 kWh of lost load can be derived by comparing the loss of GDP at local values and at a value of US$1 per kWh. There is surprising variation between countries, even for those at similar levels of GDP per capita, suggesting that the valuations were made at very different times or using different methodologies.

The World Bank's Business Enterprise Survey also provides estimates of the value lost due to power outages as a percentage of total sales for businesses. These values are not calculated from answers to hypothetical questions but are based on an ex post survey of effects during the year before the survey. Taking unweighted averages across regions for the countries surveyed yields values shown in Table A2.6.

[5] The authors provided no details on the sources or methodology of the country-specific values of lost load. It is not known whether they distinguished different user classes.

Table A2.6 Values Lost due to Power Outages as a Percentage of Sales (recent years)

World Bank regions	Value lost as percentage of sales
Africa	6.0
East Asia and the Pacific	2.8
Europe and Central Asia	3.1
Latin America and Caribbean	4.1
Middle East and North Africa	4.4
South Asia	7.4

Source. World Bank 2009.

In all regions the percentage losses are large, and in both Africa and South Asia it appears that major losses are occurring. Table A2.6 contains 18 more countries than Table A2.5 and hence the two tables are not comparable. The Enterprise Surveys date from a variety of years, while Table A2.5 data do not report the years of data collection, so that the two sources cannot be compared even for a given country. The value of lost sales can be taken as a measure of the effect of blackouts on the country's GDP.

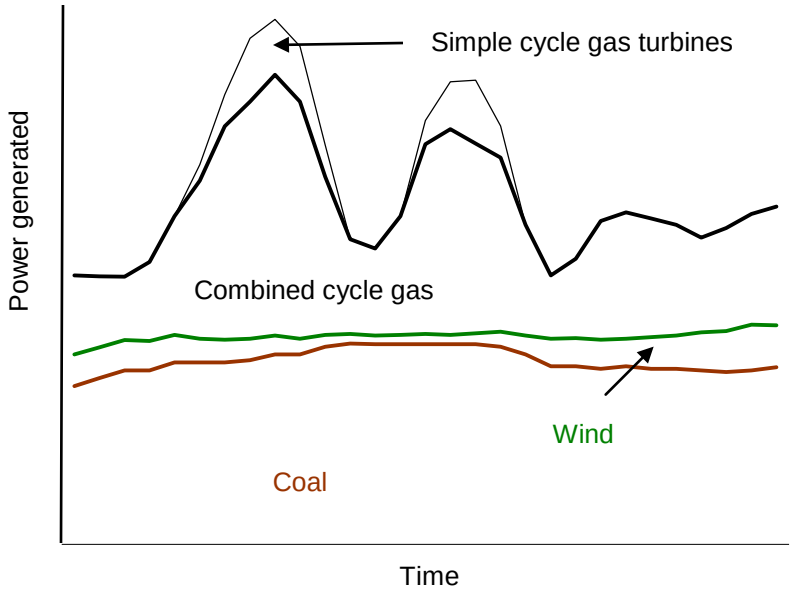
What is clear from this limited evidence for the developing world is that power outages are widespread and costly in terms of output lost. If the surveys of businesses are representative of the whole economy, it appears that in many countries power outages are leading to a lowering of national income and, if sustained, to a retardation of economic growth by a significant factor. Furthermore, even though the costs to households may not be a direct loss of national income, they are in effect equivalent to a loss of welfare as consumers are forced to pay higher prices to avoid their impact, or have to forgo activities that can generate more income and lead to a higher standard of living.

Annex 3: Electricity Basics

Sufficient supply and consistent delivery are the two main requirements of reliable power supply. This annex provides a brief overview of the roles of different technologies to meet the technical requirements for a reliable supply system. Because long-term electricity storage is not yet commercially viable (except for pumped storage), demand fluctuations are handled by instantaneously varying the amount of total power generated. For this reason, this annex focuses mostly on generation technologies. As this annex shows, a lack of commercially viable means of storing energy on a large scale in the form of electricity or heat is a serious constraint; overcoming this limitation will greatly expand generation options and transform the global power sector.

Demand for electricity varies continually, with large fluctuations during the day and even larger variation from season to season. Installed power generation capacity should be able to meet peak demand at all times. The peak demand times depend on the mix of consumers (type of industry; industrial processes used; share of industrial, commercial, and residential consumers) and the climate.

Figure A3.1 Schematic diagram of power generation



Note: The diagram is greatly simplified for illustrative purposes only and is not intended to match any actual generation portfolio.

In any power market, there is a minimal amount of power that is consumed at all times, and *base load*[6] plants run at full capacity around the clock to meet this minimal demand. In Figure A3.1, coal serves as base load plants. *Peak load* plants are brought on line to meet the additional demand during peak demand times. Open cycle gas turbines in the figure serves as peak load plants. Peak load plants operate at full capacity only during particular times of day or at times of year when there is higher demand, and tend to be cheap to construct and expensive to operate. Provided peak load plants operate only a limited number of hours through the year, their high operating costs are more than compensated by low construction costs. Load-following plants, represented by combined cycle gas turbines in the figure, can adjust output rapidly to match demand. Plants that can adjust output quickly are referred to as being dispatchable, an important concept particularly when considering certain types of renewable energy (see below).

Total installed generation capacity should take account of scheduled as well as forced shut-down times for plant maintenance and repair. The highest demand to be encountered in the future cannot be predicted precisely, requiring some cushion in generation capacity over and above the capacity needed to cover plant maintenance. In addition, extra capacity should be available for unexpected equipment failure. The amount of available capacity over and above the capacity needed to meet expected peak demand levels—as an insurance against equipment failure or sudden increases in demand—is called reserve margin (also

[6] Load in this context is moment-by-moment demand for power in the entire system.

reserve capacity). A rule of thumb for reserve capacity is 10–20 percent of forecast demand, depending on the magnitude of the most probable generation failure in the system.

The above discussion suggests that multiple generation units are needed to meet demand at all times. In the extreme, if there is only one generation unit serving a market, then when that unit is taken down for maintenance or when it fails, all electricity users in the market will be without power. Having too few generation units connected to a power system seriously compromises reliability also because the failure of one generation unit can cause other units connected through the grid to fail, causing a complete blackout in the worst case. A rule of thumb is for no single generation unit to constitute more than 10–20 percent of the total generation capacity in a given power system.

This limit on the maximum share of total capacity for any single generation unit has implications for the choice of technology. Many efficient generation technologies benefit from large economies of scale, and are not viable—technically, financially, or both—below a certain threshold unit size. For large power systems, unit size is often not an issue because even a 1,000 MW unit will account for a very small fraction of the total capacity. In contrast, in small markets, which are prevalent in many low-income developing countries, a single unit of this size may even exceed the entire national generation capacity. In these circumstances, compliance with the 10–20 percent guideline in the foregoing paragraph would make such high-efficiency technologies as supercritical and ultrasupercritical pulverized coal power plants uneconomic while over-riding the guideline and building an economic plant with the requisite scale would seriously compromise system reliability.

Another consideration is the ability to generate power on demand and the speed with which to respond to a shortfall in power generation. Base load plants should be operating at full capacity at all times except when units are taken down for maintenance. Conventional power generation facilities such as those fueled by coal and natural gas and nuclear power plants usually serve as base load plants. Certain renewable energy sources such as biomass, hydro and geothermal are also used in base load electricity production, when geographical (for hydro and geothermal) and economic conditions are favorable.

Electricity storage holds great promise for making power systems more competitive, adequate, and reliable. Historically, electricity storage, of which hydro storage has the longest history, has been used to support and optimize operations. Progress in scaling up the application of renewable energy sources relates to advancement in deployment of cost-effective energy storage systems.

Base load units tend to be expensive to build but relatively cheap to run, resulting in low unit costs of power generation as long as they run at full capacity most of the time. Because base load plants are producing a fairly constant output continually, the time it takes to start up individual units or to respond rapidly to fluctuating demand is not so important. A coal-fired power plant can take as long as 12 hours to start up from cold conditions and an integrated gasification combined cycle—suited for pre-combustion carbon capture—up to 48 hours. Load-following plants, on the other hand, should be capable of increasing and decreasing output quickly on demand. Following rapidly changing demand requires a response time ranging from milliseconds to about ten minutes. Gas-fired plants and hydro power plants are good candidates for load-following plants. High and volatile gas prices deter more widespread use of natural gas in power generation.

Providing base load or following fluctuating demand is not generally possible in the amounts required with variable power generators such as wind and solar, for which there is no or little control over when (and, under unfavorable circumstances, how much) power can be generated. As such, it needs to be complemented by other sources of power, especially those that are dispatchable. Excluding hydro power, wind is by far the cheapest renewable energy per unit cost of generation, and wind power potential is high in several cold-climate regions. Where wind speeds at different locations are not perfectly correlated, variable wind power outputs can be aggregated, thus providing a smoother power output similar to that of

conventional power generation technologies. Aggregation is facilitated by an adequate transmission system, capable of integrating a large number of variable sources of power across locations, and by advanced forecasting, telecommunications, control, and protection technologies. Besides helping to integrate variable renewable power, new technologies create a more advanced (or "smarter") power network that improves the use of its infrastructure, enables active customer participation, and enhances system reliability. Advanced power networks, strong government support, and cost reductions in renewable technologies are major factors contributing to their considerable share in total power supply in

Denmark has the highest share of wind in total power generation, about 19–20 percent, followed by Spain (about 9–11 percent) and Germany (5–6 percent); the share of wind is considerably smaller in other countries. The high penetration of wind power in Denmark is possible in part because the country is part of an integrated Nordic power system comprising five Scandinavian countries, where hydropower accounted for 55 percent and wind only 3 percent of the total power generated in the system in 2007 (Nordel 2008). Denmark can easily export excess wind power, and conversely import power, if needed, in times of power shortage caused by low winds. Denmark and Spain have invested considerably in reducing wind speed forecast errors and improving control measures. More accurate forecasting is especially important in Spain, which, unlike Denmark, has no interconnection to a much larger power system. In June 2009, Spain commissioned a special control center for renewable energy, focused primarily on wind. High penetration of wind in these countries has also been facilitated by already existing generation systems based on fossil fuels (coal and natural gas), hydropower, and nuclear, capable of providing reserve capacity and enabling the joint system to meet all demand.

Annex 4: Trends in Global Energy Supply and Demand

The major determinant of the growth in the demand for energy is income growth, while changes in the prices of fuels have smaller effects, especially over a 1–2 year horizon. The ratio of energy use to an economy's output is known as energy intensity, and some countries have managed to reduce energy intensity with rising income. Because different sectors of economies have different energy intensities, changes in sector structure also affect the aggregate demand for energy. Increasing energy efficiency, in both the power and end-use sectors, reduce the amount of energy required to produce a given level of output and the growth in total energy demand. The introduction of policies to lower the consumption of energy, such as through increased taxation on energy and stricter conservation measures, can also reduce demand growth.

The business-as-usual reference case scenario produced by IEA in November 2008 projected increases in global energy demand of 20 percent between 2006 (the last year for which data were available) and 2015 (Table A4.1). This forecast was based on existing policies as of mid-2008, but before the evidence on the current global economic slowdown could be taken into account. Projections further ahead showed global energy demand continuing to increase at a similar rate. Within the global totals, members of the Organisation for Economic Cooperation and Development (OECD) were expected to experience only modest energy growth of 6 percent until 2015, while non-OECD countries were expected to experience growth of 34 percent (IEA 2008).

Table A4.1 Projections of Global Total Energy Demand in 2015
(million tonnes of oil equivalent)

Parameter	*2006*[1]	*2015*	*% increase*
Total primary energy demand	11,730	14,121	20
OECD	5,536	5,854	6
Non-OECD	6,011	8,067	34
Input to electricity sector	4,424	5,649	28
Total final energy consumption	8,086	9,560	18
Industry	2,181	2,735	25
Transport	2,227	2,637	18
Other sectors[2]	2,937	3,310	13

Source: IEA 2008.
1 Actuals.
2 This excludes consumption of fuels for non-energy use.

In the immediate future, the slowdown in the growth of GDP would lead to slower energy demand growth than earlier anticipated. Once the global economy starts to recover, energy demand growth is likely to accelerate, now taking a year or longer to reach the levels earlier forecast for 2015. However, the overall picture is likely to remain broadly the same if policies remain unchanged.

The demand for particular fuels (Table A4.2 and Table A4.3) is linked to their use in the different sectors and the relative growth rates of the sectors. Among the major energy sources, coal was predicted to experience the most rapid growth on account of its high level of use in the rapidly growing power sector, oil was predicted to grow only modestly, and natural gas to be intermediate between the two. Nuclear was predicted to grow slightly, and hydroelectric power to experience modest growth. Other renewable energy sources such as solar, wind, geothermal, and biomass were expected to grow rapidly, but from a small base. As a result of these differential growth rates, the share of coal in total primary energy was expected to increase from 26 percent to 28 percent, that of oil to decrease from 34 to 32 percent, and that of natural gas was remain constant. In contrast, alternative forecasts by the U.S. Department of Energy (EIA 2008)

estimated that the share of natural gas would increase by 2015 and total renewable energy (including hydro, geothermal, solar, wind, tide and wave, but excluding biomass) would grow at a slower rate.

Table A4.2 Use of Global Energy Demand by Source and by Sector in 2006 (million tonnes of oil equivalent)

Energy supply source	*Total primary demand*	*Use by electricity*	*Use by industry*	*Use by transport*	*Use by other sectors*
Coal	3,053	2,075	550	—	114
Oil	4,029	277	329	2,203[1]	472
Gas	2,407	947	434	—	592
Nuclear	728	728	—	—	—
Hydro	261	261	—	—	—
Biomass and waste	1,186	81	189	24[2]	829
Other renewables	66	55	0	—	11
Electricity	—	—	560	—	764

Source: IEA 2008.
Notes: Uses exclude non-energy consumption of fuels; consumption of energy derived heat is not shown in sector use.
Other renewable energy include wind, solar, geothermal, and tidal and wave energy.
— not applicable or negligible.
1. Includes other fuels.
2. Includes biofuels.

Table A4.3 Projected Use of Global Energy Demand by Source and by Sector in 2015 and Percentage Increase Over 2006

Energy supply source	*Total primary demand*	*Use by electricity*	*Use by industry*	*Use by transport*	*Use by other sectors*
Coal	4,023 (32)	2,765 (33)	713 (30)	Negligible	118 (4)
Oil	4,525 (12)	269 (-3)	366 (11)	2,563[1] (16)	493 (4)
Gas	2,903 (21)	1,212 (28)	508 (17)	Negligible	660 (11)
Nuclear	817 (12)	817 (12)	—	—	—
Hydro	321 (23)	321 (23)	—	—	—
Biomass and waste	1,375 (16)	132 (63)	224 (19)	74[2] (208)	871 (5)
Other renewables	158 (139)	134 (144)	1	—	23 (109)
Electricity	—	—	789 (41)	—	967 (27)

Source: IEA 2008.
Notes: Uses exclude non-energy consumption of fuels. Consumption of energy derived heat is not shown in sector use. The first figure is energy demand in million tonnes of oil equivalent, the second figure in parentheses is the percentage increase in demand between 2006 and 2015.
— not applicable.
1. Includes other fuels.
2. Includes biofuels.

The global power sector was expected to experience the most rapid demand growth for primary energy, despite an increase in the average efficiency of converting fuel to electricity. The next most rapid sector growth was in industry, while transport, commercial, residential, and agricultural sectors were expected to grow more slowly.

The power sector has a wide range of technologically possible fuel choices, but the choice of fuels depends on the relative prices of the different fuels and associated technologies, and, particularly for renewable sources, their domestic availability. In addition, concerns about the security of supply for any one fuel (through global physical shortages, price volatility, or local supply bottlenecks) can lead to policies to increase fuel source diversification even if some sources appear more expensive at first.

For power generation, under existing policies and prior to the fall in oil prices and the financial crisis, the forecasts made by IEA (Table A4.4) indicated that the use of all fuels except oil would increase globally, and that the demand for all fuels except oil would increase rapidly by 2015 in non-OECD countries. The share of coal, the dominant fuel, was expected to increase. All forms of renewable energy, especially wind, were expected to increase rapidly, but, with the exception of hydropower, from extremely low levels.

Table A4.4 Electricity Generation by Fuel in 2006 and 2015 (Terawatt-hours)

Energy source	*OECD*		*Non-OECD*	
	2006	2015	2006	2015
Coal	3,931	4,342	3,826	6,758
Oil	417	291	679	755
Gas	2,098	2,303	1,709	2,422
Nuclear	2,356	2,413	437	721
Hydro	1,286	1,412	1,749	2,322
Biomass & waste	205	312	35	107
Wind	116	512	14	152
Geothermal	38	59	21	40
Solar	3	44	1	9
Total	10,452	11,690	8,469	13,285

Source: IEA 2008.

The potential shortage of power capacity, at a time when fossil fuel prices have exhibited great volatility, has increased the need to look for more efficient ways to use energy and for energy sources with less-volatile prices. These concerns are also linked to the increasing awareness of the damage that global warming is already causing and which is expected to increase rapidly. This highlights the need for increasing emphasis on several energy policies and interventions. Within the power sector these include (1) improving power system performance to reduce technical and commercial losses; (2) increasing the use of economically viable grid and off-grid renewable energy generation; (3) seeking opportunities for economically viable energy efficiency improvements of all end-user groups; (4) reducing the costs of, and fuel needed for, generation by upgrading existing inefficient technologies; and (5) adopting a range of so-called smart grid technologies (including smart meters, integrated communications systems, sensing and measurement devices, and wide-area measurement systems) to allow a better management of the power system as a whole, thus reducing the costs of generation. At the same time, the need to choose a fuel source to provide the lowest long-run cost of new baseload generation, allowing for the risk premia attached to energy security of the different fuel choices, is increasing interest in the use of clean coal and nuclear technologies.

Despite rapid growth in the power sector, about one quarter of the world's population was estimated by IEA not to have had access (connection) to electricity in 2005 (Table A4.5) (IEA 2006). The numbers in the table should be treated with caution because dates of the data sources varied by several years, and the access rates in some countries were rising rapidly during this period, India being a case in point (the access rate used by IEA dated back to 2001). Bearing the data limitations in mind, outside of Sub-Saharan Africa, at least 70 percent of the urban population and 45 percent of the rural population had access; in Africa the access rates were very much lower. Although the urban access rate is much higher, nearly 20 percent of those in developing countries without access lived in urban areas (of which one hundred million were in Sub-Saharan Africa). Even though it is anticipated that the number of people with access will continue to increase steadily, the proportion may even fall as population growth outstrips the efforts of governments to provide electricity to more households. The number of people without access is higher in Table A4.5 than in Table A6.1. The largest difference occurs in Asia. Table A6.1 excludes Myanmar and the Democratic People's Republic of Korea, where there are many people without access (63 million

according to IEA). Table A6.1 also takes data from the most recently available household surveys, including the National Sample Survey of 2004–05 in India, the National Socioeconomic Survey in 2007 in Indonesia, and the Social and Living Standard Measurement Survey in 2005–06 in Pakistan. The access rates found in these surveys are considerably higher than the electrification rates reported by IEA (2006), and these three alone account for a difference of 225 million.

Table A4.5 Electricity Access in 2005 As Reported by IEA in 2006 (millions)

Region	*Population with access*	*Population without access*	*Urban population without access*	*Rural population without access*	*Urban electrification rate, %*	*Rural electrification rate, %*
Sub-Saharan Africa	191	547	109	439	58	8
East Asia	1,728	224	39	189	95	84
South Asia	760	706	88	627	70	47
Latin America	404	45	7	38	98	66
Middle East and North Africa	291	48	16	36	88	83
Developing countries	3,374	1,569	276	1,342	85	56
OECD and transition	1,501	8	0	8	100	98
World	4,875	1,577	284	1,339	90	62

Source: IEA 2006.
Note: Although the results are reported for 2005, the data are from earlier years.

Outside of the power sector, policies to reduce the use of oil in the transport sector focus on mandating more stringent vehicle fuel efficiency standards, improving and promoting public passenger transport systems in urban areas, greater use of rail instead of road transport where cost-effective, and higher taxes on petroleum products to encourage more economical driving behavior. Reducing the direct use of oil, gas, and coal in industry and commerce requires higher energy efficiency of heat processes.

To meet this demand for primary energy and for electricity, supply will have to increase commensurately. In the coming decade, financing for investment to produce this supply may not be fully available; a prolonged duration of the current financial crisis could lead to delays in implementing investment plans. For planning future energy sector investments and policies, the rate of growth of demand and the path of fuel prices are among the crucial factors. In time, the world economy will recover from the current global recession, and the recovery is likely to result in a parallel resumption of the growth of the global demand for energy, and with it rising energy prices. IEA has suggested that oil prices may rebound to around US$100 a barrel between 2010 and 2015 (Reuters 2008).

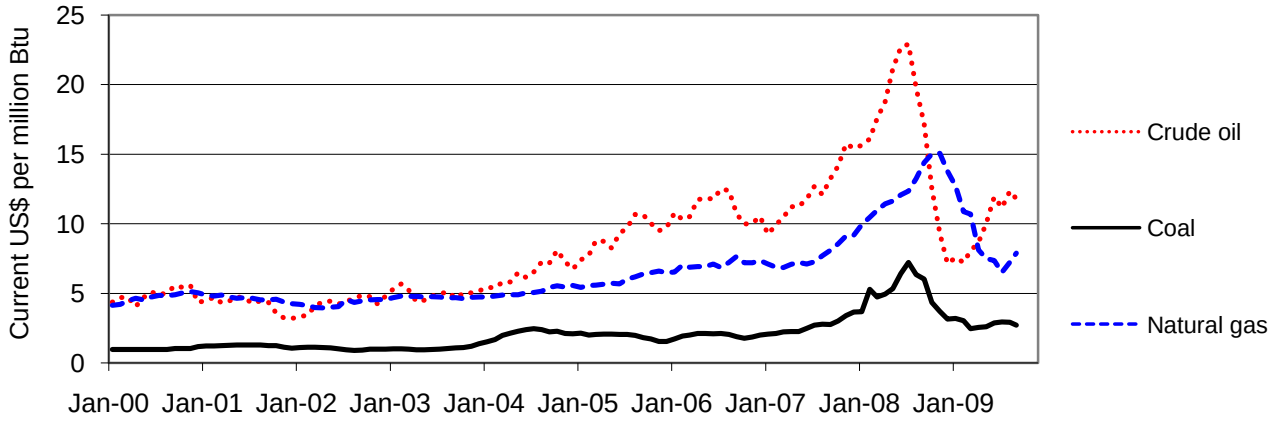
Declining production of oil has started or is expected soon in some countries and, without further investment, these countries could face a loss of government revenue, in addition to declining revenues from falling prices. For some developing countries the combination of low oil prices and flat or declining production is already having substantial effects on the fiscal position of the government, and hence on spending related to growth-producing activities and social goals. There were moves by hydrocarbon-exporting governments during the period of rising oil prices to change fiscal terms in order to capture a larger share of the rewards. Such renegotiated contracts have proved less attractive with falling prices and there is considerable interest in designing contracts that provide flexibility against volatile commodity prices.

To meet the projected global increase of generating capacity (including replacements) of 1,690 gigawatts (GW) by 2015, the IEA reference case estimated that some US$5 trillion (2007 prices) would be required between 2007 and 2015, of which 44 percent would be for generation, 17 percent for transmission, and 30 percent for distribution. For the non-OECD countries, whose demands were estimated to increase by 1,177 GW, US$3 trillion would be required, of which 39 percent would be for generation, 20 percent for

transmission and 41 percent for distribution. In many countries a delay in carrying out this investment would be damaging, since a large number of developing countries are already facing blackouts (complete lost of power) or brownouts (a drop in voltage, which could damage equipment), with the very high associated costs of power shortages (Annex 2). When economic growth recovers, the risk of power shortages will increase unless investment is undertaken soon. In countries where existing users are already being rationed, increasing the access to electricity of those without it will be hard to sustain.

The experiences of the last few years—culminating in 2008 during which oil prices first climbed to a new peak and then collapsed within a few months, and natural gas and coal prices following similar patterns reflecting competition between fuels (Figure A4.1)—have underscored the importance of energy policies that can respond to these rapidly changing circumstances and are sustainable over the long run. Considerations of political economy led many governments that control energy prices to increase energy price subsidies, decrease energy taxes, or reduce margins of state-owned energy companies that did not pass on the recent increases in international prices fully to consumers. Oil exporting countries in particular used part of extra government revenue from higher oil prices to fund energy price subsidies. The rapid growth of energy consumption in some oil-exporting countries—where consumers did not see rapidly rising energy prices—has been notable. The less prices were subsidized the more incentive users had to turn to more energy-efficient patterns of consumption and production.

Figure A4.1 Monthly Prices per Unit of Energy of Oil, Gas and Coal
January 2000–September 2009



Sources: World Bank Development Economics Prospects Group, World Bank staff calculations.
Notes: Crude oil is the average of West Texas Intermediate, Brent, and Dubai Fatah; coal prices are spot Australian coal prices; natural gas prices are those of liquefied natural gas imported by Japan; Btu British thermal units.

Evidence from the last twenty years suggests that oil, natural gas, and coal prices will continue to show considerable monthly volatility (Table A4.6). The month-to-month average percentage variation in oil and natural gas prices has remained fairly constant from 1983 onwards. Coal price volatility, however, has increased by a large fraction in the period from 2004, and become as volatile as oil prices. Natural gas prices in Europe and Japan have been considerably less volatile than those in the United States, reflecting the strong presence of the spot natural gas market in the latter and the fragmentation of the world gas market. In the face of recent high energy price volatility, countries have been adopting a number of coping strategies. Some countries have been looking at changing the fuel mix through their choice of technology for new investments. High-income countries are increasingly encouraging new renewable technologies (particularly wind and solar), especially those where the unit price of generation is falling as the market expands. At present 30 countries have operating nuclear power stations, and another 8 (all developing countries) have reactors under construction or at the planning stage. The gap between natural gas and coal prices per unit of energy has also resulted in plans for additional energy supply based on coal. At the same time, improvements in coal burning technology (such as ultra supercritical) have the

double benefit of improving energy efficiency and reducing GHG emissions relative to older coal-burning technologies. Sources of power that are intermittent (such as solar and wind) require storage to allow them to run as baseload or to be dispatchable—to "follow demand"—on a large scale but as yet storage systems that could be commercially viable are only at the pilot project stage.

Table A4.6 Average Levels and Volatility of Oil, Coal, and Gas Prices
January1983–December 2008

Parameter	*Period*	*Crude oil*	*Coal*	*U.S. gas*	*EU gas*	*Japan gas*
Mean price (US$/million Btu)	1983–1989	3.37	1.30	2.04	2.63	3.83
	2000–2003	4.59	1.07	4.28	3.72	4.59
	2004–2008	11.16	2.75	7.47	8.21	7.65
Price volatility	1983–1989	0.086	0.035	0.110	0.033	0.031
	2000–2003	0.870	0.044	0.160	0.053	0.029
	2004–2008	0.100	0.097	0.140	0.037	0.039

Source: World Bank staff calculations updated from Bacon and Kojima (2008a).
Notes: Calculation of mean prices per unit of energy as explained for Figure A4.1. Volatility of prices is measured by the standard deviation of the return (change) of natural logarithms of monthly prices. For relatively small changes the volatility measure multiplied by 100 is approximately equal to the average percentage change of monthly prices.

As well as looking to change fuel mix, some fuel-importing countries have diversified the sources of supply for a particular fuel. This form of diversification has included signing long-term contracts with exporting governments, and even acquiring the rights to explore, develop, and import oil—and more recently coal—from a number of countries. The inflexibility of source for natural gas supplied by pipeline, where the supplier can restrict supply in order to obtain better rewards while the purchasers cannot turn in the short term to an alternative source, is leading some gas-importing countries to actively seek alternative sources of gas (even if supplied by another pipeline).

The reference case scenario constructed by IEA provides estimates of global and regional CO_2 emissions from energy consumption in 2015 (Table A4.7). These show that emissions from OECD countries would increase slightly, while those from non-OECD countries would increase rapidly. By 2030 total OECD emissions were predicted to fall slightly, while non-OECD emissions were predicted to be almost double the 2006 level, reaching 26 gigatonnes. IEA estimated that global anthropogenic GHG emissions in 2005 amounted to 44 gigatonnes of CO_2 equivalent, of which CO_2 accounted for 81 percent and energy-related CO_2 emissions for 61 percent. By 2015 global GHG emissions were projected to reach about 52 gigatonnes, of which energy-related CO_2 would account for about 65 percent. Between 2006 and 2015 the growing consumption of coal in the power sector would account for 44 percent of the increase in energy-related non-OECD emissions, while the growing use of oil in the transportation sector would account for 14 percent of the increase.

Table A4.7 Emissions of energy related CO_2 in 2006 and 2015 (million tonnes)

Parameter	*OECD*		*Non-OECD*	
	2006	2015	2006	2015
Total	**12,791**	**13,274**	**14,119**	**19,610**
Power	4,985	5,406	6,450	9,398
Coal	3,727	4,066	4,609	7,047
Oil	302	208	580	644
Gas	956	1,131	1,261	1,707
Final consumption	7,153	7,181	6,985	9,336
Coal	596	560	2,538	3,436
Oil	4,913	4,877	3,327	4,505
Transport	3,462	3,575	1,822	2,599
Gas	1,644	1,744	1,119	1,395

Source: IEA 2008.

If the business-as-usual policies considered by the IEA reference case were actually continued, the concentration of CO_2 in the atmosphere would double and the increase in the global average temperature could be as much as 6°C by the end of the century. Such an increase would be catastrophic, and accordingly business-as-usual policies are unsustainable.

Faced with the possibility of steadily increasing energy demand and the associated emissions that would likely occur under existing policies, changes in government policies are a key to ameliorating the situation. With the Kyoto protocol set to expire in 2012, the United Nations Climate Change Conference met in Poznan in 2008 to prepare the way for full negotiations at the meeting in Copenhagen at the end of 2009. The outcomes of that meeting are expected to have a major impact on the energy strategies of governments that sign up to the final agreement.

Policies to limit CO_2 levels to 450 parts per million will require investment in renewable energy and energy efficiency to more than triple from 2007 to an average of US$515 billion a year through 2030, according to the World Economic Forum (2009).[7] Although clean energy investment increased rapidly from US$34 billion in 2004 to US$142 billion in 2008, a large gap still remains. Eight sectors were expected to contribute to the shift to green energy: onshore wind, offshore wind, photovoltaic solar power, solar thermal energy, municipal solar waste-to-energy, sugar-based ethanol, cellulosic and other second-generation biofuels, and geothermal power.

A related issue is the health impact of local pollutants emitted during energy production and consumption. The IEA reference case scenario provided estimates for oxides of sulfur and nitrogen and fine particulate matter (Table A4.8). Policies already enacted in OECD countries were expected to steadily reduce the levels of all three pollutants, but in the non-OECD countries where such policies are not yet in place, or are less stringently applied, emissions of oxides of sulfur and nitrogen were expected to increase.

[7] This estimate, which averages the total investment to 2030 on an annual basis, is not incremental to a business-as-usual figure.

Table A4.8 Emissions of major air pollutants in 2005 and 2015 (million tonnes)

Country grouping	*2005*	*2015*
	Sulfur dioxide	
OECD	27.8	13.3
Non-OECD	61.0	71.6
	Oxides of nitrogen	
OECD	37.0	23.9
Non-OECD	43.3	51.0
	Particulate matter (PM2.5)	
OECD	4.4	3.2
Non-OECD	32.7	29.7

Source: IEA 2008.
PM2.5 fine particulate matter with an aerodynamic diameter of 2.5 microns or smaller.

Global warming, to which the energy sector is a significant contributor, also affects the energy sector. The nature and magnitude of this adaptation is expected to vary substantially among countries depending on such factors as their geographical location, their dependence of hydropower and water sources for generation cooling, and the quality of their power sector infrastructure. Lower or more irregular rainfall linked to global warming could reduce the potential for hydropower and the availability of water for power units and biomass-based fuel supply in some countries. In the near term, increased glacier melt may increase river flows even while rainfall-fed supply is diminishing. Hotter summers increase electricity demand for air-conditioning, and warmer winters decrease demand for heating. The balance between these two effects depends on the climatic pattern throughout the year. The demand for power in many developing countries is expected to increase and the peaks to become sharper. At the same time transmission losses may increase and hydropower availability may be reduced at the hottest times of the year, exactly when it is needed most. Policies to adapt to these changes, such as improving energy efficiency, can also contribute to the mitigation of GHG emissions.

Conclusions

The business-as-usual scenario produced by the IEA in November 2008[8] highlighted the expected growth of global primary energy demand in the period to 2015. This would be 20 percent larger than the 2006 figure, with electricity being the largest and most rapidly growing primary energy use sector. Although the global recession has led to a slowdown in the growth of demand for energy, it is clear that this will delay, but not prevent, such a level of demand being reached. The implications of this increase in the demand for energy on the emissions of CO_2 are unsustainable, and worldwide policies to reduce the growth of emissions will have to be implemented. An increasing use of energy with low lifecycle GHG emissions, increased demand- and supply-side energy efficiency improvements, and energy conservation measures will all be required if a sustainable energy path is to be achieved. In many countries improvement in energy efficiency will also be the key to meeting development objectives—by matching supply and demand more closely and reducing the costs of power shortages—while extending access at lower rates of growth of power generation. The increased use of renewable energy as well as slowing down the growth of emissions can also help countries diversify their energy source and to reduce their vulnerability to future energy price shocks.

[8] The World Energy Outlook 2009 is expected to be available in November 2009, although a Climate Change Excerpt will be made available earlier to governments participating in the international climate change negotiations.

Annex 5: Benchmarking Against Fuel for Thought

The targets for the WBG as a whole, found in the executive summary of *Fuel for Thought* (represented by the three headings—strategic objectives, outcomes, and actions needed), have been assessed. Some targets were largely outside the energy sector (for example, setting up air quality management systems, developing capacity for environmental regulation) and progress in achieving these targets was not assessed, as they fall under the ambit of the new WBG environment strategy. The targets from FFT are underlined, and the assessment appears in this font.

Strategic Objectives	*Outcomes*	*Actions needed*
Facilitate more efficient use of and substitution from traditional fuels in rural and peri-urban areas to reduce health damage from indoor air pollution and pressures on natural resources (land and forestry).	Significant progress in household access to cleaner commercial energy: • Increase share of cleaner commercial energy by 5–10 percent for at least five borrowers by the year 2005; and by 10–20 percent for at least ten borrowers by the year 2010. In the context of sustainable use of natural resources, indoor air pollution, and traditional fuels, the issue at hand is primarily cooking and heating energy sources, and not lighting. Assessment is complicated by the fact that • The energy ladder model has been shown to be less accurate than a fuel portfolio approach, whereby households continue to use traditional fuels even as they take up cleaner commercial fuels (kerosene, liquefied petroleum gas, and natural gas); traditional fuel use can even increase with rising income. • There is no database for this information, except in a handful of developing countries where detailed household expenditure surveys with questions involving expenditures on kerosene, liquefied petroleum gas (LPG), and natural gas are asked. Because many households use multiple fuels, unless households abandon traditional fuel use altogether, calculating the *share* of cleaner commercial energy is complex even where the expenditure data are available. WBG's work analyzing policy options to promote fuel switching to cleaner fuels from traditional use of solid fuels includes "India household energy, indoor air pollution, and health" (2002), "Energy strategies for rural India; evidence from six states" (2002), "India access of the poor to clean household fuels"	**Long-term (FY08):** Integrate energy access to rural communities and urban poor in Bank operations in about ten borrowers; and in other borrowers have firm government commitment to improved rural energy access; promote an approach focusing on private sector, communities, and innovative financing for small local schemes. Since 2003, rural electrification projects have been carried out in Eritrea, Ethiopia, Ghana, Guinea, and Senegal in Africa; Cambodia, Lao PDR, Mongolia, Philippines, Timor Leste, and Vietnam in EAP; Honduras, Nicaragua, and Peru in LAC; and Yemen in MNA. In FY08, there were 81 projects that were classified as access projects according to the criteria set forth in the Investment Framework for Clean Energy and Development formulated in FY06. In FY2003-FY08, 255 access projects in total were approved, of which 136 were in AFR, 34 in SAR, 33 in EAP, 24 in LAC, 20 in ECA, and 8 in MNA.

Strategic Objectives	*Outcomes*	*Actions needed*
	(2003), "Pakistan oil and gas sector review" (2003), "Environmental health and traditional fuel use in Guatemala" (2005), and "Pakistan household use of commercial energy" (2006). The Urban Heating Project in Armenia increased the share of urban households with gas-based heating from 11 percent in 2004 to 45 percent in 2008 through an output-based capital grants scheme. • Significant increase in wood fuel production by increasing sustainable agriculture and land management. Being outside the energy sector, this target was not reviewed. • Substantial increase in production and use of biogas and charcoal. Overall, the WBG has not been all that active in this area. There have been few projects on biogas and charcoal (Nepal biogas, China Shangdong manure biogas, China Hubei eco-farming biogas, and Senegal Sustainable and Participatory Energy Management projects). The project in Senegal, which closed in 2004, was rated highly satisfactory by IEG (called OED at the time). Addressing charcoal production and use, its sustainable woodfuel management component had multiple sub-components including sustainable community-based forest management, and establishment of micro enterprises and an incremental income generation base. The demand management and inter-fuel substitution component promoted sustainable production and sale of improved stoves for charcoal including establishment of suitable financial intermediation, and fuel switching to kerosene and LPG through distribution of improved stoves.	
Protect health of urban residents from air pollution due to fuel combustion in the residential, transport, industrial, and power sectors.	Measurable improvements in air quality in at least twenty major cities worldwide by the year 2010: • Reduction of atmospheric particulates concentration by at least 10 percent of current levels in ten large cities by 2005, and by at least 20 percent in twenty large cities by 2010.	**Long-term (FY08):** Have comprehensive air pollution control programs in place at least in ten major cities; and introduce similar programs in at least ten other major cities.

Strategic Objectives	*Outcomes*	*Actions needed*
	The pollutant of relevance is PM2.5, and PM10 in the absence of PM2.5 data. Unfortunately, few developing country cities were measuring PM10 in 1999 when *FFT* was issued; most were measuring TSP (total suspended particles), which do not have a statistically significant link health effects. Among the cities that have been measuring PM10, Bangkok, Kolkata, Mexico City, Mumbai, New Delhi, Santiago, and Sao Paulo reduced PM10 concentrations by more than 20 percent by 2005.	Lima, several cities in Mexico, Quito, Santiago de Chile, and Sao Pauo in LAC, and Bangkok, Beijing, and Shanghai in EAP, and New Delhi in SAR have comprehensive air pollution control programs in place. Bogota, Teucigalpa, and San Pedro Sula in LAC; Ho Chi Minh, Jakarta, and Manila in EAP; and Colombo, Kolkata, and Mumbai are working to improve their air pollution control programs. Dhaka and Kathmandu in SAR and Hanoi and Surabaya in EAP have introduced programs but need to strengthen their management capacity considerably.
	• Leaded gasoline phased out in the major cities of half of borrower countries by 2005, and in all countries by 2010. Lead phaseout has been completed with possibly a couple of exceptions. The World Bank played an important role in LAC through the ESMAP funded "Elimination of lead in gasoline in LAC," Region/ESMAP funded "Cleaner transport fuels for cleaner air in Central Asia and the Caucasus," sub-Saharan Africa Clean Air Initiative (CAI-SSA), and earlier efforts (see below). The most recent of these efforts is CAI-SSA, which organized a large regional conference on gasoline lead phase out in June 2001 in Dakar where the decision to eliminate lead in gasoline throughout the region by the end of 2005 was taken by the representatives of the governments and the oil industry. From 2001 through 2005, CAI-SSA organized a series of national and sub-regional workshops in sub-Saharan Africa on gasoline lead phaseout, the harmonization of fuel specifications, and urban air quality management. CAI-SSA published dissemination materials (publications, videos, compact discs) on the progress of these activities in order to promote the exchange of information on the subject and to strengthen local expertise. In ECA, the role played by the Bank earlier in the regional	

Strategic Objectives	*Outcomes*	*Actions needed*
	process coordinated by the UN-Economic Commission for Europe— which led to an agreement on lead phaseout at the Arhus Environment Ministerial Conference and its follow-up activities—laid the foundation for lead phaseout throughout the region later. In Romania, the Bank had a transport project in which lead phaseout was an integral component. In Asia, earlier work by the Bank through URBIAR had a strong lead phaseout focus. In SAR, the Bank played a particularly active role in lead phaseout in Bangladesh, Pakistan, and Sri Lanka. • Sulfur content of motor diesel reduced to less than 0.5 percent in half of borrower countries by 2005, and in all countries by 2010. Most countries are at 0.5 percent or lower, with the exception of Sub-Saharan Africa. A large technical assistance program is underway in sub-Saharan Africa to enable production and sale of lower-sulfur diesel through CAI-SSA.	
Promote environmentally sustainable development of energy resources	Reduce air and water pollution and land degradation from the extraction, processing and transport of commercial sources of energy by • Promoting environmentally sound exploration and production of oil, gas, and coal. On the advisory front, promoting environmentally sound exploration and production of oil and gas through helping to establish suitable legal, regulatory, and fiscal frameworks represents an important aspect of the World Bank's work in extractive industries. The new Transaction Advisory Facility – currently under preparation – can also be used to support environmentally sound exploration and production by assisting governments to agree on appropriate transaction standards. Strategic social and environmental assessments are in our assistance in the development of the petroleum sector (for example, Mauritania and Côte d'Ivoire). One of the three pillars under the Petroleum Governance Initiative is environment, which encompasses a survey of	**Long-term (FY08):** Implement strategy and launch several rehabilitation, clean up, coal waste (ash) management, utilization, disposal, gas flaring and leakage reduction, and energy trade projects. There have been many projects aimed at promoting energy trade (see the next section). Gas flaring reduction is being addressed by the Global Gas Flaring Reduction Partnership involving participation of oil companies and governments. Under the Petroleum Governance Initiative a toolkit on decommissioning covering environmental, social, legal, regulatory and technical issues is being prepared. The Cleanup and Land Reclamation

Strategic Objectives	*Outcomes*	*Actions needed*
	environmental management systems for oil and gas, a strategic assessment of the social and environmental challenges of offshore oil development in Mauritania, and preparation of a tool-kit for safe decommissioning of petroleum fields and mines. Under this initiative, a toolkit on decommissioning covering environmental, social, legal, regulatory, and technical issues is being prepared.	project in Kosovo is addressing environmental legacy issues related to open dumping of ashes on land and aims to enable Kosovo to restore the land, currently covered by mining materials, for community development purposes. The project will (1) apply environmental control measures to the ash dump belonging to the Kosovo A lignite power plant, to stop dust generation and prevent contamination of groundwater; (2) re-cultivate areas occupied by coal mining materials; (3) remove hazardous chemicals from a former gasification plant site; and (4) build capacity for continued clean-up and environmentally sound mining. The World Bank in 2005 signed an emission reduction purchase agreement with the project sponsor to recover about 180 million cubic meters of coal mine methane annually from existing operations to fire a 120 megawatt (MW) power plant in Shanxi province. The agreement is for reducing emissions equivalent to 8 million tonnes of carbon dioxide (CO_2) to 2013.
	• Reducing spillage (of oil), flaring (of gas) and waste. The Global Gas Flaring Reduction Initiative is a major effort undertaken in partnership with petroleum companies to reduce flaring of associated gas. An oil spill national response plan, including institutional responsibility and related regulatory instruments, was developed under the Petroleum Sector Capacity Building Project in Chad.	
	• Rehabilitation and clean-up of selected degraded facilities and areas.	

Projects under this category include mine closure projects in Poland and Romania, Kazakhstan Uzen Oil Field Rehabilitation, Romania Petroleum Sector Rehabilitation, and Russia Emergency Oil Spill Recovery and Mitigation.

- Improving utilization and disposal of bi-products and residuals.

There have been analytical and lending activities for coal bed methane. In cement manufacture, IFC as a matter of routine looks for opportunities for blended cement. The World Bank has several carbon-financed blended cement projects in Indonesia.

- Where applicable, making progress toward compliance with the protocol on long-range transboundary sulfur dioxide and nitrogen oxide pollution.

The only international convention on long-range transboundary SOx and NOx is the Economic Commission for Europe Long Range Transport of Air Pollutants. This 1979 convention and its related protocols affect only ECA countries. Projects that reduce SOx or NOx emissions help make progress toward compliance. The Serbia Energy Efficiency Project replaced boilers fueled by coal and heavy fuel oil with natural gas, reducing SOx and NOx emissions. The Energy Community of South East Europe APL 3 project has a technical assistance component on Design for reduction of SOx and NOx emissions at a thermal power plant in Kakanj in central Bosnia.

Outside of ECA, WB contributed to the extensive discussion on SOx and NOx pollution through CAI-Asia which WB helped establish. Through RAIN-Asia, which was completed around 2000, the World Bank advocated work on SOx and NOx control. The model developed by RAIN-Asia and the results have been used by governments in EAP and SAR to look at control options and costs.

New environmental, health, and safety guidelines for thermal power plants by the WBG published in December 2008 will lead to reduced levels of air pollutant emissions, particularly for district heating systems, and lower long-range trans-boundary

Strategic Objectives	*Outcomes*	*Actions needed*
	SOx and NOx. • Increased international trade in electricity, especially hydroelectricity, and natural gas. Examples of projects that involve international trade include • Southern Africa power market APL • Shared Vision Program regional power trade (Nile Basin) • West Africa Power Pool Adaptable Program Loan • Mozambique-Malawi transmission interconnection • Niger Basin water resources • Azito: power exports from Côte D'Ivoire to Ghana (IFC) • Endesa Brazil: power exports from Brazil to Argentina (IFC) • Nam Theun 2 power • Greater Mekong Subregion power trade • Ethiopia-Nile Basin • Electric Power Restoration 3 Project in Bosnia and Herzegovina • Energy Community APL in ECA (9 projects in 7 countries to develop a regional energy market and integrate it into the EU internal energy market). • Romania electricity market (to facilitate national, regional, and European power trade) • Afghanistan Emergency Power Rehabilitation project as part of a broader project bringing power from Uzbekistan to Kabul • West Africa Gas Pipeline • Mozambique-South Africa gas pipeline and associated gas development (World Bank, MIGA, and IFC) • Peru LNG project (IFC) • India LNG import terminal (IFC) • Karachaganak (Kazakhstan) gas/condensate development (IFC) • Bhutan-India power transmission line (IFC)	
Mitigate the potential impact of energy use on global climate change	For Bank-financed projects in at least 10 countries, achieve 5–10 percent reduction in cumulative GHG emissions projected for the year 2015 relative to cases without Bank Group financing. This expected outcome will be achieved through the	**Long-term (FY08):** Have in place policy, institutional and regulatory framework to develop clean energy projects in at least 15 countries and an advanced dialogue with other governments; and mainstream

Strategic Objectives	*Outcomes*	*Actions needed*
	implementation of a combination of • Power sector reform and energy efficiency programs in ten states or countries by FY2008. **Armenia** – Adjustment lending and policy dialogue have facilitated power sector reform, improving operational and financial performance and eliminating the fiscal burden on the government budget since distribution was privatized in 2002. The Electricity Transmission and Distribution Project reduced technical and commercial losses by more than 50 percent. **Bulgaria and other EU accession countries** – In Bulgaria, electricity and heating tariffs have been substantially reformed while applying social protection measures. The Energy Efficiency Global Environment Facility (GEF) project is among the most successful energy projects. The project was instrumental in developing a dedicated, self-sustaining, and market-based finance facility (BEEF), which is considered an international best practice in scaling up financial intermediation for energy efficiency. Similar projects and technical assistance have been provided to other EU accession countries. **Gabon** – Following the granting of a 20-year concession to Vivendi in 1997, electricity subscribers increased by 80 percent, cash collection rose considerably, and losses reduced to 16 percent, translating into financial performance improvement. **Kenya** – Reform efforts were launched in 1997 and achievements include far-reaching operational efficiency improvement in Kenya Power and Lighting Company; much greater fiduciary control, transparency, and accountability within the sector agencies; an energy regulatory commission with a significant degree of autonomy; tariff reform; and government policy that encourages private investment in traditional and renewable energy generation. **Macedonia** – IFC has supported the privatization of the ESM distribution company and provided financing for the company's loss reduction program through network upgrades and the reconstruction of substations and distribution lines. **Moldova –** IFC invested $25 million in UF Moldova, an electricity distribution company, in November 2001. At the time of privatization (2000), the company had aggregate energy losses of 40 percent. The losses had come down to 16.9	advisory services to promote energy trade and renewable energy and energy efficiency projects. The countries that fall in this category include Ethiopia, South Africa, Tanzania, Uganda, and Zambia in AFR; China, Indonesia, some Pacific Islands, the Philippines, and Papua New Guina in EAP; Croatia, Serbia, and Turkey in ECA; Mexio in LCR; Algeria, Egypt, Jordan, Morocco, and Tunisia in MNA; and Bangladesh, India, and Sri Lanka in SAR. WBG-wide renewable and energy efficiency projects in FY2001–08 totaled US$7.7 billion, of which more than 80 percent were in FY2005–08.

Strategic Objectives	*Outcomes*	*Actions needed*
	percent by 2007. IFC's investment was aimed at supporting the government's efforts to reform the power sector from an integrated state-owned monopoly to one of privatized distribution and generation companies. **Russia** –The power sector reforms have been almost completed, resulting in the privatization of the most of power generation companies (except for hydro and nuclear). The Federal Tariff Service, which acts as the energy sector regulator, has been continuously improving its capacity and now demonstrates a strong level of professionalism. Electricity tariffs have been steadily raised toward cost-recovery levels and bill collection has improved. Although the WBG's role has been small, its activities illustrate the kind of contributions various actors can make to move the sustainable energy agenda forward. The World Bank had a technical assistance loan to the Federal Tariff Service and Inter RAO UES (electricity trading and holding company) for reforming the power sector. The World Bank and IFC have jointly conducted an energy efficiency study, followed by technical assistance on energy efficiency at the regional level, and the study was one of the contributors to the development of new energy efficiency regulation by the federal authorities. A loan for heating system rehabilitation reduced fuel consumption by 20 percent and heat losses by 35 percent for the system covered under the loan. **Turkey** – Projects and technical assistance have supported reform and energy efficiency improvement, including reducing technical and commercial losses. • Development of cleaner sources of energy (e.g., hydropower, gas) and, where economically feasible, substituting for dirty fuels. There are numerous projects utilizing hydro, wind, or solar for electricity, as documented in the annual review of renewable energy (and energy efficiency) projects. To the extent that these replace emergency diesel power generation, they are substituting for dirty fuels. An example is the Bujagali (Bank/IFC financed) hydro project in Uganda where there is considerable reliance on emergency diesel power generation. IFC has played an important role in hydro power by being the	

Strategic Objectives	*Outcomes*	*Actions needed*
	first private financier in some countries. In Chile, IFC financed the first two project finance hydro power transactions (quasi-merchant) after passage of the country's Short Law I and II (La Higuera, 159 MW, $45 million committed in Nov 2005; and La Confluencia 160 MW, $83 million committed in Oct 2007). Following IFC support, other investors have entered the hydropower market in Chile. In India, IFC invested $49 million in Allain Duhangan hydro in February 2005. This was the first private merchant hydro power plant in India and served to launch a demonstration effect for future private financing of the hydro power market in the country. In Turkey IFC financed the first merchant company (Enerjisa, $247 million committed in June 2008) of 10 hydros and 1 combined cycle thermal plant after passage of the Electrictiy Market Law of 2001 and the Renewable Energy Law of 2005. • Regional integration of power grids. Increase the volume of energy trade between at least 6 countries by FY08. The Nigeria-Benin segment of the West Africa Power Pool Coastal Transmission Line was commissioned in February 2007 with support from an "Operational Security and Mitigation Plan" funded in part by the IDA WAPP APL 1 operation. IFC's Azito project has enabled power exports from Cote D'Ivoire to Ghana. Power was flowing by FY08. IFC's Endesa project has enabled power exports from Brazil to Argentina. Power was flowing by FY08. The commissioning of West Africa OMVS 220 kV Power System, linking Senegal to Mali and Mauritania, was completed in 2002. In 2008, electricity was shared among the three countries as follows: 393 GWh for Mali, 113 GWh for Mauritania, and 249 GWh for Senegal. The Electric Power Restoration 3 Project in Bosnia and Herzegovina interconnected Croatia and a part of Bosnia and Herzegovina and their power systems operated synchronously as part of the main European power system administered by the Union for the Coordination of Transmission of Electricity (UCTE). The rest of South East Europe (except Turkey) was	

Strategic Objectives	*Outcomes*	*Actions needed*
	synchronously interconnected on October 10, 2004, following the completion of rehabilitation in Croatia and Bosnia of facilities required for the synchronous interconnection of the whole region with the main European power system. • Doubling of power generation through renewable energy sources in at least 10 borrowers by FY08. The countries in which WBG has had renewable energy projects and the quantity of power generated from renewable energy has doubled since 1999 are Belize, Chile, China, Ethiopia, Jordan, Mauritius, Morocco, Mozambique, Nepal, Senegal, and Vietnam.	
Develop capacity for environmental regulation, monitoring and enforcement across all levels of governance This is the focus of the environment sector and the environment sector strategy will address this point.	Efficient environmental policies and regulations related to energy production and use; and transport fuels and vehicle emissions enacted and enforced by 2010 in at least half of client countries (significant progress in enforcement achieved by 2005). The progress here will be assessed in the environment sector strategy. IFC's new performance standards have become widely adopted by the world's international banking industry (Equator Banks) and influenced the approach to environmental and social performance in investment projects, including energy projects financed by such banks. More specifically, IFC has updated more than 50 industry guidelines including several that relate specifically to the energy sector. The World Bank had 26 projects between FY00 and the first half of FY09 in energy, transport, industry and trade in which main objectives included development and improvement of the client's capacity for environmental regulation, monitoring, and enforcement linked to pollution management and environmental health. They consisted of 11 in energy, 6 in industry and trade, and 9 in transport.	**Long term (FY08):** Establishing a coherent regulatory framework consistent of improved standards, regulations, and incentives for internalizing externalities and backed up by sound economic analysis of environmental impacts for planning and effective implementation programs. The progress here will be assessed in the environment sector strategy.
Make the Bank more responsive to addressing the adverse	• Develop more effective ways of generating and sharing knowledge; enhance awareness campaigns; build	**Long-term (FY08):** Mainstream creating and dissemination of knowledge;

Strategic Objectives	*Outcomes*	*Actions needed*
environmental impacts of energy sector	partnerships with strategic partners; and establish a framework for wider participation of non-governmental organizations and civil societies. Regional Clean Air Initiatives have involved extensive participation by non-governmental organizations and civil society. The World Bank actively led or co-led CIA in Asia (SAR and EAP), LAC, and Africa. South Asia Urban Air Quality Management involved civil society through workshops and dissemination of 15 briefing notes. South Asia Two-Stroke Engine Initiative involved two-stroke engine vehicle manufacturers and "baby-taxi" drivers in addressing emissions from two-stroke engine three-wheelers. The energy, environment, and transport sector boards jointly established an Air Quality Thematic Group in 2001. Drawing staff and expertise from the three sectors, the thematic group produced two major publications, one on reducing air pollution from urban transport (Gwilliam and others 2004) and another on biofuels (Kojima and Johnson 2005). Extensive internal and external consultations were conducted in the preparation of these reports, which were widely disseminated. • Full compliance with Bank safeguards policies. IEG assessment due for release in fall 2009 will be reviewed. • Distill the policy content of existing good practice notes on the power sector and on energy efficiency into Operational Policies (OPs). OP4.37, issued in October 2001, deals with the safety of dams. Although not an OP, three operational guidance notes for WBG staff have been issued: "Public and private sector roles in the supply of electricity services" (February 2004), Public and private sector roles in the supply of gas in developing countries" (April 2004), and "Designing sustainable off-grid rural electrification projects: principles and practices" (November 2008).	introduce environmental considerations in energy operations. The Air Quality Thematic Group—established by the Energy and Mining, Environment, and Transport Sector Boards in 2001—focused on knowledge creation and sharing. On account of growing global awareness about environmental sustainability, environmental considerations are integral to energy operations.

Notes: 1) "Borrowers" refers to countries or sub-national entities (e.g. states, provinces, municipal governments) that are recipients of World Bank lending and non-lending services.

2) Estimates of numbers of borrowers implementing particular activities and numbers of projects and activities are provisional and are dependent on further analytical work, agreements with borrowers, and integration with Country Assistance Strategies and Business Plans.
3) “Dirty” fuels here mean unprocessed solid fuels—coal, wood and biomass, and heavy fuel oil; for example, fuels with high emission factors for particulates and other harmful pollutants. “Cleaner” sources of energy include renewables, natural gas, biogas, distilled petroleum products (e.g., LPG and kerosene) and processed solid fuels with lower emissions factors, such as smokeless coal or charcoal.

Annex 6: Benchmarking Against 2001 Energy Strategy

The 2001 energy strategy set several quantitative targets for developing countries to be achieved in 10 years:

- Share of households with access to electricity increases from 65 to 75 percent.
- Average carbon dioxide (CO_2) emission intensity of energy consumption declines from 2.90 tonnes per tonne of oil equivalent (toe) to 2.75 tonnes per toe.
- Average energy consumption per unit of gross domestic product (GDP) declines from 0.27 toe/US$1,000 to 0.24 toe/US$1,000.
- Where the power industry stops being a burden on the budget increases from 34 to 50 percent.
- Where private ownership and financing play a dominant role in the energy sector increases from 25 to 40 percent.
- Where regulators oversee natural monopolies in an objective, transparent and nondiscriminatory manner increases from 35 to 50 percent.
- Where the industrial consumers have a choice of suppliers increases from 15 to 40 percent.
- Share of large cities with acceptable air quality increases from 15 to 30 percent.

All the targets are global metrics, and as such assessing the WBG's contribution to each is difficult. Interim results for the key targets in IBRD and IDA countries are given below. All the results need to be interpreted with caution for two reasons. Accurate quantitative data are not available in many developing countries. For example, information on access to electricity relies on a comprehensive household survey—utility data often under-estimate access because of widespread existence of illegal or informal connections in developing countries—but these data are never available annually in any developing country, and even when surveys are conducted, sampling bias could be serious or there may not be specific questions about electricity use. And even when there are several questions about electricity use, the responses may not be internally consistent (for example, the number of households that reply that they are using electricity for lighting may differ significantly from the number reporting positive expenditures on electricity). Lastly, Table A6.4–Table A6.7 require subjective judgment, and the nature of judgment may have different in the data collection in 2001 and the data collection today.

- **Share of households with access to electricity increases from 65 to 75 percent**.
  A preliminary summary of access data, many of which are based on household surveys, is given in Table A6.1. In addition to the share of households, the share of population is also shown. Most household surveys were conducted in 2006 or earlier, and as such the aggregate statistics are not derived for the same year. The methodology for estimating the share of people with access to electricity consisted of taking the share of households and converting to the share of people based on the average household size obtained from household surveys or those published by the United Nations for 2005 (UN-Habitat 2007). The total number of people for whom access data are available numbered 5.2 billion (based on 2005 population statistics); the total population in IDA and IBRD countries in 2005 numbered 5.4 billion. As such, data coverage is good. Although the global target has been met, large regional differences are apparent, with Africa far lagging behind other regions, followed by South Asia. The findings should be interpreted with caution because household surveys do not have the same coverage as censuses; the main advantage of using household surveys is that they provide more recent data. Based on the data used for constructing Table A6.1, the number of people who lack access is in the range 1.2–1.4 billion.

Table A6.1 Access to Electricity in IDA and IBRD Countries

Region	*Percent of households*	*Percent of people*
Africa	30	28
East Asia and the Pacific	97	96
Europe and Central Asia	100	100
Latin America and the Caribbean	92	91
Middle East and North Africa	94	93
South Asia	64	64
Total	81	77

Sources: Household surveys, government statistics, data from utilities, World Bank calculations.

- **Average CO_2 emission intensity of energy consumption declines from 2.90 tonnes per toe to 2.75 tonnes per toe**.
  There are two ways of computing averages: (1) computing CO_2 emission intensity by country and averaging across countries, and (2) summing CO_2 emissions across all countries first and dividing the sum by total energy consumption across all countries. In the second procedure, such large economies as China dominate the results, and hence the first method was used for this comparison. Table A6.2 shows the results for 1999 and 2006, the last year for which data for developing countries are available, using data from the U.S. Energy Information Administration (EIA 2009). Neither method yielded 2.90 tonnes per toe for any of the years in the period 1997–2000. One possible explanation is that the 2001 strategy used data from the International Energy Agency (IEA). The EIA database was used here because it has wider coverage of developing countries. The reduction between 1999 and 2006 is greater than the target set in both percentage and tonnes per toe. If weighted averages are taken, then CO_2 emissions intensity actually increased from 2.61 to 2.65 between the two years, in part because China's share of CO_2 emissions in the sample (China's CO_2 emissions intensity at 3.2 was above average in both years) increased rapidly between the two years.

Table A6.2 Tonnes of CO_2 per Tonne of Oil Equivalent of Energy Consumed

Region	*1999*	*2006*
Africa	3.2	2.7
East Asia and the Pacific	2.5	2.5
Europe and Central Asia	2.3	2.2
Latin America and the Caribbean	2.3	2.2
Middle East and North Africa	2.7	2.6
South Asia	2.2	2.1
Total	2.7	2.4

Sources: EIA 2009 and World Bank calculations.

- **Average energy consumption per unit of GDP declines from 0.27 toe/US$1,000 to 0.24 toe/US$1,000**.
  The results for IBRD and IDA countries, taking unweighted averages, are given in Table A6.3. Global purchasing power parities were revised in 2005 based on new data. The calculations in the table are based on the new purchasing power parities in 2005 U.S. dollars. As such, the numbers in 1999 do not match those from the 2001 strategy, which used earlier purchasing power parity figures. The reduction achieved to date is the same as the target in toe/US$1,000 and greater in percentage terms. If weighted averages are taken, then energy intensity declined from 0.26 in 1999 to 0.24 in 2006.

Table A6.3 Energy Intensity in IDA and IBRD Countries (toe/GDP)

Region	*1999*	*2006*
Africa	0.10	0.11
East Asia and the Pacific	0.15	0.15
Europe and Central Asia	0.46	0.33
Latin America and the Caribbean	0.18	0.17
Middle East and North Africa	0.24	0.22
South Asia	0.15	0.12
Total	0.21	0.18

Sources: EIA 2009, World Bank 2008a, and World Bank calculations.
Units: Ratio of tonnes of oil equivalent of energy consumed to GDP at purchasing power parity in 2005 U.S. dollars.

- **Where the power industry stops being a burden on the budget increases from 34 to 50 percent**. The World Bank staff were asked about the countries in their respective regions in early 2009, and the results are summarized in Table A6.4. Because precise information on the power industry's burden on the budget is often not available, subjective judgment was used in many cases. As such, this result should be interpreted with caution.

Table A6.4 Percentage of Countries where the Power Sector Is Not a Budgetary Burden

Region	*Percentage*
Africa	2
East Asia and the Pacific	80
Europe and Central Asia	37
Latin America and the Caribbean	52
Middle East and North Africa	23
South Asia	14
Total	26

Source: World Bank staff.

- **Where private ownership and financing play a dominant role in the energy sector increases from 25 to 40 percent**.
The World Bank staff were asked about the countries in their respective regions in early 2009, and the results are summarized in Table A6.5. There has been no progress in this area, and in fact the percentage appears to have declined, although without examination of the original data, including country-by-country comparison, it is difficult to conclude definitively that the role of private ownership has declined.

Table A6.5 Percentage of Countries with Significant Private Sector Participation in Energy

Region	*Percentage*
Africa	0
East Asia and the Pacific	10
Europe and Central Asia	36
Latin America and the Caribbean	55
Middle East and North Africa	17
South Asia	0
Total	17

Source: World Bank staff.

- **Where regulators oversee natural monopolies in an objective, transparent and nondiscriminatory manner increases from 35 to 50 percent**.
  The original question asked about the power and the downstream natural gas sectors. The results are shown in Table A6.6. These results should be interpreted with caution because, short of establishing a series of objective indicators to answer the question, the wording in the original questionnaire for the 2001 strategy, "Is there currently a regulator operating in an objective, transparent, and non-discriminatory manner whose tasks are to oversee natural monopolies and to promote competition for (a) power, (b) downstream gas," calls for a subjective response. As such, although the target appears to have been met, without country-by-country comparison between the two years and confirming that the same criteria were applied at least for the same country in the two rounds of data gathering, this result should be interpreted with caution.

Table A6.6 Percentage of Countries with Regulators in the Energy Sector

Region	*Percentage*
Africa	44
East Asia and the Pacific	43
Europe and Central Asia	79
Latin America and the Caribbean	60
Middle East and North Africa	17
South Asia	71
Total	52

Source: World Bank staff.

- **Where the industrial consumers have a choice of suppliers increases from 15 to 40 percent**.
  As Table A6.7 shows, no progress has been made in this area.

Table A6.7 Percentage of Countries with Choice of Suppliers in the Energy Sector

Region	*Percentage*
Africa	0
East Asia and the Pacific	0
Europe and Central Asia	36
Latin America and the Caribbean	45
Middle East and North Africa	0
South Asia	0
Total	13

Source: World Bank staff.

One target was not assessed.

- **Share of large cities with acceptable air quality increases from 15 to 30 percent**.
  The data for this target could not be identified, and the text does not make clear how large is a large city nor what is considered "acceptable air quality." For this reason, no attempt was made to measure performance against this target.

Annex 7: Key Funds, Initiatives, and Programs for the WBG's Energy Activities

Asia Sustainable and Alternative Energy Program (ASTAE)

ASTAE was established in 1992 to mainstream alternative energy (defined to include renewable energy and energy efficiency) in the World Bank's power sector lending operations in Asia. Since its inception, ASTAE has supported a broad portfolio of alternative energy projects and activities throughout Asia. While lending operations are funded primarily by the World Bank and GEF, ASTAE has relied on a number of donors and partners to support its work program.

Carbon Partnership Facility

This new facility targets long-term emissions after 2012, scaling up, and strategic contributions to transformational interventions. Eligible categories include electricity generation, transmission, and distribution; energy efficiency; and oil and gas.

Carbon Finance Funds

The purpose of the ten Carbon Finance Funds—the first of which was established in 2000—is to purchase project-based GHG emission reductions in developing countries and economies in transition. The emission reductions are purchased through one of the carbon funds on behalf of governments and companies (the contributors), and within the framework of the Kyoto Protocol's Clean Development Mechanism or Joint Implementation. The Carbon Finance unit within the Bank serves as an in-house secretariat that manages and coordinates the program and constituent funds.

Climate Investment Funds, Clean Technology Fund, and Scaling-up Renewable Energy Program for Low-Income Countries

The Climate Investment Funds (CIFs), approved by the World Bank Group's Board of Executive Directors in July 2008, consist of two funds: the Clean Technology Fund (CTF) and the Strategic Climate Fund (SCF). The CIFs will invest in projects and programs in developing countries that contribute to the demonstration, deployment, and transfer of low-carbon technologies. The SCF will serve as an overarching fund that can support targeted programs with dedicated funding to provide financing to pilot new approaches with potential for scaled-up, transformational action aimed at a specific climate change challenge or sectoral response. The Program for Scaling-Up Renewable Energy in Low Income Countries (SREP) is within the framework of the SCF. The SREP, in the final stages of the design process, will demonstrate the economic, social, and environmental viability of low-carbon development pathways in the energy sector by creating new economic opportunities and increasing energy access through the use of renewable energy. The CIFs are managed by the World Bank and implemented jointly with the regional development banks (the African Development Bank, the Asian Development Bank, the European Bank for Reconstruction and Development,and the Inter-American Development Bank). As provided in the CIF design, an equal number of donors and recipient and donor countries hold seats on the decision-making committees, as provided for in the CTF Governance Framework and the SCF Governance Framework. Donors pledged over US$6 billion for the CIFs in September 2008.

Extractive Industries Transaction Advisory Facility (EI-TAF)

EI-TAF is a newly established multi-donor trust fund managed by the World Bank. EI-TAF's objectives are to (1) address country demand for rapid-response advisory services in the oil, gas, and mining sectors; and (2) contribute to global knowledge management in extractive industries sector governance through the gathering and dissemination of good practices.

Extractive Industries Transparency Initiative (EITI)

The initiative, announced in 2002 and launched in 2003, promotes and supports improved governance in resource-rich countries through the full publication and verification of company payments and government revenues from oil, gas, and mining. As a voluntary association of stakeholders with shared goals, the EITI structure comprises resource-rich developing countries, donors, international and national resource companies, and civil society.

Energy Sector Management Assistance Program (ESMAP)

Founded in 1983, this global technical assistance program helps build consensus and provides policy advice on sustainable energy development to governments of developing countries and economies in transition. ESMAP also contributes to the transfer of technology and knowledge in energy sector management and the delivery of modern energy services to the poor. Annual disbursements total some US$10million. The program is administered by the Bank on behalf of a consultative group comprising 10 bilateral donor agencies along with the World Bank.

Global Environment Facility (GEF)

The objective of the program, founded in 1991, is to protect the quality of the regional and global commons by supporting (1) the transfer of financial resources and environmentally friendly technologies, (2) technical assistance for policy and institutional reform, and (3) development of markets for environmental goods and services. In addition to supporting renewable energy and energy efficiency, GEF also supports new technologies that are not yet cost effective, ranging from large-scale solar power plants and distributed power generation in fuel cells to building-integrated solar photovoltaics. The World Bank administratively supports the GEF Secretariat.

Global Gas Flaring Reduction Partnership (GGFR)

Established in 2002, the partnership facilitates and supports national efforts, particularly in developing countries, to use currently flared gas by promoting effective regulatory frameworks and tackling the constraints on gas utilization, such as insufficient infrastructure and poor access to local and international energy markets. The program disburses US$3 million annually and is led by the World Bank.

Global Partnership on Output-Based Aid (GPOBA)

GPOBA is a partnership of donors and international organizations working together to support output-based aid approaches. As of June 2008, GPOBA's donors had provided US$179 million in contributions and pledges. GPOBA's mandate is to fund, design, demonstrate, and document output-based aid approaches to improve delivery of basic infrastructure and social services to the poor in developing countries. The goal is to have output-based aid being used on a regular basis in project design. GPOBA focuses on the poorest countries, and energy is one of the focus sectors.

IFC Cleaner Production Lending Pilot

IFC set up the Cleaner Production Lending Pilot in 2007 to encourage portfolio clients to undertake cleaner production investments and to demonstrate the financial viability and environmental benefits of such projects. Through the US$20 million facility, the IFC provides debt financing from US$250,000 to US$5 million per project, and the loan transaction is swift because of a streamlined process. Loan recipients also have access to IFC's technical and environmental specialists who can serve as a sounding board and help quantify project benefits. Advisory services can also be arranged as part of the program. Assistance is offered in designing comprehensive audits of clients' operations, which are conducted by external specialists.

IFC Climate Change Joint Investment Initiative

IFC has committed US$135 million, on behalf of the Government of the Netherlands, to purchase emission reduction credits from projects eligible under the Kyoto Protocol's Clean Development Mechanism and the Joint Implementation mechanism. IFC has concluded 12 transactions to purchase emissions reductions from more than 40 renewable energy projects (wind farms, small hydros, landfill and coalbed methane, and industrial gas).

IFC InfraVentures

InfraVentures is a fund of US$100 million which will provide (1) risk capital to fund the early stages of the development of infrastructure projects in IDA countries through a variety of financial instruments, and (2) expertise in critical areas of the earliest stages of project development, in order to successfully bring private and public-private-partnership infrastructure projects to the financing stage. Its first transaction in 2008 was for a geothermal plant in Djibouti.

Lighting Africa

This WBG initiative targets 2030 for bringing light to 250 million Sub-Saharan Africans who do not have electricity. The World Bank, IFC, other development organizations, and local lighting suppliers and service providers are involved. Lighting Africa will create partnerships under which the World Bank and the IFC will provide market information, capacity building services, and financing and micro-financing for both production and marketing.

The undertaking will use CFLs and LEDs powered by renewable energy sources such as solar, wind, micro hydropower, and mechanical means (such as hand cranking and pedal power) to illuminate homes, businesses, health centers, and other sites that are not connected to the power grid. The new lighting will be portable, durable, cheaper, safer, and cleaner than lighting from kerosene and LPG.

Public Private Infrastructure Advisory Facility (PPIAF)

Established in 1999, PPIAF is a technical assistance facility that works with developing countries to improve the quality of their infrastructure through public-private partnerships. PPIAF helps developing countries through two main mechanisms: (1) offering governments technical assistance on strategies and measures they can use to tap the full potential of public-private partnerships in infrastructure; and (2) identifying, disseminating, and promoting best practices on matters relating to public-private partnerships in infrastructure. The program disburses some US$20 million annually and is managed by a unit within the World Bank.

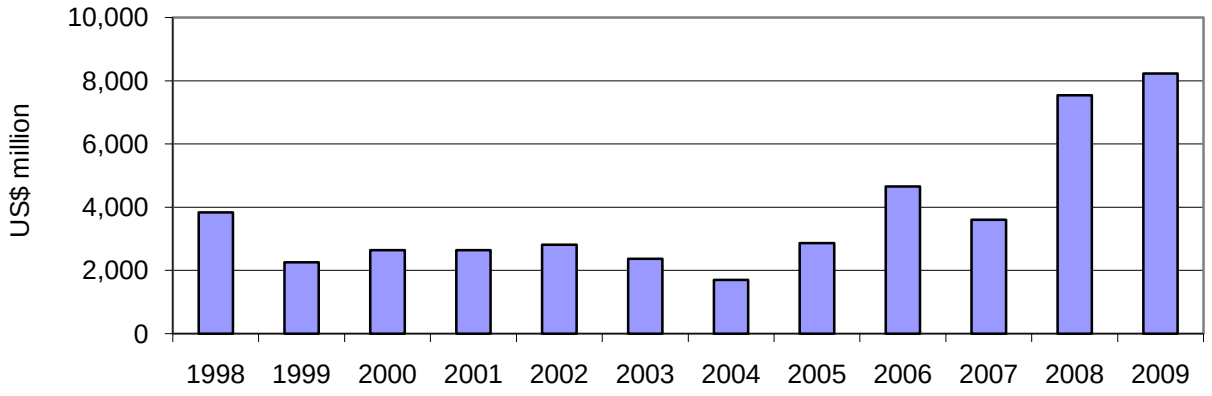
Water Partnership Program

The Water Partnership Program seeks to enhance World Bank assistance in the water sector in two ways: by enabling the World Bank and client governments to generate and explore new opportunities for projects; and, at the project level, by enhancing the quality of World Bank water-related operations through incremental expert support and applied global knowledge.

Annex 8: World Bank Group Lending Patterns and CAS Assessment

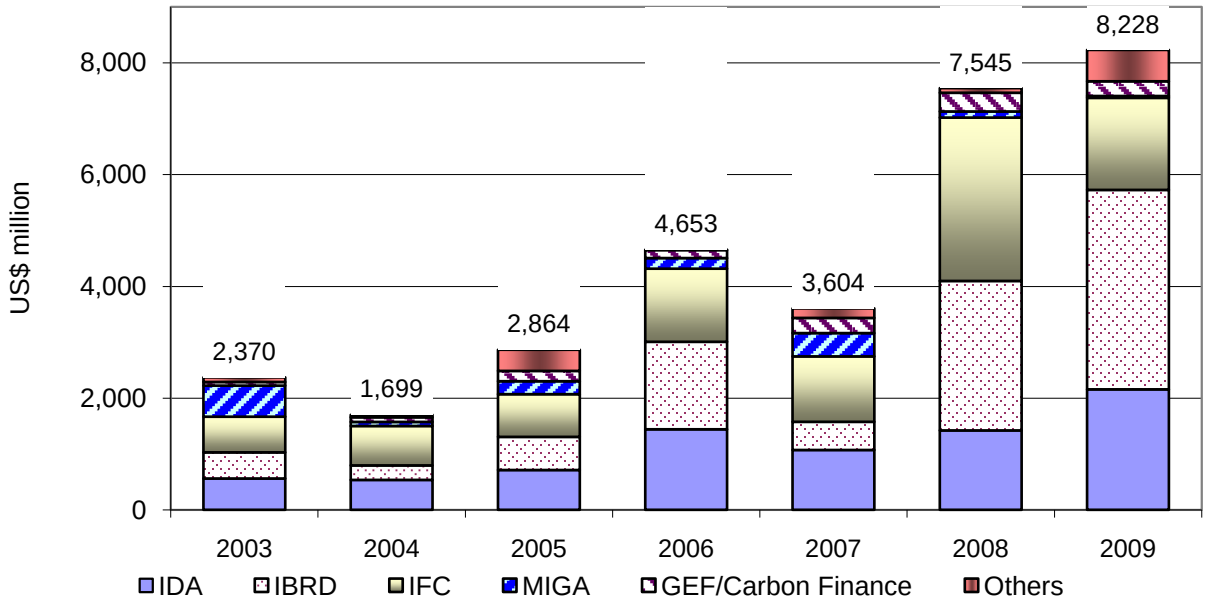
WBG lending for the energy sector fluctuated around US$2.4 billion from FY99 to FY04. In 2003, Bank management launched an Infrastructure Action Plan covering IDA and IBRD for FY04–07 to revitalize the World Bank's engagement in the sector. Lending began to increase rapidly, surpassing all earlier lending levels to reach US$8.2 billion in FY09 (Figure A8.1). IFC was not part of the 2003 Infrastructure Action Plan, but its lending for energy has also increased correspondingly (Figure A8.2). SIAP covers the entire WBG and sets targets for FY09–11. Comparison of FY2003–05 and FY2007–09 shows that the volume of lending for energy on average increased markedly for IDA, IBRD, and IFC—nearly tripling for IDA and IFC and more than quintupling for IBRD—and declined for MIGA. Carbon finance overtook GEF in 2006 and MIGA in 2008.

Figure A8.1 World Bank Group Lending for Energy (New Approvals)



Source: World Bank Group.

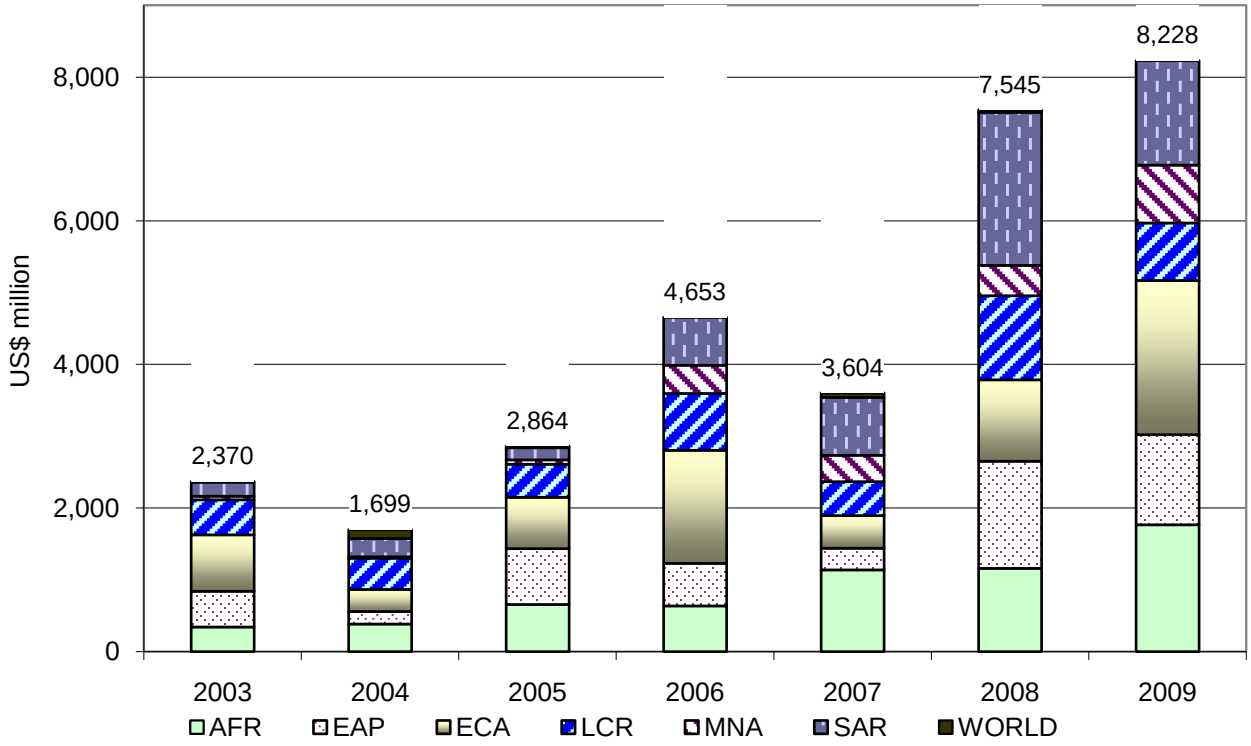
Figure A8.2 World Bank Group Lending for Energy by Institution



Source: World Bank Group.

A regional breakdown is shown in Figure A8.3. The three-year average volume of lending between FY2003–05 and FY2007–09 doubled in EAP, ECA, and LCR; tripled in AFR; increased seven-fold in SAR; and 12-fold in MNA.

Figure A8.3 World Bank Group Lending for Energy by Region

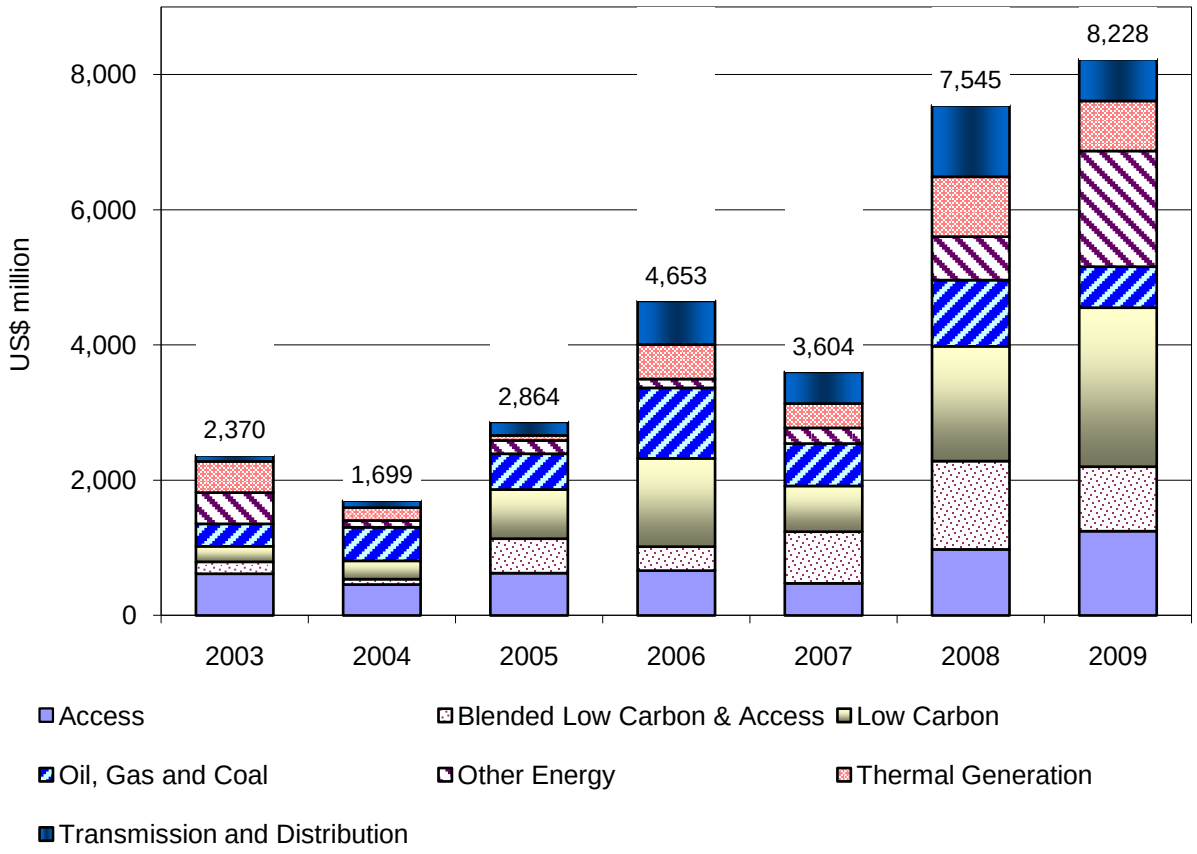


Source: World Bank Group.

Figure A8.4 shows lending by categories defined under the Clean Energy Investment Framework. This framework focused on access to modern energy services, climate change mitigation, and adaptation to climate and weather variability. As a result, the categorization of the energy lending portfolio followed the first two priority areas: access and mitigation. Low-carbon activities include renewable energy projects including hydropower of all sizes, energy efficiency, power plant rehabilitation, district heating, biomass waste-fueled energy, gas-flaring reduction, and gas or coal plants with higher efficiency than the baseline. However, higher-efficiency new coal-fired power plants have not been included in low-carbon projects to date, and in the future they will be excluded from this category. It is worth noting that those not falling under the low-carbon category are not by definition high carbon. More than one-third of the WBG's total investments support modern energy transmission and distribution systems (shown as transmission and distribution in the figure) and services and policy work within countries (shown as other energy or access)—for example, building capacity in national energy sectors or supporting countries as they reform their energy markets to make them more efficient and inclusive. These are critical to both meeting the energy access and growth agenda and providing a platform for low-carbon growth.

The share of low-carbon projects in total energy lending averaged 40 percent over the last three years and, when averaged over the first three and the last three fiscal years, nearly quadrupled in lending volume between FY2003–05 and FY2007–09. By the same measure, lending for access more than doubled during the same time period.

Figure A8.4 World Bank Group Lending by Clean Energy Investment Framework Classification



Source: World Bank Group.

A detailed breakdown of lending for renewable energy and for energy efficiency in fiscal 2009 (Table A8.1) shows that lending for energy efficiency had the largest share, followed by lending for new renewable energy (solar, wind, biomass, geothermal, and hydro plants smaller than 10 MW); lending for hydropower plants greater than 10 megawatts (MW) attracted the smallest share. Global Environment Facility (GEF) and Carbon Finance contributed just over 3 percent of the total funding. The total of US$3.1 billion for new renewable energy and energy efficiency far exceeded the agreed-upon Bonn commitment for FY09 of US$520 million (see Annex 11 for a discussion on the WBG's commitment in Bonn); the additional lending of US$177 million for large hydropower plants is not covered by the Bonn commitment.

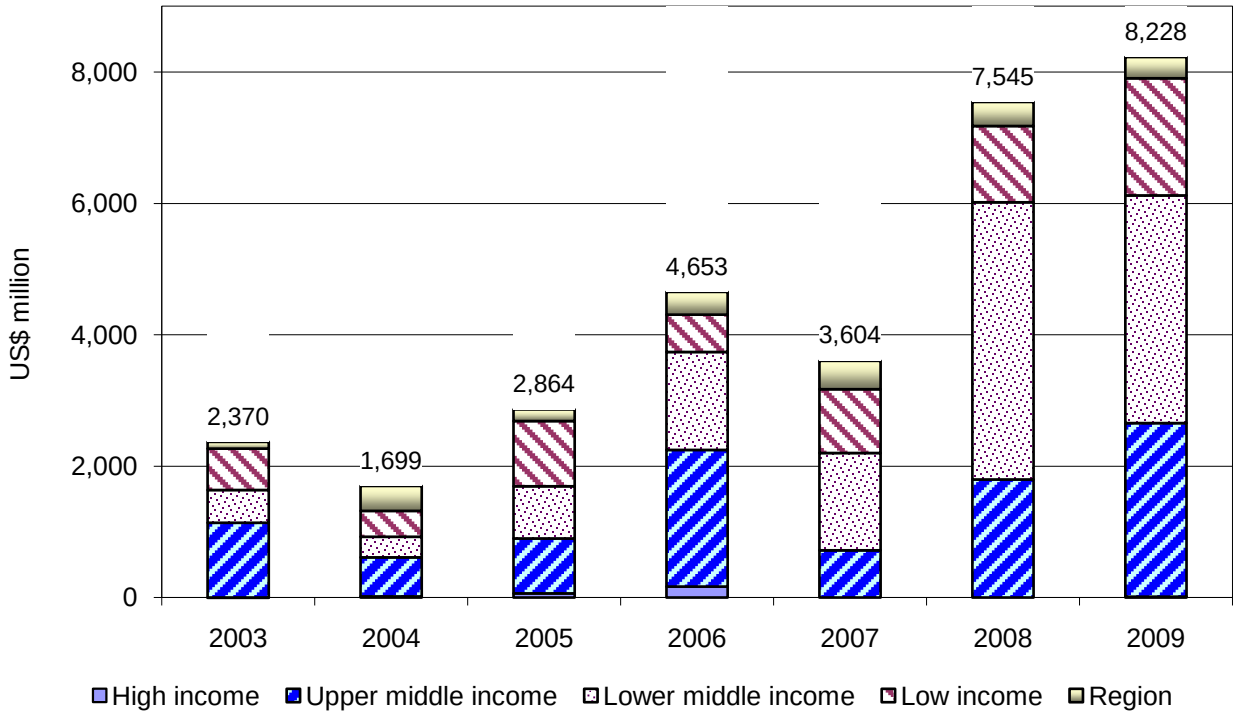
Table A8.1: WBG Commitments for Renewable Energy and Energy Efficiency in 2008 (US$ millions)

Source of Funds	*New renewable energy*	*Hydro > 10 MW*	*Energy efficiency*	*Total*
World Bank	*840*	*43*	*1,386*	*2,269*
IBRD/IDA	804	43	1,311	2,157
GEF	15	0	68	83
Carbon finance	21	0	8	29
IFC	*587*	*135*	*315*	*1,036*
Own funds	587	135	315	1,036
GEF	0	0	0	0
Carbon finance	0	0	0	0
MIGA	*0*	*0*	*0*	*0*
Total	1,427	*177*	*1,701*	*3.350*

Source: World Bank Group.

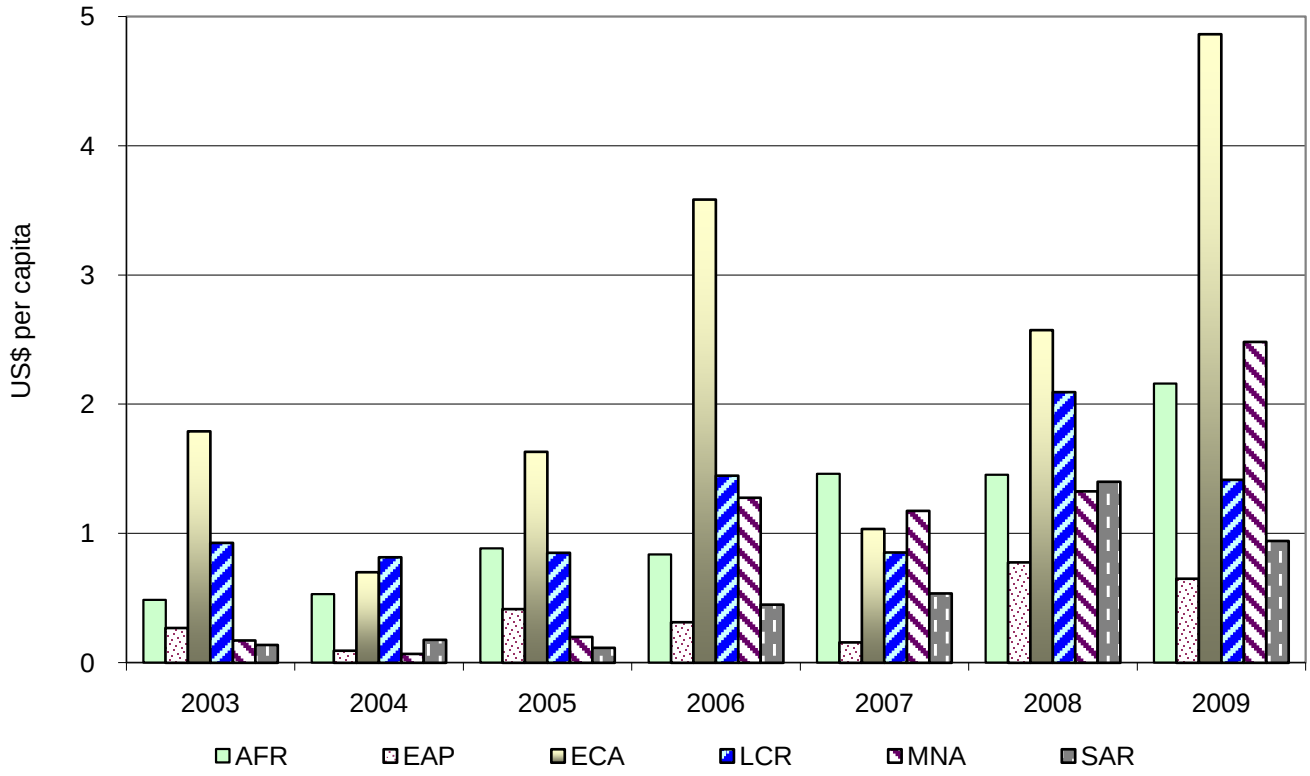
Energy lending to countries grouped by their income classification increased most rapidly in lower-middle-income countries, which attracted more than 40 percent of total energy lending in FY09 (Figure A8.5). On a per capita basis, on average, ECA had the highest lending per capita and EAP lowest over the last three fiscal years (FY2007–09). AFR, LCR, and MNA were comparable. As with total lending, during the last three fiscal years, per capita lending showed considerable variation from year to year in EAP and ECA (Figure A8.6).

Figure A8.5 World Bank Group Lending by Country Income Class



Source: World Bank Group.

Figure A8.6 World Bank Group Lending per Person by Region



Source: World Bank Group.

The emphasis on different aspects of the World Bank's policies toward the energy sector can be gathered from a detailed analysis of Country Assistance Strategies (CAS). Fifty-eight CAS completed in the period from FY2006 to the middle of FY2009 were examined for nine energy related themes. The themes are shown in Table A8.2. The table shows the percentage of CAS that raised issues under each theme, made energy policy recommendations, and set targets for action or stated desired results. On average, energy issues and energy policy were addressed in 50 percent of the CAS, while targets were set in 40 percent. There was a substantial difference in the attention paid to different themes. Improving access and energy supply was the most frequently present: the issues were discussed in 84 percent of the CAS, and actual targets were provided in 62 percent. The theme least often raised was management of state-owned energy enterprises, and energy efficiency and renewable energy were also below average on all three indicators. A separate analysis showed that 70 percent of CAS acknowledged a link between poverty and a lack, or inadequate supply, of energy. However, this link was mentioned in 93 percent of the CAS completed in FY2006 and FY2007, but only in 46 percent of the CAS issued in FY2008 through the middle of FY2009.

Table A8.2 CAS Treatment of Energy Sector Issues (percent)

Fiscal year	*2006–09*			*2006–07*			*2008–09*		
Theme	*Issues*	*Policy*	*Target*	*Issues*	*Policy*	*Target*	*Issues*	*Policy*	*Target*
Management of state-owned energy enterprises	31	33	21	30	43	20	32	21	21
Energy financing/investments	70	60	43	59	63	47	82	57	39
Energy pricing, taxation, subsidies	53	36	29	47	33	30	61	39	29
Regulation and competition	57	64	50	53	70	53	61	57	46
State management of energy resources	66	62	43	83	87	60	46	36	25
Energy efficiency and demand management	36	38	34	33	30	30	39	46	39
Access to clean commercial energy, energy supply issues	84	71	62	83	83	70	86	57	54
Rural energy	33	34	34	33	37	30	32	32	39
Renewable energy and climate change considerations	41	50	38	37	43	30	46	57	46
Overall	52	50	39	51	54	41	54	45	38

Source: World Bank analysis

Annex 9: IEG and QAG Assessment of IDA and IBRD Projects and Review of Inspection Panel Cases

Since 1973, the Independent Evaluation Group (IEG), reporting directly to the WBG's Board of Executive Directors, has been providing an objective basis for assessing the results of IDA and IBRD projects. A key activity of IEG is to evaluate individual project operations in terms of their outcomes, risks to these development outcomes, and Bank and Borrower performance, normally within 1 to 2 years of project completion. These project-level evaluations are carried out through IEG reviews of individual Implementation Completion Reports,[9] or through selective, in-depth Project Performance Assessment Reports (PPARs) for broader learning purposes. PPARs are independent evaluations of selected completed World Bank operations involving field visits to the project. They are carried out on about one fourth of completed projects and publicly disclosed.

The Quality Assurance Group (QAG) was established in 1996 for the specific purpose of improving the quality of the Bank's operational work and providing real-time feedback on issues affecting project outcomes. Since 1996, QAG has had two main review instruments for assessing the quality of Bank project operations: (1) quality at entry (QEA) for newly approved operations; and (2) quality of supervision (QSA), which examines the quality of the Bank's assistance for project operations already under implementation. As with PPARs, both QEA and QSA select sub-samples of projects for review. In 2008, a new review instrument—quality assessment of the lending portfolio (QALP)—was introduced, which combines QEA and QSA into a single instrument. The main focus of this new instrument was to assess the prospects for achieving the development objectives of project operations already under implementation but which have yet to reach the mid-term review. All QAG instruments have the capability of providing real-time feedback to task team leaders and sector managers to enable adjustments to be made in project design and implementation performance in order to enhance the prospects for achieving the development objectives.

Since the late 1990s, QAG has also been undertaking an annual review of the Bank's portfolio performance (ARPP). The purpose of this review is to provide the WBG's Board and senior management with a strategic overview of the effectiveness of the Bank's lending in delivering results to its clients. The ARPP is closely linked to the other QAG instruments and provides real-time information on what is working well or less well, together with specific recommendations to help maintain or improve the quality of the Bank's project portfolio.

The Inspection Panel was established by the Executive Directors of IDA and IBRD in September 1993. The primary purpose of the Inspection Panel is to address the concerns of the people who may be affected by IDA and IBRD projects and to ensure that the World Bank adheres to its operational policies and procedures during design, preparation and implementation phases of projects.

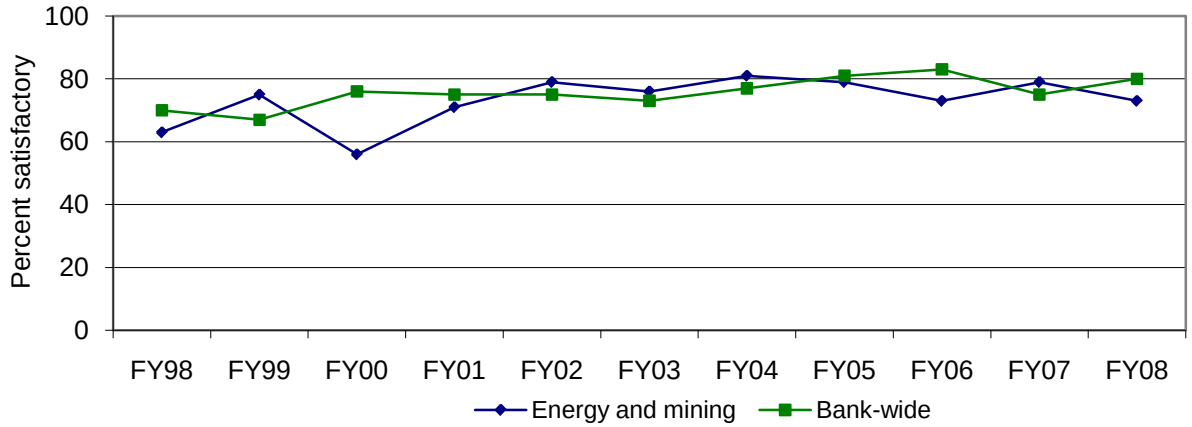
This annex provides a review of the main trends in the energy and mining sector performance since 2000, based on reviews of IEG assessments, the findings from different QAG reviews, the main recommendations of the ARPP reports, and the findings of the Inspection Panel cases examining energy projects. Although mining (other than coal mining) is not part of energy, IEG and QAG group energy and mining into one category. Because the number of mining projects is small, the qualitative results of IEG and QAG reviews do not change on account of inclusion of mining.

[9] Upon completion of each lending operation financed by the World Bank, the World Bank reviews the results, and prepares an assessment of the operation known as an Implementation Completion Report.

Review of IEG assessments

Between FY2000 and FY2008, 183 energy and mining operations exited from the Bank portfolio. Of these, all but four were evaluated by IEG, and 130 operations, or 71 percent, had outcomes rated "moderately satisfactory" or better. The performance of energy and mining was poorer than the Bank-wide satisfactory rating average of 77 percent for the same period, particularly in FY00 and FY06 when energy and mining outcomes fell ten or more percentage points below the Bank wide average. More than 80 percent of the 179 energy and mining operations that were evaluated in this period were approved by the WBG's Board in the period FY91–00. This was a period in which Bank energy policies gave strong emphasis to sector reform objectives through increased private sector participation in the management and ownership of energy utilities in developing countries. Historical trends are shown in Figure A9.1.

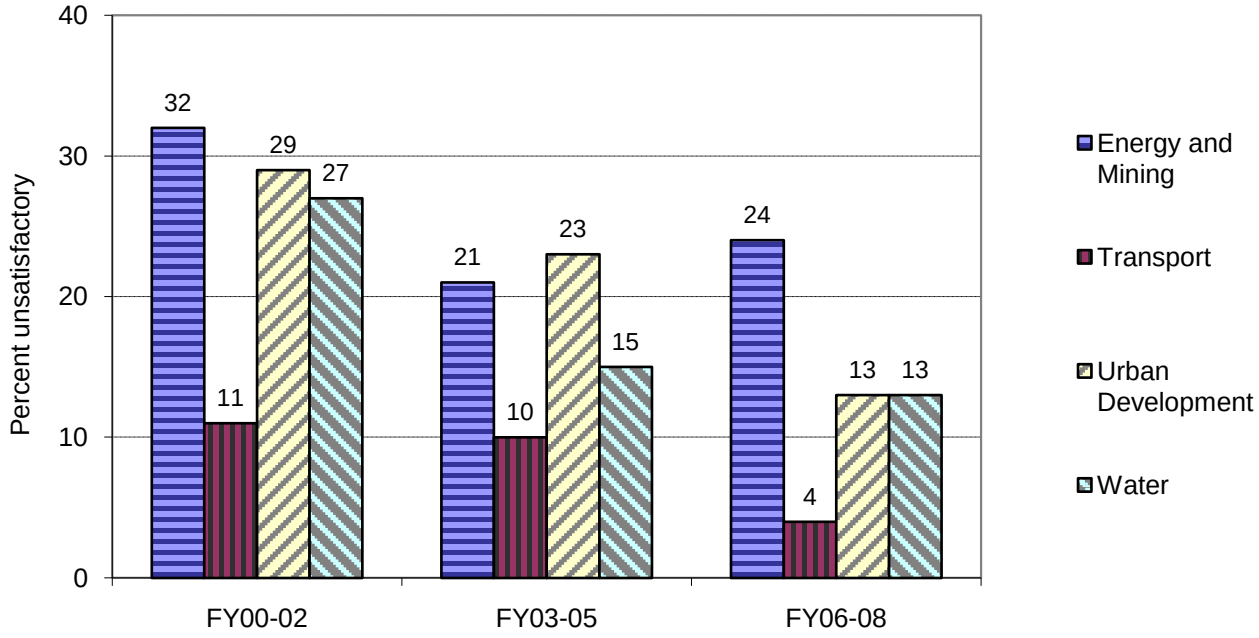
Figure A9.1 Comparison of Energy and Mining with Bank-wide Average IEG Ratings



Source: IEG database.

Within infrastructure operations, energy and mining operations have had a relatively higher proportion of "unsatisfactory" exits than other infrastructure areas such as transport, water, and urban development, including FY06–08. In this period, energy and mining outcome performance actually declined in comparison with the previous three-year period, FY 03–05, while water and urban development operations showed significant improvement and transport maintained its past strong performance (Figure A9.2)

Figure A9.2 Comparison with Other Infrastructure Sectors



Source: IEG database.
Notes on the number of projects: 88 for energy and mining, 87 for transport, 38 for urban development, and 30 for water in FY00–02; 50, 69, 54, and 49, respectively, in FY03–05; and 45, 74, 30, and 31, respectively, in FY06–08.

A more detailed analysis of the 179 energy and mining operations exiting the Bank's portfolio between FY00 and FY08 and evaluated by IEG shows the following:

1. FY00 has the single largest number of energy and mining portfolio exits over this eight-year period, numbering 34. After FY00, energy and mining operations exiting annually from the Bank's portfolio declined steadily to an average of 15 during the final four years, FY05–08. The declining number of energy and mining exits after FY00 reflects the overall reduction in energy lending, which took place in the 1990s until preparation of the Infrastructure Action Plan in 2003.
2. FY00 is the weakest year in outcome performance: only 19 of the 34 energy and mining operations (56 percent) that exited the Bank's portfolio in FY00 had "satisfactory" outcomes, more than 20 percent below the FY00 Bank wide average of 79 percent. The regional distribution of unsatisfactory outcomes comprised 5 out of 7 in AFR, 2 out of 10 in EAP, 3 out of 9 in ECA, 2 out of 4 in LCR, 1 out of 1 in MNA, and 2 out of 3 in SAR. After FY00, energy and mining outcome performance improved toward the Bank-wide average of 76 percent satisfactory.
3. The majority of the unsatisfactory energy and mining exits over the FY00–08 period are concentrated in the Africa region (16 out of 49), while the percentage of the unsatisfactory exits in SAR is also high, more than 40 percent. Other regions have much lower percentages of unsatisfactory exits, generally 20 percent or lower, though there can be a wide disparity between individual country performance in the same region, as is the case in EAP and ECA.
4. The outcomes in IBRD countries are significantly stronger than in IDA countries, which is consistent with Bank-wide findings. Individual countries with consistently strong energy and mining outcomes include Brazil, China, Poland, Thailand, and Vietnam.

In FY06–08, 24 percent of the energy and mining operations that exited from the Bank portfolio (11 of the 45) had unsatisfactory outcomes, having been rated "moderately unsatisfactory" or lower by IEG. All but one of the 11 unsatisfactory energy and mining operations were prepared during the period FY95–01. Although this percentage is lower than the percentage of unsatisfactory exits during the previous six

years, the proportion of operations with unsatisfactory outcomes still remains relatively high. Moreover, energy and mining performance declined during this three-year period at a time when 11 of the 17 World Bank sectors showed significant improvement.

A striking feature of energy and mining performance during this three-year period is the large performance gap between IBRD and IDA projects (Table A9.1) due mainly to weaker performance of IDA operations in AFR.

Table A9.1 Project Outcomes by Sector in FY06–08

Sector	*IBRD*		*IDA*	
	Outcome % satisfactory by number of projects	*Outcome % satisfactory by disbursement*	*Outcome % satisfactory by number of projects*	*Outcome % satisfactory by disbursement*
Agriculture and Rural Development	87.4	91.4	91.7	78.3
Energy and Mining	**86.7**	**81.8**	**53.0**	**58.8**
Environment	100.0	100.0	90.4	75.0
Economic Policy	100.0	100.0	81.8	84.6
Financial and Private Sector Development	85.8	73.7	74.8	72.0
Health, Nutrition and Population	90.9	68.8	66.9	52.4
Public Sector Governance	63.9	68.4	90.2	62.5
Urban Development	91.4	88.9	78.6	80.0
Water	97.1	94.1	82.9	84.6
Overall Result	89.1	83.8	77.8	70.1

Source: IEG database.

A review of the 11 energy and mining operations that exited the portfolio between FY06–08 with unsatisfactory outcomes indicates that two key factors were responsible for their unsatisfactory rating: (1) weak Borrower commitment to overambitious development objectives, often involving power sector reform or privatization goals, and underestimating the political constraints to attaining these development objectives; and (2) complex project designs, frequently involving multiple components, the implementation of which was typically beyond the institutional capacity of the responsible ministry or agency.

Of the 11 energy and mining operations that failed to meet their development objectives, eight of these operations had power sector reform, privatization, or both among their primary objectives. By region, five of these operations were in AFR, two in SAR and one in ECA. Most of these objectives lacked political realism for timing; they also underestimated the complexity of the steps needed to bring about reform. Lessons from the IEG evaluations of these operations confirm overly ambitious objectives in attempting to address, frequently in a single operation, both urgent investment needs and a range of policy issues accumulating over years—in one particular case, after absence of more than 20 years from the sector. Some of these operations provided examples of a formulaic approach that plagued the Bank's reform agenda in electric power during the 1990s, as discussed in IEG's "Power for Development: A review of the World Bank Group's experience with Private Participation in the Electric Power Sector" (World Bank 2003). Experience from countries that have implemented successful power sector reform programs highlight the importance of country ownership and sustained political commitment that are essential to achieving a successful outcome, both of which were lacking in most of these operations.

Weak institutional capacity in energy ministries and related government agencies responsible for policy and regulatory reform is a serious constraint to improving the operational and management efficiency of

energy utilities in many developing countries. As a result, institutional deficiencies are often a major impediment to achieving well founded development objectives unless strengthening measures are in place before funding is committed. In many IDA countries, particularly in AFR, there needs to be a proper balance between project design, institutional capacity, and realistic development objectives.

In many of the energy and mining operations reviewed that had unsatisfactory outcomes, there was a general tendency to include several components covering a number of sub-sectors, resulting in the implementation of too many activities in a single operation. As a result, project design ended up being overly complex in countries where the implementation capacity of the borrowers was limited. Even though provisions were made to strengthen capacity, these steps were either late or inadequate to meet the implementation needs. Complex project designs, with multiple components, often result from limited financing availability for energy operations in country lending programs and the consequent decision to address several objectives within a single operation.

In addition to these two main findings, there were several implementation weaknesses that characterized many of these unsatisfactory operations.

- *Weak Implementation Performance.* There was typically a lack of readiness at Board approval that led to implementation delays of at least one year. Key staff of the project implementation units was often not in place at Board approval, procurement capacity was weak, and there were frequent procurement problems during implementation.
- *Failure to Take Corrective Action.* At the time of the mid-term review, when it was apparent that implementation was well behind the original schedule and the development objectives were at risk, opportunities were not taken to (1) rationalize the operation, (2) cancel funds that were unlikely to be utilized, and (3) improve prospects for attaining the development objectives.

Review of Quality Assurance Group findings

There have been five QEA and four QSA reviews since FY2000. A QALP review, the findings of which are discussed in the next section, was undertaken for the first time in the period August 2008 to February 2009. The main findings from the QEA and QSA reviews are summarized in Table A9.2 and Table A9.3, respectively.

Table A9.2 Comparison with Bank-wide Average for Quality at Entry (percent satisfactory)

FY	*QEA*	*Energy and mining*	*Bank-wide*
2000–01	QEA4	83	94
2002	QEA5	86	88
2003	QEA6	100	87
2004–05	QEA7	92	92
2007–08	QEA8	100	91
2000–08	QEA4–8	93	91

Sources: Various QEA reports.

Table A9.3 Comparison with Bank-wide Average for Quality of Supervision (percent satisfactory)

FY	*QSA*	*Energy and mining*	*Bank-wide*
2000	QSA4	100	91
2002	QSA5	100	83
2003–04	QSA6	71	86
2005–06	QSA7	100	94
All	QSA4-7	94	89

Sources: Various QSA reports.
Note: In FY01, QAG did not have a QSA and instead did a report on QSR (quality of supervision of risky projects).

For QEA, a total of 45 energy and mining operations were reviewed out of an aggregate Bank-wide sample of 480 operations. In the earlier QEA 4 and 5 reviews, energy and mining performance was at, or below, the Bank-wide average. Energy and mining performance improved significantly from QEA 4–5 to QEA 6–8 in comparison with the Bank-wide average. Among the shortcomings identified in the QEA 4–5 reviews were (1) inadequate capacity and commitment of the implementing agencies; (2) insufficient evaluation of impact and outcomes; (3) inadequate stakeholder analysis, consultation, or both; and (4) a lack of readiness of the first year program. The only shortcoming identified clearly in later reviews was the need to pay more attention to implementation arrangements.

For QSA, a total of 35 energy and mining operations, constituting approximately 7 percent of an aggregate Bank-wide sample of 510 operations, were reviewed. With the exception of QSA 6, the ratings of energy and mining operations exceeded the Bank-wide average by 6 percentage points or more in each QSA review while the overall energy and mining performance, averaged across the four QSA reviews, was superior to the Bank-wide average by 5 percentage points. In QSA 6, there was a decline overall in the quality of supervision due to two energy and mining operations in AFR that were rated less than satisfactory. Notwithstanding this decline, overall energy and mining performance improved in QSA 7, outperforming all other sectors with the exception of public sector governance.

In summary, both QEA and QSA reviews show an overall energy and mining sector performance superior to the Bank-wide average since 2000 and an improving trend over this period. These findings need to be qualified by the fact that the number of energy and mining operations assessed was not large. While there have been performance declines in individual QEA and QSA reviews, these declines have been followed by sustained improvements, which continue to be reflected in the more recent QALP findings.

Performance in FY08

There were 16 energy and mining operations—5 in AFR, 5 in EAP, 4 in ECA, none in LCR, 1 in MNA, and 1 in SAR, comprising 14 energy and 2 mining[10]—in the sample of 135 operations reviewed for QALP. The 14 energy operations financed a diverse group of investments, which included increasing or rehabilitating generation, transmission, and distribution capacity; expanding rural energy access; developing renewable energy; investing in district heating; and improving energy efficiency in urban residential buildings and health facilities. GEF grants supported a number of the energy efficiency components or operations.

The review panels judged 92 percent of the 16 operations to have a moderately satisfactory or higher likelihood of achieving their main development objectives. Among them, almost two-thirds were rated satisfactory or highly satisfactory. Only two operations were judged moderately unsatisfactory or lower

[10] The two mining operations, both in AFR, helped fund small-scale and artisanal mining investments, institutional capacity building, promotion of private investment in minerals, and technical assistance.

with limited prospects for achieving their development objectives. The energy and mining sample is statistically significant (confidence interval of 7.6 percent) and was the strongest performer among sector boards with 10 or more projects in the QALP sample.

IEG outcomes of energy and mining operations that exited from the Bank's portfolio in the period FY98–07 provide a reference point for the 2008 QALP findings. During this 10-year period, 71 percent of the 230 energy and mining operations that exited from the portfolio had satisfactory outcomes, slightly lower than the 75 percent satisfactory performance for the rest of the Bank. In terms of regional performance, about 75 percent of the unsatisfactory energy and mining exits over the FY98–07 period are concentrated in two regions: AFR (44 percent) and SAR (32 percent).

Of the 14 energy operations reviewed in the 2008 QALP sample, 9 (or 65 percent) were from EAP and ECA, where past performance in achieving development objectives, based on IEG outcomes, has been strong. The QALP results show that 8 of the 9 operations in these two regions are rated satisfactory or higher for likelihood of achieving their development objectives and only one was considered unlikely to achieve its development objectives. In contrast, the 7 remaining operations—5 energy and 2 mining operations, consisting of 5 in AFR, 1 in SAR, and 1 in MNA—were being implemented in countries with weaker institutional capacity than in most EAP or ECA countries. The QALP findings for the 5 AFR operations as well as for the MNA and SA operation show greater uncertainty in regard to meeting their development objectives in comparison with the EAP and ECA operations.

Given the small sample size, findings at the regional level need to be interpreted with caution. Nevertheless, IBRD-financed operations showed a higher likelihood of reaching their development objectives than IDA-financed operations, a finding consistent with the review of IEG outcomes of energy and mining operations over the period FY 98–07. For example, the 5 energy and mining operations in AFR (as well as a 6th AFR multi-component power and water operation mapped to the water sector) exhibited some of the same weaknesses identified in the outcomes of earlier energy and mining operations in AFR and discussed in the FY08 ARPP: (1) multiple development objectives, reflected in a relatively complex project design, that do not take into account adequately the institutional capacity of the sector; (2) design weaknesses in which components are not linked sufficiently to development objectives; and (3) unrealistic development objectives, sometimes involving sector financial sustainability and privatization goals, that lack strong government commitment to the policy measures required to reach these goals.

All energy and mining operations, with one exception, were prepared after the preparation and Board discussion of the Infrastructure Action Plan in the first half of 2003. Among the key goals of the plan was to respond more effectively to client demand for infrastructure by offering a broad menu of options for public and private infrastructure provision. In addition, increased emphasis was placed on financing investments that would improve energy access, energy efficiency, and the development of renewable energy resources. The impact of the Infrastructure Action Plan on the design, content, and objectives of the energy operations was considerable. Operations in EAP and ECA pursued well-defined objectives in energy efficiency, renewable energy development, and improving access, and were generally successful.

Findings from the QALP 2008 review of EAP and ECA energy operations reinforce well-established lessons that help ensure successful outcomes. *First*, strong government commitment to the main development objective of the operation is essential, irrespective of the nature of the operation and whether ownership is public or private. An energy efficiency operation in Bulgaria, a renewable energy operation in China, and rural energy access operation in Vietnam each had strong and sustained government commitment to the main development objective. *Second*, a capable, experienced, and well staffed institution is needed to ensure efficient project implementation as occurred in the Bulgaria, China, and Vietnam operations. Capacity assessments always need to be an integral part of the appraisal process, with project design then carefully tailored to the findings of the institutional capacity assessment. In

regions with weaker institutional capacity, especially fragile states, design should be kept simple and steps taken, prior to start up, to have key staff in place. *Third*, on the Bank side, strong and sustained supervision is a key ingredient that helps ensure project success.

Overall, the QALP findings for energy and mining operations are encouraging and suggest a stronger cohort of energy operations prepared since 2003 that are more likely to achieve their development objectives. At the same time, it is still uncertain whether these findings represent a real, overall improvement across all regions, particularly in AFR and in fragile states where past performance has been weak and where the current QALP findings suggest a higher degree of uncertainty in attaining development objectives in comparison with other regions. In the meantime, energy sector managers need to monitor closely the realism of development objectives in both ongoing and new operations, taking into account issues of political economy and past country implementation performance. They need also to ensure that higher-risk energy operations in countries with weak institutional capacity be staffed by experienced task team leaders.

Inspection Panel Investigations

Over the period FY2001 to FY2008, eight Inspection Panel investigations were undertaken of energy operations, or groups of related energy operations, including an investigation of a project related to coal mining.[11] The reviews covered a range of WBG financing and guarantee instruments involving IDA, IFC, and MIGA. Across all World Bank sectors, thirty-two requests for inspection were received and 17 Inspection Panel investigations of World Bank operations were carried out during the same period. The investigations into energy projects comprised three hydropower developments projects, three oil and gas pipeline investments, one combined cycle thermal power generation plant located in a coastal area, and one coal mining project. Five of the investigations were in the Africa region, and one each in ECA, LAC, and South Asia region. The eight cases reviewed here are

1. Chad: Chad-Cameroon Petroleum Development and Pipeline Project (Ln.4558-CD); Petroleum Sector Management Capacity Building Project (Cr. 3373-CD); and Management of the Petroleum Economy Project (Cr. 3316-CD)
2. India: Coal Sector Environmental and Social Mitigation Project (Cr. 2862-IN) and Coal Sector Rehabilitation Project (Cr.4226-IN)
3. Uganda: Third Power Project (Credit-2268), Fourth Power Project (Credit-3545-UG) and proposed Bujagali Hydropower Project
4. Argentina: SEGBA V Power Distribution Project (Ln 2854-AR)
5. Cameroon: Petroleum Development and Pipeline Project (Ln 7020-CM) and Petroleum Environment Capacity Enhancement Project (Cr 3372-CM)
6. Ghana: West Africa Gas Pipeline Project (IDA guarantee No. B-006-0-GH)
7. Uganda: Private Power Generation (Bujagali) Project (Guarantee B0130-UG)
8. Albania: Power Sector Generation and Restructuring Project (IDA Credit 3872).

The cases are described in more detail in the attachment at the end of this annex.

Two of the eight Inspection Panel investigations involved the same hydropower development in Uganda while another investigation represented a second Inspection Panel review of the Yacyretá hydroelectric power development between Argentina and Paraguay, for which an Inspection Panel investigation had been first requested in the 1990s.

The different Inspection Panel reports found that the Bank was either not in compliance or in partial compliance with several provisions of its safeguard policies and procedures. The most frequently found

[11] The list includes all cases for which a request for an investigation was received during FY2001 to FY2008. It excludes the request related to the Romania Mine Closing and Social Mitigation Project, for which the Panel did not recommend an investigation because the matter was satisfactorily resolved during the eligibility phase, as well as those requests that were not registered.

safeguard policies that were not in compliance were Operational Policy (OP) 4.01 (environmental assessment), OD 4.30 and OP 4.12 (involuntary resettlement), OMS 11.03 and OP 4.11 (management of cultural property), and OD 4.20 (indigenous peoples). Other policies that were not in compliance in certain of the operations investigated included OP 10.04 (economic evaluation of alternatives) and OP 13.05 (project supervision). No violations were found for OP 4.37, the dam safety safeguard policy.

Regarding *environmental assessments*, the main areas of concern noted by the Inspection Panel were (1) the lack of assessments of the cumulative effects of existing developments in the environmental impact assessments or environmental management plans; (2) lack of provision for capacity building in key institutions to monitor safeguard compliance during implementation; and (3) failure to appoint an independent panel of experts to provide advice during the implementation phase, particularly in the Chad, Cameroon, and West Africa Gas Pipeline projects. In general, environmental impact assessments for these operations were carefully prepared and appropriately categorized.

Social compliance with the Bank's policies and procedures was a frequently noted concern by the Inspection Panel. In the SEGBA V (Yacyretá) Project, resettlement plans were not based on accurate census data as required by Operational Directive (OD) 4.30 and OP 4.12 (on involuntary resettlement), nor did the census data constitute an adequate basis for restoring income. More generally, the provision of adequate compensation was a problematic area noted by the Inspection Panel, as in the West Africa Gas Pipeline Project, even though the Panel recognized some of the practical difficulties in complying with the OD 4.30 (involuntary resettlement). There was equally a need to monitor the overall resettlement process, particularly in countries with weak institutional capacity as is the case for the Chad and Cameroon projects. The need to ensure an effective disclosure of information was also noted by the Inspection Panel, for example in the West Africa Gas Pipeline project where emphasis needed to be placed on translating the environmental management plan into local languages, accompanied by a strong dissemination effort and more public awareness meetings with key stakeholders.

Concerns were also expressed by the Inspection Panel regarding the thoroughness with which *economic alternatives* were considered at the project concept stage, including with respect to different project design configurations. The Private Power Generation (Bujagali) project was a particular case in point where the Panel felt that the examination of alternative power generation options were not given thorough attention in the Project Appraisal Document as required by OP 10.04. The rigor of the risk analysis in some operations and inadequate analysis of the economic impacts on lower-income communities were two further concerns expressed by the Panel in some of these operations.

The number of energy operations reviewed by the Inspection Panel over this seven-year period is relatively small, particularly considering that three of the eight investigations involved related energy operations or an energy operation that had been previously investigated. Also, since they represent a diversified set of energy operations, it is difficult to draw broad conclusions based on specific energy operations.

Nevertheless, the findings emerging from these Inspection Panel investigations point to three areas in need of strengthening in preparing future energy operations:

1. Improved consultation with communities affected by proposed hydropower, pipeline, or other energy investments, and more thorough gathering of baseline data about people to be displaced
2. More careful examination of environmental and economic alternatives at the project concept stage that take into account social costs and benefits of different alternatives
3. A stronger focus on supervision of project implementation to ensure compliance with the World Bank's main environmental and social safeguard policies, particularly in countries with weak institutional capacity such as in the Africa region.

Annex 9 Attachment: Inspection Panel Cases

Case 1 - Chad: Chad-Cameroon Petroleum Development and Pipeline Project (Ln.4558-CD); Petroleum Sector Management capacity Building Project (Cr. 3373-CD); and Management of the Petroleum Economy Project (Cr. 3316-CD)

Background: The Chad-Cameroon Oil and Pipeline Project was the largest energy development infrastructure project at the time on the African continent. The estimated invested cost was US$3.7 billion, largely funded by the three oil companies: ExxonMobil, Petronas, and Chevron. The project involved the drilling of 300 oil wells in Southern Chad and the construction of a 1,100-kilometer export pipeline through Cameroon to an offshore loading facility, and was expected to generate US$2 billion in oil revenue for the government of Chad over a 28-year period. The World Bank and IFC contributed US$39 million and US$100 million, respectively. Two complementary projects were supported by IDA financing: (1) US$23.7 million for a *Petroleum Sector Management Capacity Building* project to build Chad's capacity to manage oil revenue and use them efficiently for poverty reduction, and (2) US$17.5 million *Management of the Petroleum Economy Project* which aimed to assist the government to build capacity to implement its petroleum revenue management strategy.

Board Approvals:
Chad-Cameroon Petroleum Development and Pipeline Project on June 6, 2000
Petroleum Sector Management Capacity Building Project on June 6, 2000
Management of Petroleum Economy Project on January 23, 2000.

Inspection Panel Request: The request for inspection was submitted on March 21, 2001, by a member of Chad's National Assembly and an active opposition leader, acting on behalf of 100 residents living in the vicinity of the oil fields. The requestors claimed that the Pipeline Project constituted a threat to local communities, their cultural property, and the environment, and that they were likely to be harmed by the pipeline development because of a lack of adequate environmental assessment and compensation, as well as inadequate disclosure of information to local communities. The request for inspection was approved by the Bank's Board of Executive Directors on October 1, 2001.

Management Response to Request: Management maintained that the World Bank had complied with its operational policies and procedures in regard to environmental, social, cultural, and procedural matters raised by the request. In addition, management maintained that people in the project area would not be directly affected as a result of the project design and its implementation. Finally, management did not feel that the requestors would be adversely affected by future implementation of the project since systems were in place to help ensure that their views would be adequately addressed.

Inspection Panel Findings:

- **General Environmental Compliance Concerns**. There was substantial effort to prepare a 19-volume environmental management plan following the environmental impact assessment of 1997. However, the study area of the project was not defined, there was no cumulative-effects assessment in the environmental management plan, the independent expert advisory panel was not engaged, and the capacity for formulation of the environmental management plan needs to be matched by institutional capacity for implementation.
- **Specific Environmental Concerns**. *Oil Spill:* In compliance with OP 4.01 (environmental assessment) regarding the assessment and management in the event of an oil spill.
  Contamination of Lake Chad and Groundwater: Not in violation of OP 4.01, although continued monitoring will be required, possibly by an international advisory group.
  Air Pollution: Probability of harm from flared gas is low, although future monitoring will be needed.
  Natural Habitats: In compliance with OP/BP 4.04 (natural habitats) although will future

monitoring will be required as construction progresses.
Forestry: In compliance with OP 4.36.
Pest Management: In compliance with relevant provisions of OP 4.09.
Consultation: Since 1999, considerable effort made to consult with affected groups in compliance with paragraph 19 of OP 4.01.
Disclosure of Operational Information: In compliance with Bank Procedure (BP) 17.50.

- **Social Compliance**. *Involuntary Resettlement:* In compliance with OD 4.30 (now OP 4.12) concerning compensation. However, the overall resettlement process still needs to be monitored.
  Indigenous Peoples: OD 4.20 (now OP 4.10) is not applicable in this case.
  Cultural Property: In compliance with Operational Policy Note 11.03 (now OP 4.11).
  Governance and Human Rights: There are concerns in regard to human rights, which warrant continued monitoring.
- **Economic Compliance**. *Economic Evaluation* (OP 10.04): Consideration of project alternatives for oil field development and oil transportation is given sketchy treatment in the Project Appraisal Document with no quantitative evidence to support the findings reported. Since proper project analysis of alternatives is an important feature of economic analysis, the Panel felt the economic analysis of alternatives presented in the appraisal document is not in compliance with paragraph 3 of OP 10.04. The Panel also expressed concern about the adequacy of revenue allocation to Chad; the Panel was unable to find any analysis to justify the allocation of revenues amongst Chad, Cameroon, and the Consortium. Regarding other aspects, the Panel found risk analysis to be broadly in compliance. However, the discussion of sustainability and risks is very brief and not in compliance, while the treatment of externalities is in compliance.
  Poverty Reduction (OP 4.10 paragraph 7): Not in compliance with regard to risk analysis and institutional design.

Case 2 – India: Coal Sector Environmental and Social Mitigation Project (Cr. 2862-IN) and Coal Sector Rehabilitation Project (Cr.4226-IN)

Background: The US$63 million Coal Sector Environmental and Social Mitigation Project, approved in May 1996, was designed to assist Coal India's ongoing efforts to mitigate the environmental and social impacts of mining expansion in 25 mines under a US$530 million Coal Sector Rehabilitation Project, approved in September 1997. The Coal Sector Rehabilitation Project investment loan was subsequently cancelled in July 2000 but the Coal Sector Environmental and Social Mitigation Project continued until June 2002. The Inspection Panel investigation concerned the Parej East mine which was operated by a subsidiary of Coal India, following a complaint submitted by a local non-governmental organization representing the residents of Parej East.

Board Approvals:
Coal Sector Environmental and Social Mitigation Project on May 16, 1996
Coal Sector Rehabilitation Project on September 9, 1997.

Project Objectives:

- The objective of the Coal Sector Environmental and Social Mitigation Project was to assist Coal India in making coal production more environmentally and socially sustainable through technical assistance, including in the implementation of the Environmental Action Plans, Rehabilitation Action Plans, and Indigenous Peoples Development Plans in 25 coal mines.
- The objective of the Coal Sector Rehabilitation Project was to support India's market-oriented reforms in the coal sector and to provide financial and technical support for Coal India's efforts to make itself commercially viable and self-sustaining.

Inspection Panel Request: The request for inspection was submitted on June 21, 2001 and claimed that the residents of Parej East had suffered harm as a result of failures and omissions of IDA in the design and implementation of the Coal Sector Environmental and Social Mitigation Project. In particular, they focused their main complaint on the failure to restore their income levels. As a consequence, they asserted that management violated the policies of the following Bank policies and procedures: Involuntary Resettlement (OD 4.30), Indigenous Peoples (OD 4.20), Environmental Assessment (OD 4.01), Project Supervision (OD 13.05), Disclosure of Information (Bank Procedure [BP] 17.50) and Management of Cultural Property (Operational Policy Note [OPN] 11.03).

Management Response to Inspection Panel Request: Management maintained that it had complied with all relevant policies and procedures related to the design and implementation of the Coal Sector Environmental and Social Mitigation Project. It emphasized that consultation and participation on social and environmental mitigation activities had been a continuous process. There had been extensive consultation with different stakeholders, including at Parej East where 54 consultations took place over a six- year period from 1995 to 2001. Both Resettlement Action Plans and Indigenous Peoples Development Plans were developed in consultation with the affected populations. While acknowledging that income restoration activities had been slow initially due to a number of factors, management felt that there had been improvement in performance. Furthermore, management was satisfied that compensation for agricultural land and houses under the Coal Bearing Areas Act had been sufficient to replace lost assets. At the same time, it recognized that compensation for land held under customary tenure was a more complex process due to problems in identifying the entitled persons. In regard to cultural property concerns, management pointed out that the environmental assessment did not identify any such issues; furthermore, when a few such issues did present themselves during implementation, they were handled in accordance with OPN 11.03. Finally, in regard to adequate disclosure of operational information, management pointed out that 25 public information centers had been set up to disseminate such information, including in Parej East.

Inspection Panel Findings: The main findings of the IP were as follows:

- **Involuntary Resettlement**. There was a failure during appraisal to ensure that the original Resettlement Action Plan reflected reality on the ground at Parej East, which became the root of the requestors' complaints. Hence, management was not in compliance with paragraph 30 of OD 4.30. There were a number of other problems related to the level of compensation: not providing a full replacement cost to project-affected persons for their land; a similar problem for house replacement costs; a general lack of transparency in the compensation process; and some resettlement sites were hardly fit for human habitation.
- **Cultural Property**. Management acted responsibly in consulting local people and was in compliance with OPN 11.03.
- **Traditional or Customary Land Rights**. Management was unable to provide the indigenous peoples with evidence that it has complied with OD 4.30 with regard to the compensation of project-affected persons, who own traditional or customary rights, prior to their relocation.
- **Forest Resources**. There was a failure to recognize the dependence of tribal people on natural resources for their subsistence and ensuring continued access to these resources and no compensation for the loss of access. The income of at least 21 percent of project-affected persons entitled to economic rehabilitation assistance in Parej East had not been restored.
- **Income Restoration**. The Inspection Panel found several areas of non-compliance that adversely affected the Parej East PAPs, including jobs in the mine, land for land; and income restoration through self employment.
- **Indigenous Peoples' Development Plan**. There was inadequate attention and focus on the needs of tribal and vulnerable peoples.
- **Environmental Compliance**. There were concerns in regard to land reclamation of mined areas, although there were no formal violation of OD 4.01. There were concerns in regard to

the possible discharge of raw sewage from employees' living facilities. This requires careful monitoring.

- **Disclosure of Information**. The Inspection Panel found was no evidence that sectoral environmental impact assessment, environmental action plan, and resettlement action plan were made readily accessible, in a public place, to local groups and non-governmental organizations for their review and comments.
- **Consultations**. The Inspection Panel found no evidence of meaningful consultations on the environmental impact assessment and the environmental action plan with project-affected persons and local non-governmental organizations.
- **Supervision**. Prior to 1998, the World Bank was not in compliance with supervision requirements. After 1998, the World Bank was in compliance with OD 13.03 as a result of intense supervision effort, especially to Parej East mine, frank reporting of difficulties, and so on.

Case 3 – Uganda: Third Power Project (Credit-2268), Fourth Power Project (Credit-3545-UG), and proposed Bujagali Hydropower Project

Background: IDA has been involved with the power sector in Uganda for more than 20 years providing financial support for the Owen Falls Dam and Extension, a hydropower complex that has been in operation for some 50 years. In 1991, IDA financed the Third Power Project (US$125 million), which supported the construction of the Owen Falls Extension. In January 2000, IDA provided a Supplemental Credit (US$33 million) to the Third Power Project. Further IDA funding was provided in July 2001 through the Fourth Power Project (US$62 million) to help finance generation units 14 and 15 in the Owen Falls powerhouse. At the same time, the government of Uganda requested new financial assistance from IDA and IFC for the proposed Bujagali hydropower development. An IDA Partial Risk Guarantee of US$115 million and IFC financing—involving an A loan (up to US$60 million), a B loan (up to US$40 million), and risk financing instrument (up to US$10 million)—were approved by the Board on December 18, 2001. A further US$113 million was to be provided by the private sponsor for the project, AES.

Board Approvals:
Third Power Project on June 13, 1991
Fourth Power Project on July 3, 2001
Bujagali Hydropower Project on December 18, 2001.

Project Objectives:

- The objectives of the *Third Power Project* were to assist the Government of Uganda with the continued rehabilitation of its power system, develop its hydro-resources, and expand its transmission and distribution system. The project had different investment components at Owen Falls, including dam strengthening, construction of a spillway, plant capacity expansion, and civil works to accommodate a plant capacity of 170 megawatts (MW). The Supplemental Credit financed cost over-runs, urgent remedial works, and technical assistance.
- The objectives of the *Fourth Power Project* was to (1) expand power supply in order to meet demand on a least-cost basis through the installation of 40-80 MW of additional capacity at the Owen Falls Extension and (2) provide technical assistance to strengthen the government's capacity in managing energy reform and privatization.
- The proposed *Bujagali Hydropower Project* was to support the installation of a 200 MW run-of-the-river power plant at Bujagali Falls as well as the construction of about 100 kilometers of transmission lines and related sub-stations.

Inspection Panel Request: On July 27, 2001, a request for inspection was received for the above projects. The request was submitted by the National Association of Professional Environmentalists of Kampala, Uganda Save Bujagali Crusade, and other local institutions. The requestors claimed that the construction of the Owen Falls Extension and the proposed Bujagali Hydropower Project had resulted (and would continue to do so) in social, economic, and environmental harm to the local population. The requestors further claimed that there was a failure to undertake an environmental assessment for the Owen Falls Extension and for the cumulate environmental assessment for the dams already built. They further questioned the economic, financial, institutional, and environmental analysis of the Third Power Project. Finally, they argued that the proposed Bujagali Hydropower project was not the least-cost option for generating power.

Management Response to Inspection Panel Request: Management made the following points:

- The directives, policies and procedures prevailing at the time were adhered to. No environmental impact assessment was prepared because the World Bank's Operational Manual at the time did not require an environmental impact assessment.
- The appraisal of the project was robust and carried out in accordance with policies and procedures in place at the time.
- For the Bujagali project, an environmental impact assessment had been carried out by the project's private sector sponsor.
- The Resettlement and Community Development Action Plan prepared by the private sector sponsor responds to OD 4.30.
- The proposed Bujagali Hydropower project is the next least-cost generation option after the Owen Falls Extension.
- There will be no additional impact on fisheries although the tourism industry will be affected.
- There was no relation between the proposed Bujagali project and recent tariff increases.
- On disclosure, there has been continuous consultation with affected stakeholders since 1997. Other information will be disclosed as it is made available.

Inspection Panel Findings:

Power III

- **Environmental Assessment** (OD 4.00). Partial compliance.
- **Sectoral Environmental Assessment/Cumulative Impacts Assessment** (OD 13.05 – Project Supervision). While cumulative effects analysis was not required by World Bank policy, management recommended in the Staff Appraisal Report that a sectoral environmental assessment be carried, drafted the terms of reference, but then failed to carry out the assessment during supervision.
- **Economic Analysis** (OD 10.00). There was a lack of full disclosure to the Board of Executive Directors. The economic analysis of the investment was broadly in compliance with Operational Manual Statement (OMS) 2.20 and 2.21. However, there was non-compliance with OMS 2.21 since externalities—resettlement compensation—were not included in the analysis.
- **Safety of Dams** (OP 4.37). In compliance.

Power IV

- **Environmental Category/Assessment**. In compliance with OP 4.01.
- **Environment – Disclosure of Information**. Not in compliance with OP 4.01 in regard to public consultation or disclosure of information.
- **Hydrology Debate**. Cautious approach adopted is considered appropriate.
- **Safety of Dams**. In compliance with OP 4.37.

Bujagali Hydropower Project

- **Environmental Assessment**. Procedures followed during preparation are in compliance. Regarding the project's impact on fisheries and aquatic systems, it is in compliance with the applicable sections of OP 4.01. However, a sectoral environmental assessment—to examine the cumulative effects of several investments—was not undertaken and is therefore not in compliance with the OP 4.01 requirement for a sectoral environmental assessment.
- **Environmental Offset** (OP/BP 4.04 – Natural Habitats). Since the government has no obligation to maintain the Kalagala Falls as an environmental offset in perpetuity, management is therefore not in compliance with OP 4.04. The technical adequacy of this offset is also unclear, based on the Bujagali environmental impact assessment.
- **Safety of Dams** (OP 4.37). In compliance.
- **Demand Range Forecast Too Narrow** (OP 10.04 – Economic Evaluation of Investment Operations). A wider range of load forecasts should have been part of the sensitivity analysis, which would have enabled a more robust analysis of the risks and rewards of the Bujagali project. Therefore, it does not fully satisfy paragraph 6 of OP 10.04.
- **Institutional, Tariffs and Affordability Risks** (OP 10.04). The institutional risks to sustainability as a result of delayed distribution, privatization, or underperformance should have been more thoroughly examined. There is also potentially a serious affordability problem which should have been part of the risk analysis. Consequently, there is a lack of compliance with paragraph 5 in OP 10.04.
- **Examination of Power Generation Alternatives** (OP 10.04). Alternative generation options to Bujagali—for example, geothermal energy options—were not adequately considered or analyzed, as required in paragraph 3 of OP 10.04.
- **Externalities in Economic Evaluation**. The loss of white water rafting should be part of the costs of the project and, consequently, is not in compliance with paragraph 8 of OP10.04.
- **Disclosure of Factual Technical Documents**. Not in compliance with BP 17.50 because of refusal to release a factual technical document for the proposed investment, "Economic Review of the Bujagali Hydropower Project," by Acres International. The Panel felt that the restrictions governing this policy directive did not apply in this case.
- **Power Purchase Agreement and Related Agreements**. There should be additional risk mitigation measures beyond those already provided for.
- **Project Risks**. The Inspection Panel views many risks as "high," not as "substantial" or "moderate" as described in the Project Appraisal Document.
- **Social Compliance – Resettlement Action Plan and Community Development Action Plan** (OD 4.30 – Involuntary Resettlement). The resettlement action plan is formally in compliance with OD 4.30 but important requirements remained be met. However, the community development action plan is weak and sketchy and does not meet the requirements of OD 4.30. There are also likely to be a few people inadequately compensated for land and crops despite most resettled people being better off.
- **Compensation for Tourism**. Not in compliance with OD 4.30.
- **Cultural Property Management Plan.** The plan meets applicable policies and implementation is satisfactory although not free of controversy.
- **Disclosure of Power Purchase Agreement.** Management action, which did not require disclosure of the power purchase agreement be disclosed, is consistent with IDA disclosure policy, under which there is no specific requirement to disclose contracts to which IDA is not a party.
- **Disclosure of Environmental Information.** The project is in compliance with OP 4.01 in regard to environmental matters.

Case 4 – Argentina: SEGBA V Power Distribution Project (Ln 2854-AR)

Project: The Yacyreta Hydroelectric project is a joint venture established in a 1973 treaty between Argentina and Paraguay. The project covered more than two decades and was financed by a series of loans, including financing from the Inter-American Development Bank. The last phase of financial support was provided through two loans to Argentina: Loan 3520-AR for US$300 million approved in 1992 and Loan 2854-AR for US$276 million approved in 1988; the latter loan was restructured in 1994 to allow US$135 million to be used for funding the Yacyreta project. Funding from US$46.5 million Loan 3842-PA to the government of Paraguay (Asuncion Sewerage Project, which was later restructured) was also used to finance complementary investments linked to the Yacyreta project. The SEGBA V Power Distribution Project (Ln 2854-AR) closed on October 31, 2002.

Inspection Panel request: On May 17, 2002, a second request for an Inspection Panel review was submitted by the *Federacion de Afectados por Yacyreta de Itapua y Misiones*, a local non-governmental organization that claimed to represent more than 4000 families whose lives had been affected environmentally and socially by the development of the Yacyreta Hydroelectric dam; the request was also signed by six coordinators of communities affected by the project.[12]

Management Response to Inspection Panel Request: Management response noted that this second request was similar to the first request brought to the Inspection Panel in 1996, which claimed that the World Bank violated its policies in environmental assessment, involuntary resettlement, and project supervision. Management provided a detailed response to each of the claims, arguing that (1) the reservoir's water quality poses no health risks; (2) there has been no violation of Bank resettlement policy; and (3) Bank supervision has been thorough. As a result, management felt that an inspection panel investigation was not warranted. Nevertheless, at the subsequent Board discussion on September 9, 2002, the Bank's Board of Executive Directors approved Inspection Panel's request.

Inspection Panel Findings: The panel's main findings were described in their report of February 24, 2004.

- **Environmental Compliance.** Environmental screening process was appropriate. Environmental assessments were prepared but judged inadequate, especially in its consideration of urban and peri-urban environments. Environmental and social assessments should have anticipated induced effects. Environmental alternatives were considered and in compliance with OD 4.01.
- **Social Compliance.** Resettlement plans are not based on accurate census data as required by OD 4.31, nor are the census data adequate as a basis for the restoration of income. Existing procedures to correct census data are ad hoc.
- **Compensation and Resettlement**. Detailed resettlement and compensation plans, with a budget and timetable, were prepared. However, the Panel found a number of infringements on the requirements in OD 4.30, including (1) a failure to consider alternative sites, (2) inadequate measures to restore income earning capacity, (3) exclusion of large numbers of informal workers from the compensation scheme, and (4) the influx of ineligible populations into the resettlement area, which could not be prevented because of an inadequate legal framework.
- **Project Supervision.** Supervision is not in compliance with OD 13.05 in certain respects.

[12] A first request for an Inspection Panel investigation was submitted in September, 1996, which, in consultation with the Board of Executive Directors, led to a limited, rather than a full, investigation as to whether World Bank staff had followed World Bank procedures.

Case 5 – Cameroon: Petroleum Development and Pipeline Project (Ln 7020-CM) and Petroleum Environment Capacity Enhancement Project (Cr 3372-CM)

Background: For information on the Chad-Cameroon Oil and Pipeline Project, see the background section for case 1. In June 2000, the World Bank provided a US$53.4 million loan to the government of Cameroon to help finance its equity share in the Cameroon segment of the oil export system. An IDA credit for US$5.77 million was also approved to help the government develop a national capacity for the environmental management and monitoring of the pipeline project.

Inspection Panel Request: The request was received on September 25, 2002. It was submitted by a local non-governmental organization representing residents living along the pipeline route as well as workers and sub-contractors based in Cameroon. The request alleged that the World Bank had not complied with the following policies and procedures: Environmental Assesssment (OD 4.01), Natural Habitats (OP/BP 4.04), Poverty Reduction (OD 4.15), Indigenous Peoples (OD 4.20), Involuntary Resettlement (OD 4.30), and Project Supervision (OD 13.05).

Management Response (October 2002)**:**

- **Environmental Assesssment** (OD 4.01). Management maintained that the 1999 environmental assessment/environmental management plan is in conformity with OD 4.01. The potential impacts of the project are identified and evaluated and mitigation measures fully described. The analysis of alternatives was carried out correctly while the environmental assessment/ environmental management plan took into account the cumulative impacts of the investment. Other concerns such as the risk of oil spills, the fishery losses, and the loss of drinking water were also considered and will be carefully monitored during implementation.
- **Natural Habitat** (OD 4.04). A core area of the Campo-Ma'an UTO is an appropriate offset for the loss of biodiversity in the Atlantic coastal forest of Cameroon.
- **Poverty Reduction** (OD 4.15). No structural impoverishment will result from the pipeline investment.
- **Indigenous Peoples** (OD 4.04). Despite a slow start, education, health, and other assistance is being provided to the indigenous Bakola people who are affected by the project.
- **Involuntary Resettlement** (OD 4.30). The compensation plan of the 1999 environmental assessment/environmental management plan is being implemented in accordance with OD 4.30.
- World Bank staff in the field and regular supervision missions from Washington report regularly to World Bank management on the status of the project. Supervision has intensified since March, 2002.

Inspection Panel Findings (May 2003). In general, the Panel was pleased with World Bank management efforts to meet compliance with its own policies and procedures. A number of non-compliance instances were identified, especially at the design stage. The slow start-up and subsequent delays of the capacity building project could endanger the sustainability of the pipeline project.

- **Environmental Assessment** (OD 4.01). Compliance was assessed during two phases: (1) the evaluation and assessment phase followed by (2) implementation and monitoring. An independent panel of experts is required to be retained for large investments such as this one. However, an independent panel was not fully engaged during preparation and has since been disengaged. The World Bank's international advisory group is not adequate as a substitute since it lacks the technical independence intended by OD 4.01. Other aspects judged not to be in compliance were the lack of a full year of baseline data; inadequate analysis of cumulative effects of the investment; and the lack of adequate environmental capability to assess construction impacts. Aspects found to be in compliance were the analysis of alternatives, impacts on water quality and quantity, and impacts on freshwater fisheries.

- **Natural Habitats** (OD 4.04). The location of the Campo Ma'an offset area provides the only opportunity for preservation of this important habitat type in Cameroon.
- **Occupational Health and Public Safety** (OD 4.01). Occupational health and safety was consistent with OD 4.01. However, in regard to public health, while the project is committed to an HIV AIDS mitigation strategy, the failure to carry out a wider regional assessment of health risks in the pipeline construction area means baseline data are not available as required by OD 4.01.
- **Social Impact and Mitigation Measures** (OD 4.20 and 4.30). The Panel investigated several individual cases brought to their attention and could not find any violation of OD 4.30. The Panel also found the design and implementation of the compensation policy and grievance mechanism to be transparent and fair. Regarding OD 4.20, the designation of the Bakols as a vulnerable population is correctly identified. Also, in regard to the indigenous peoples plan, the Panel found that the plan is compliance with OD 4.20 except for the baseline survey data and recognizes management strategy that the indigenous peoples plan is a "work in progress."
- **Project Supervision** (OD 13.05). Adequate resources and attention continue to be given to supervision.

Case 6 – Ghana: West Africa Gas Pipeline Project (IDA guarantee No. B-006-0-GH)

Board Approval: November 23, 2004

Project: IDA provided a US$50million Partial Risk Guarantee to the Government of Ghana for obligations related to the purchase of natural gas from the West Africa Gas Pipeline Company Limited (WAPCo) and MIGA provided a US$75 million Political Risk Guarantee to WAPCo. The project concerns the construction of a 678-kilometer gas pipeline system to transport natural gas from Nigeria to Togo, Benin, and Ghana for power generating units in these three countries in order to improve the efficiency of the energy sector and diversify fuel supply for power.

Inspection Panel Request: A request for Inspection was submitted by the Ifesowapo Host Communities Forum, an association of 12 local communities in Lagos state in southwest Nigeria affected by the project. The request was received on April 26, 2006. The Inspection Panel's recommendation for an investigation was approved on March 13, 2007.

Inspection Panel Findings:
- **Involuntary Resettlement and Disclosure Policy** (OP/BP 4.12). Not in Compliance.
- **Environmental Assessment** (OP/BP 4.01). In compliance for Category A project; not in compliance with requirement to establish an independent advisory panel, to evaluate other alternative offshore routes, and that disclosure be in a form that is understandable to affected groups. Key steps have not been taken to ensure livelihood restoration for affected people.
- **Project Supervision** (OD/OP/BP 13.05). Not in compliance. Management did not ensure adequate supervision, which resulted in a responsibility vacuum during the resettlement action plan process. It was also slow to address the compensation process.

Management Response and Action Plan
- **Involuntary Resettlement and Disclosure Policy** (OP 4.12). The West Africa Gas Pipeline Company will establish a grievance mechanism to resolve disputes. It will ensure adequate institutional capacity in the area of social safeguards.
- **Environmental Assessment and Mitigation** (OP 4.01). An environmental and social advisory panel will be retained, and emphasis to be placed on translation of the environmental management plan into local languages, strong dissemination effort, and increased public

awareness meetings with key stakeholders. Community development programs will also be strengthened to focus on restoration of livelihoods.

- **Project Supervision** (OP 13.05). Management will ensure a minimum of two supervision missions during remaining construction period and the supervision budget increased threefold. Management will also develop a best-practice tool kit to assist task teams in AFR region.

Investigation Case 7 – Uganda: Private Power Generation (Bujagali) Project (Guarantee B0130-UG)

Background: The project represents the second attempt of the government of Uganda to develop the Bujagali hydropower plant. The first attempt, which was also the subject of an Inspection Panel review in 2002, was later abandoned in 2003. The project concept remains basically the same and involves the construction of the Bujagali hydropower plant on the Nile River near the Bujagali Falls, downstream from existing hydropower plants. It is designed to provide an additional 250 MW of power generation capacity to the national power grid in Uganda. The project would inundate the Bujagali Falls and nearby natural habitats, which are sites of cultural and religious significance. It would also result in the displacement and resettlement of people from their lands.

The Project is a public-private partnership between private sponsors and the government of Uganda. The financing is provided by private lenders and by both multilateral and bilateral agencies. World Bank Group support included a Partial Risk Guarantee from IDA, loans from IFC, and a guarantee from MIGA.

Inspection Panel request: On March 5, 2007, the Inspection Panel received a request from the Ugandan National Association of Professional Environmentalists and from other local organizations and individuals. The request raised a number of environmental, hydrological, social, and economic concerns relating to the project design and contended that the World Bank's failure to follow up on its operational policies and procedures would result in serious harm to people living in the project area as well as to the environment.

Management Response to Request: Management submitted its response to the request for an Inspection Panel investigation on April 5, 2007. It argued that the project is being developed to provide needed power generation capacity in a least-cost manner. Furthermore, following the first Inspection Panel review in 2002, an action plan was prepared (and approved by the WBG's Board of Executive Directors) which addresses each of the issues raised in the first request for an Inspection Panel review. Management maintained that the government had since learned from this experience and was better able to understand the concerns of the stakeholders. Moreover, it maintained that the project adhered to the World Bank policies and, more importantly, that the project developers and financiers have been conscientious in pursuing the welfare of the project-affected persons.

Board Approval of Inspection Panel request: The Inspection Panel recommended an investigation because of the conflicting assertions and interpretations between the request and management's response. The Board of Executive Directors approved this investigation on May 18, 2007.

Inspection Panel Findings:

- **Environmental Issues**. The Inspection Panel found areas of compliance with OP 4.01, 4.04 (Natural Habitat) and 4.37 (Dam Safety). The Panel commended the World Bank for helping in conserving the Kalagala Falls as an environmental offset. However, there were some areas of non-compliance, including no capacity building in social and environmental aspects and a lack of any reference in the project social and environmental assessment to the strategic/sectoral social environmental assessment of the Nile Basin Initiative, which addressed climate change and cumulative effects issues. The cumulative effects of the existing projects were also not adequately addressed.

- **Hydrological and Climate Change Risks**. The Panel found important areas of non-compliance with OP 4.01 and OP 10.04: discrepancy between the Project Appraisal Document and an economic study as to which water release scheme will be in effect once Bujagali becomes operational; potential social and environmental impacts due to changing water levels of Lake Victoria not assessed; possible climate change impact on water release not identified as potential risk factor.
- **Economic and Environmental Analysis of Alternatives**. Examination of project design configurations, including off-grid options or designs that would have lower social and environmental costs, were not given thorough attention and, hence, a lack of full compliance with OP 10.04 to evaluate alternatives.
- **Economic Evaluation: Poverty Reduction and Risks**. There is no assessment of economic impact of project on low-income households (as opposed to better-off urban households). There is high allocation of risk to the power purchaser, and hence the government of Uganda, which increases the likelihood that the government will have to make payments under its guarantee or increase subsidies.
- **Involuntary Resettlement**. Management chose to assess adequacy of past resettlement actions and the action plan since affected groups had already been relocated and some had received compensation. However, the Inspection Panel found that the project still did not comply with the policy to restore, in real terms, livelihoods of people displaced by the project. There was no violation of policy on indigenous peoples.
- **Cultural and Spiritual Values.** The World Bank misjudged the Bujagali Falls as important only to those living in the vicinity of the Falls. A cultural properties management plan was not prepared. Further, OP 4.04 states that the World Bank does not support projects that result in the destruction of critical natural habitats, which include "sacred grove" areas protected by local communities. Thus, the Panel felt the World Bank may be in violation of OP 4.04.
- **Systemic issues**. Particular complexities of this project include (1) addressing legacy issues from preceding projects; (2) achieving transparency in economic and other impacts for public-private partnerships; (3) incorporating climate change issues into project design; and (4) application of World Bank policies of natural habitats to sacred groves.

Bank Management Response and Board Discussion, December 4, 2008

The WBG Board approved the range of actions set forth in Management's response to the Inspection Panel report, including the additional actions Management intends to undertake in view of the Inspection Panel investigation. These would include timely implementation of a sustainable management plan for Kalagala Falls; updating and implementation of a cultural property management plan; and undertaking an enhanced socio-economic study to support and fully achieve livelihood restoration. Management plans to undertake these actions in consultation with the Government of Uganda, affected people and the project sponsor.

Investigation Case 8: Albania Power Sector Generation and Restructuring Project (IDA Credit 3872)

Project: A US$25 million IDA credit to the government of Albania was approved by the Board of Executive Directors on March 16, 2004. Two main components involve (1) construction of a combined-cycle power plant (85–135 MW) at a greenfield site close to Vlora on the Albanian coast, and (2) provision of technical assistance to KESH, the Albanian Power Corporation.

Inspection Panel Request: On April 30, 2007, a request for inspection was submitted on behalf of the Civil Alliance for the Protection of the Bay of Vlora. The request claims that the World Bank may have violated several provisions of its policies and procedures including the following: Project Appraisal

(OMS 2.20), Environmental Assessment (OP 4.01), Natural Habitats (OP 4.04), Involuntary Resettlement (OP 4.12), Economic Evaluation of Investment Operations (OP 10.04), Management of Cultural Property (OPN 11.03), and Project Supervision (OP 13.05).

Management Response: Management provided detailed responses to each of these claims. It believes the World Bank has followed the guidelines, policies, and procedures applicable to the issues raised in the request for inspection, nor will the requestors' rights and interests be adversely affected by a failure of the World Bank to implement its policies and procedures.

Board Approval of request for Inspection Panel: August 10, 2007

Inspection Panel Findings: The Panel had not yet issued a report as of this writing.

Annex 10: Links to the Existing Energy Strategy, Millennium Development Goals, and the WBG's Six Strategic Themes

This annex briefly reviews the links between the twin objectives, supporting strategic pillars, and proposed areas of action on the one hand with the six strategic objectives of *FFT*, the four lines of business in the 2001 energy strategy, and the WBG's six strategic themes. All the objectives of *FFT* and the 2001 strategy remain valid, but the relative importance of different components has shifted. The new strategy will focus on some more than others, and this will be considered more during the preparation of the strategy.

Strategic Objectives of FFT

The six strategic objectives of *FFT* were the following (see Annex 5 for more detail):

1. Facilitate more efficient use of and substitution from traditional fuels in rural and peri-urban areas to reduce health damage from indoor air pollution, and pressures on natural resources (land and forestry).
2. Protect health of urban residents from air pollution due to fuel combustion in the residential, transport, industrial and power sectors.
3. Promote environmentally sustainable development of energy resources
4. Mitigate the potential impact of energy use on global climate change
5. Develop capacity for environmental regulation, monitoring and enforcement across all levels of governance
6. Make the Bank more responsive to addressing the adverse environmental impacts of energy sector.

Objective 4 is essentially the global aspect of the second of the proposed twin strategic objectives of the new energy strategy. Objective 1 will be re-assessed during the preparation of the energy strategy. To the extent that the energy sector engages in more efficient use of traditional fuels and they affect natural resource management, the energy sector will work with sector colleagues working on land management and forestry. Objectives 2 and 5 are more suited for the environment strategy, as indicated in appendix 1. Objective 3 as described in *FFT* concerns mostly extractive industries and is an integral part of the WBG management response to the Extractive Industries Review (paragraph 20). Objective 6 as described in *FFT* is about knowledge management and dissemination, including working with civil society, and full compliance with safeguard policies. They remain important, although *where* we work in knowledge management and dissemination and with civil society has shifted. *FFT* emphasizes local pollution and estimating ambient concentrations, whereas the focus today is increasingly shifting to energy efficiency, renewable energy, and climate change. Engagement with civil society in EITI is also a new development since *FFT*.

2001 Energy Strategy

The four lines of business in the 2001 strategy were the following:

1. Helping the poor directly by
    a) Facilitating access to modern fuels and electricity
    b) Reducing the cost and improving the quality of energy supplied to low-income households
    c) Ensuring that energy subsidies are targeted to and reach the poor
    d) Promoting energy-efficient and less polluting end-use technologies for traditional fuels
    e) Creating energy service enterprises run by the poor
    f) Supporting energy needed for social services (health, education, communication).

Increasing access to modern commercial energy, and particularly electricity, will be an important focus of the new strategy. Reducing the cost and improving the quality of energy supplied falls under improving reliability and increasing supply efficiency. The energy sector will continue to support targeted energy subsidies where they are effective and appropriate. Work on traditional fuels and on creating energy service enterprises run by the poor will be re-assessed during the preparation of the energy strategy. Energy for social energy services will continue to be important, especially in rural areas.

2. Improving macroeconomic and fiscal balances, including protecting budgets for social programs that help the poor
    a) Rationalizing energy taxes.
    b) Replacing public investments with private ones.
    c) Managing risks associated with contingent public liabilities
    d) Closing loss-making coal mines and oil refineries and financing restructuring costs that fall on government budgets
    e) Enhancing effective payment by all energy users to eliminate operating subsidies to state-owned enterprises
    f) Improving procurement and marketing of imported and exported energy products.

    The new strategy is likely to focus on rationalizing energy taxes and subsidies and reducing commercial losses (e). Risks associated with contingent public liabilities will be addressed in the context of strengthening the financial performance of public utilities and reducing large universal subsidies. The new strategy will take a more measured approach to private sector investment. Replacing public investments with private ones will not be an objective but will be pursued in the context of creating an enabling environment for private investment. Work on closing loss-making coal mines and oil refineries will be rare, as is (f).

3. Promoting good governance and private sector development
    a) Creating objective, transparent, and nondiscriminatory regulatory mechanisms
    b) Introducing and expanding competition and cross-border trade
    c) Divesting assets to strategic investors and regulating markets in ways that are socially responsible and corruption free
    d) Catalyzing private investment by liberalizing entry to energy markets
    e) Strengthening the voice of consumers and communities
    f) Strengthening local financial institutions to provide long-term financing for rural energy business.

    The new energy strategy is likely to focus on (a) and cross-border trade. Asset divestiture and market entry liberalization will be pursued where appropriate in the context of creating an enabling environment for private investment. Work on (e) and (f) will not be a core agenda.

4. Protecting the environment
    a) Promoting clean transport fuels and switching from coal to gas
    b) Facilitating environmentally sustainable extraction, production, processing, transport, and distribution of oil, gas, and coal
    c) Strengthening environmental management capacity in energy supply
    d) Removing market and regulatory barriers to renewable energy and energy efficiency investments for power and biomass (such as improved cooking stoves for the poor)
    e) Reducing gas flaring and facilitating carbon trading and joint investments to reduce greenhouse gas emissions

The new energy strategy will focus on removing market and regulatory barriers to renewable energy and energy efficiency. Environmentally sustainable extraction is an integral part of the implementation of the management response to the Extractive Industries Review. GGFR is tackling gas flaring reduction. Carbon trading will be an integral part of the second strategic objective in the new strategy. There will be less work on promoting clean transport fuels and the Bank is unlikely to mount a world-wide initiative as it did with gasoline lead phaseout. Switching from coal to gas is important but there have not been many opportunities in an environment where new supply is having to be added constantly. Energy efficiency investments for biomass will likely remain limited. Strengthening environmental management capacity in energy supply is an integral part of the management response to the Extractive Industries Review in hydrocarbon and coal extraction.

Millennium Development Goals

The areas of focus in the energy strategy can contribute to the achievement of the Millennium Development Goals in the following manner.

- Goal 1: Eradicate extreme poverty and hunger
  Increasing the reliability of energy supply can increase economic growth (paragraphs 7 and 32 of the main text). Strengthening governance in the energy sector can contribute to equitable economic growth, and that in turn will reduce poverty and hunger.

- Goal 2: Achieve universal primary education
  Increasing access to electricity will increase the number of hours a child can study, and supplying schools with reliable electricity will likewise enhance opportunities for primary education.

- Goal 3: Promote gender equality and empower women
  Increased access to energy through electrification increases information provided to women through radio and television, reduces their work load, and provides income-generating opportunities. Increasing the availability of modern fuels for cooking through reducing fuel shortages and other means reduces women's work load significantly and protects their health.

- Goal 4: Reduce child mortality
  Increasing access to electricity reduces the incidence of food and water-borne illnesses by boiling water and refrigerating food. Replacing kerosene lamps with electricity can reduce indoor air pollution, thereby protecting children's health. Increasing the availability of modern fuels for cooking through reducing fuel shortages and other means can likewise reduce indoor air pollution and protect health.

- Goal 7: Ensure environmental sustainability
  Ensuring environmental sustainability is the second of the proposed twin strategic objectives.

World Bank Group's Six Strategic Themes

To help achieve an inclusive and sustainable globalization, the WBG has outlined six strategic directions:
(1) Poorest countries—help to overcome poverty and spur sustainable growth in the poorest countries, especially in Africa
(2) Fragility and conflict—address the special challenges of states coming out of conflict or seeking to avoid breakdown of the state
(3) Middle-income countries—develop a competitive menu of "development solutions" for middle-income countries, involving customized services as well as finance
(4) Global public goods—play a more active role with regional and global public goods

(5) The Arab world—support those advancing development and opportunity in the Arab World
(6) Knowledge—foster a "knowledge and learning" agenda across the WBG.

There is a direct link between the proposed new energy strategy and five of the six strategic themes (1, 2, 3, 4, and 6), and an indirect link with strategic theme 5. The Approach Paper proposes specific areas of focus for countries falling under strategic themes 1 and 2. In these countries, the primary area of focus will be increasing access and reliability of energy supply. For strategic theme 3, paragraph 34 proposes areas of focus specific to middle-income countries, particularly on support for innovation and transformation. Mitigating GHG emissions is a global public good, and as such the second of the twin objectives is aimed at strategic theme 4. Strategic theme 6 will remain an integral part of the WBG's engagement in the energy sector, as discussed in paragraph 52. The Approach Paper does not address issues specific to the Arab world; they are covered to the extent that the issues requiring attention in the coming years in MNA (see Approach Paper Appendix 1) are mostly about the Arab world.

Annex 11: Sub-Sector Strategies and Business Plans

Strategies and business plans in the energy sector formulated in the last few years are briefly described below.

New renewable energy and energy efficiency

New renewable energy includes solar, wind, geothermal, biomass, and hydropower with less than 10 MW per facility. Energy efficiency covers both demand-side and supply-side efficiency. Demand-side efficiency includes load management, demand response programs, and direct load control in the electricity supply system; improvements in end-use energy efficiency in the residential, commercial, industrial, public, municipal, agricultural, and transport sectors; and energy conservation. Also included are energy efficiency improvements through institutional development, regulatory reforms, and improvements in utility management performance, introduction of more stringent building codes and appliance energy efficiency standards and labeling systems, retrofits to meet new standards, energy audits, waste heat recovery, tighter fuel-efficiency standards for automobiles, use of drip irrigation or irrigation pumping in agricultural systems, municipal water pumping, energy efficiency financing through financial intermediaries, and implementation of consumer awareness programs. Supply-side energy efficiency encompasses transport systems (including modal shifts from private cars to high-occupancy public passenger transport); more efficient district heating; reducing losses in electricity transmission and distribution including enhanced metering systems, capacitors, and substation rehabilitation; power system optimization; and higher efficiency power generation, such as through the installation of supercritical boilers (although the WBG has not counted supercritical coal plants toward energy efficiency), plant rehabilitation, better operation and maintenance, and combined heat and power plants.

At the International Conference on Renewable Energies in Bonn in June 2004, the WBG committed to increasing investments in new renewable energy and energy efficiency. The specific goals included a target of at least 20 percent average growth annually in these two areas in FY05– FY09. The WBG would work to ensure that renewable energy and energy efficiency are seen as economically viable and essential ingredients in the energy choices of our member nations, not marginal considerations, and increase not only the WBG staff capacity but also the resources at its disposal and the incentives within its programs to help country and sector teams in these two areas and transfer best practice more rapidly.

In FY 2005–08, WBG committed close to US$3.8 billion for new renewable energy and energy efficiency against the Bonn commitment goal of US$1.3 billion. In FY2008, WBG committed US$2.7 billion for renewable energy and energy efficiency in developing countries. The cumulative WBG financial commitments for renewable energy and energy efficiency from FY1990 to 2008 exceed US$14 billion. Total cumulative commitments for new renewable energy in FY2005–08 were nearly US$1.5 billion, three times larger than in the previous four years.

In September 2008, the World Bank Board endorsed “Development and Climate Change: A Strategic Framework for the World Bank Group,” which committed the WBG to increase financing for energy efficiency and new renewable energy by an average of 30 percent a year from a baseline of US$600 million in average annual commitments during FY2005–07, and expand lending to hydropower, with the share of low-carbon projects rising from 40 percent in FY2006–08 to 50 percent in FY2011.

The current action plan comprises several principal actions.

1. Support project development to meet the 30 percent annual growth target for new renewable energy and energy efficiency.

- Support project development work needed to prepare new renewable energy projects.
- Integrate renewable energy and energy efficiency into Country Assistance Strategies and poverty reduction strategy papers. A program of upstream analytical, policy, and planning studies will be supported to provide the necessary information and rationale for scaling up access to new renewable energy.
- Provide additional assistance for renewable energy project preparation. Preparation costs for renewable energy projects have tended to be higher than the Bank average for project preparation, particularly for initial projects in a country, as little experience is available to draw on as a guide and implementation capacity is weak.

2. The World Bank continues to expand its non-lending and lending portfolio for supply-side and demand-side energy efficiency as envisaged in its "Energy Efficiency for Sustainable Development Scale-Up" program, supported by a gradual increase in staffing and strengthening of the learning program through its energy efficiency thematic group and other learning initiatives. The Energy Sector Management Assistance Program and the World Bank's urban sector jointly developed and launched the Energy Efficient Cities Initiative in November 2008. The initiative will mainstream and scale up energy efficiency investments in cities where demand for energy is growing the fastest and which offer some of the highest cost-effective GHG reduction possibilities, including buildings. Energy efficiency improvement can ease strains on existing infrastructure, reduce the costs to customers for municipal services, improve a city's competitiveness, and reduce the environmental footprint of the city.

3. Improve instruments to mobilize financing for scaling up renewable energy and energy efficiency in developing countries. These include existing instruments such as GEF and carbon finance, and proposed new instruments under the Strategic Climate Fund (Scaling Up Renewable Energy for Low-Income Countries), the Clean Technology Fund, and new trust fund facilities established in ESMAP and Africa.

4. Enhance international cooperation. The WBG continues to expand its engagement with international energy organizations such as the Renewable Energy Global Policy Network (REN21), UN-Energy, IEA, International Renewable Energy Agency, United Nations Industrial Development Organization (UNIDO), United Nations Development Programme (UNDP), Renewable Energy and Energy Efficiency Partnership, and the Alliance for Rural Electrification.

5. Improve knowledge, learning, and analytics. This activity comprises several knowledge products:
    - Operational toolkits and handbooks for renewable energy development and specific types of energy efficiency projects and programs
    - Renewable energy technology characterization studies
    - Guidance to staff on off-grid electrification
    - Issuing Knowledge Exchange series on renewable energy good practices
    - Guidebook on renewable energy for health, education, and community water supply

6. Disseminate information. WBG issues annual reports on the WBG's progress on renewable energy and energy efficiency (five reports have been issued to date), maintains an external website on renewable energy, and publishes papers and articles on the WBG's renewable energy efforts.

Hydropower

The role of hydropower infrastructure in development and poverty alleviation is expanding. In addition to bringing electricity to those who lack access, hydropower offers a hedge against volatile fuel prices and

can play an important role in energy trade and regional power pools. The imperatives of water management are also repositioning hydro infrastructure. A deeper understanding of potential harmful impacts of significant hydrological variability on economic growth puts a premium on better water resources management and infrastructure, especially in the world's 260 international river basins. Hydropower infrastructure also plays two critical roles in meeting the climate change challenge: renewable hydro energy offers an alternative to fossil fuels, and well planned, high-quality water resources infrastructure can help countries adapt to changes in hydrology.

Hydropower currently accounts for about 20 percent of the world's electricity supply and more than 80 percent of the supply from (nonbiomass) renewable resources. Scaling up hydropower is not limited by physical or engineering potential; OECD countries have exploited more than 70 percent of economically feasible potential. Yet only 23 percent of hydropower potential in developing countries has been exploited. Indeed, 91 percent of unexploited economically feasible potential worldwide is located in developing countries, with one quarter in China. In absolute terms, the 1,330 giwawatts (GW) of unexploited potential in developing countries far exceeds the existing installed capacity of 437 GW in developing countries and 315 GW in North America and Europe.

The challenges are to define hydropower's strategic role at the country, basin, and regional levels, and to bring adequate resources and skills to realizing its value in an environmentally and socially sustainable manner. Key constraints in scaling up hydropower infrastructure lie in lack of financing, lack of comprehensive planning and adequately assessed project pipelines, limited hydrological data and analysis, and unsettled conditions that discourage private sector participation.

Hydropower is and will remain risky. A sound framework for hydropower has to encompass both careful project preparation and supervision (including efficient decision making) and strengthening of the entire sector's basic foundations. A decade of learning about environmental and social risks has shifted the definition of sustainable hydropower infrastructure. The World Commission on Dams, the follow-up work of the UN Dams and Development Program, sustainability initiatives of both industry and nonindustry organizations, and the requirements of financing institutions have redefined the standards for environmental and social management. On this basis, there is a growing openness in civil society to see hydropower as an important element of a low-carbon future. Implementation of good practices is challenged by lack of capacity throughout the industry and in client countries, and by weak regulatory and policy frameworks. Inherent complexities and the multi-sectoral, multi-objective nature of hydropower projects call for a strong risk management approach to the sector.

The World Bank Group's role in scaling up hydropower

New dimensions of value for hydropower projects, rising standards for environment and social management and governance, and the active participation of a wider range of players create new opportunities for the WBG in hydropower. The WBG formulated a business plan for hydropower in 2008 and will pursue two parallel but reinforcing tracks: increased investment and sector strengthening (World Bank 2009b).

On the first track, the WBG must lead its own scale-up through direct investment in good-quality projects executed in a timely manner. After a decline in lending during the late 1990s and early this decade, lending for hydropower increased from an annual average of US$250 million in FY2002–04 to US$500 million in FY2005–07 and to more than US$1 billion in FY2008 across IBRD, IDA, IFC, MIGA, and GEF. IFC, for example, has mobilized project finance for more than 2,200 MW of small to medium-sized greenfield hydro projects. Consistent with industry-wide trends, the WBG's lending prospects in hydropower shows renewed strength. Comprehensive programs are emerging in Africa and South Asia. A greater focus is needed in Central Asia and Latin America and in accelerating broad basin-level plans (for

example, the Nile and Mekong). These projects must be measured not only by lending volume but also in terms of SIAP's triple bottom line.

On the second track, WBG has an important role in leveraging sources of finance and broadening development benefits by strengthening the basic foundations of the sector. The hydropower business plan identifies five priorities for engagement; specific attention to climate change is embedded in each element:

1. *Scale up financing*. Address financial barriers and constraints to projects, and increase resources to realize good practice in project preparation and supervision.
2. *Promote good practice*. Mainstream current knowledge and invest in continuous improvement, with specific emphasis on governance (such as in procurement), environmental management (for example, environmental flows), social inclusion (such as work with indigenous communities) and hydrological data and analysis.
3. *Strengthen planning*. Support governments, through adequate planning and enabling policies, regulatory frameworks, and institutions, to help realize the strategic value of hydropower. This task calls for significant investment in prefeasibility studies, development of a pipeline of quality projects, and river basin planning to ensure identification of high-value storage sites.
4. *Leverage regional development*. Explore synergies among complementary projects and development opportunities for the benefit of local communities, either directly through benefits-sharing or indirectly through poverty-targeted revenue management.
5. *Build partnerships*. Enhance cooperation among internal and external players to strengthen financing options and maintain global dialogue on sustainability.

Small-scale natural gas to power

In addition to the more traditional large-scale gas to power, a 2009 natural gas strategy for the World Bank focuses on "early stage" gas to power. Natural gas has several advantages in the power sector—it is the least carbon-intensive fossil fuel and emits less harmful local pollutants during combustion; it is suited for peaking; and the efficiency of widely available gas-burning technologies is much higher than the best established coal technologies. Several developing countries have under- or unutilized natural gas reserves that could be developed for power generation.

Effective early-stage gas industry development, however, is complex and requires integration and coordination across the supply chain:

- *Initiation of the chain*. The upstream component is usually the most complex economically and technically, and demands the highest returns. The entire chain depends on reliable supplies from the field.
- *Completion of the commercial chain*. Sales and purchase arrangements that provide the commercial foundation for the supply chain require creditworthy gas and power purchasers, guarantees, or both.
- *Risk-sharing*. How to apportion volume and price risks along the supply chain requires careful consideration.
- *Large upfront investment*. Gas infrastructure can require large upfront capital and longer lead times, even more than power generation which can be built in increments as small as 10–15 MW.
- *Lack of easy transportability*. Unlike oil, gas cannot easily be transported elsewhere if the targeted market disappears or proves to be unprofitable.

Typical hurdles include inadequate planning, policy, and regulation; a lack of investment to prove sufficient reserves and to develop them; limited flexibility on fiscal terms to stimulate gas development; an undefined or poorly formulated gas licensing strategy; discretionary gas and electricity pricing leading to uncertainties about future prices and making it difficult to do financial analysis; challenges in aligning

private and public stakeholders from "wellhead to light bulb"; differing views on requirements for government guarantees (for contractual performance, foreign exchange, and so on); and the absence of creditworthy offtakers for gas, electricity, or both.

The WBG can play an important role as an integrator and a coordinator. Key success factors include transparency whereby clarity is brought to the flow of gas, electricity, and revenues, and communicating with all stakeholders and the public; providing guarantees where appropriate and bringing in anchor investors; and having honest brokers to break the inertia. Well structured gas-to-power transactions can offer good governance as an outcome more so than oil development, because the interconnected contractual linkages throughout the supply chain necessitate scrutiny by a number of parties.

While continuing to work on gas to power in more established gas economies, the WBG will engage actively in early-stage gas to power, focusing especially on countries that meet the majority of the following criteria:

- Unexploited reserves of gas (potentially relatively small and could include coal bed methane, but sufficient for a viable project)
- No other significant surplus domestic fuels that are substitutes
- No or limited previous experience in gas to power development
- Current or anticipated electricity deficits
- Lack of incentives (regulations, terms, market, pricing, guarantees) for infrastructure investment
- Elevated investment risk
- Likely presence or prospect of creditworthy offtakers.

Potential candidate countries in Africa include Botswana, Cameroun, Gabon, Ghana, Mauritania, and Namibia.

EITI++

A "paradox of plenty" and "resource curse" have become two commonly used phrases to describe the impact of oil wealth on the economies of producing countries. Oil revenues are extremely volatile, unpredictable, and large relative to total exports, government revenue, or GDP. Oil prices are notoriously difficult to predict; a prudent approach would be to forecast future oil prices conservatively and save in times of high oil prices, but the political pressure to spend increases with increasing savings. Researchers have noted that resources that are localized—such as oil, gas, and minerals—slow down economic development much more than resources that are widely spread. Concentrated resources are capital-intensive to extract, employ relatively few, and tend to be concentrated in the hands of a small number of firms. A concentrated revenue stream in turn tends to create a politically powerful minority that does not consider itself accountable to the rest of the population. Since the 1970s, resource-rich developing countries on average have grown more slowly than their resource-poor counterparts. Recent research has investigated, and found some evidence for, causality through corruption—that hydrocarbon and mineral resources lower economic growth through deteriorating governance. Weak governance in many oil-exporting countries pre-dates oil development and has made oil wealth management difficult from the outset. However, there is increasing awareness that the arrival of significant oil wealth can itself worsen governance, creating a vicious cycle.

Against this backdrop, the WBG launched EITI++ in April 2008. EITI++ complements EITI (Extractive Industries Transparency Initiative) which is focused on reconciling payments made by companies and revenues received by governments. EITI++ covers the entire value chain in the extraction of hydrocarbons and minerals. Several developing countries have successfully avoided the paradox of plenty, and there is a wealth of international experience from which to draw lessons on how best to manage hydrocarbon resources. Five stages in the value chain are identified for improving revenue collection, transparency, accountability, management, and use (Mayorga-Alba 2009):

1. Award of contracts and licenses
2. Regulation and monitoring of operations
3. Collection of extractive industry revenue
4. Revenue management and allocation
5. Implementation of sustainable development policies and projects.

EITI++ encourages countries to take a comprehensive view on how to translate resource wealth into growth and development impact. EITI++ participants have or are interested in developing a program of policy actions, institutional and capacity strengthening, and investments consistent with the good governance and sound management of its extractive industries. To date, the World Bank has

- fielded scoping missions to help frame a dialogue with the authorities and other partners on an EITI++ approach at the country level,
- established a technical advisory group, and
- explored establishment of a rapid response technical assistance facility intended to provide "just-in-time" advisory services to countries on demand, mostly for exploration and production of resources.

The energy specialists and macro-economists at the World Bank will be working together to integrate the insights from these missions and other applications of the EITI++ approach into the Country Assistance Strategies and adapting existing IBRD/IDA instruments in meeting specific country demands.

Annex 12: WBG Partners

Institution	*Areas with significant overlap*	*Areas with limited or no overlap*	*Observations*
AfDB	Considerable overlap in all aspects of energy in Africa.	AfDB does not work outside of Africa.	
ADB	Considerable overlap in all aspects of energy in Asia	ADB does not work outside of Asia.	ADB can offer small-size (up to about US$1 million) free technical assistance quickly
EBRD	Considerable overlap in all aspects of energy in ECA.	EBRD finances nuclear safety improvements, waste handling, and decommissioning. EBRD does not work outside of ECA for the most part.	Two-thirds of EBRD's financing is for the private sector. EBRD is strong at clean production audits and processing energy efficiency projects, and has significant resources available for project preparation.
EIB		EIB finances nuclear power generation. EIB finances developed countries in Europe.	EIB is larger than the WBG—the commitments in 2007 totaled €56 billion. Although the focus is on Europe, EIB operates globally.
IDB	Considerable overlap in all aspects of energy in LCR.	IDB has placed a much greater emphasis on biofuels. IDB does not work outside of LCR.	
Islamic Development Bank (IsDB)		IsDB does not work outside of the Organization of the Islamic Conference. IsDB offers extensive scholarship programs.	IsDB's operations are based on the principles of Shari'ah jurisprudence.
UNDP	UNDP works in all developing countries. Its energy related activities focus on access to sustainable energy services		In each country the UNDP Resident Representative serves as coordinator for development activities of the UN system as a whole.
AFD (France)	AFD works in all regions. AFD supports programs for economically competitive energy, increasing access, and sustainable energy (low lifecycle GHG emissions, end-use energy efficiency). PROPARCO is AFD's equivalent of IFC.		AFD works in more than 60 developing countries with a strong presence in Francophone countries. Its focus is the Millennium Development Goals.
AusAID (Australia)	AusAID provides assistance for a number of topics including improving poor people's access to essential infrastructure services including energy. AusAID	AusAID generally does not work outside of Asia.	

Institution	*Areas with significant overlap*	*Areas with limited or no overlap*	*Observations*
	concentrates its program to countries in EAP and SAR.		
CIDA (Canada)	CIDA's program is focused around the Millennium Development Goals. Support for energy projects is largely for those with environmental benefits.		Future activities will be increasingly concentrated on selected countries.
DANIDA	DANIDA contributes to the climate change agenda through support for renewable energy projects. DANIDA works mainly in Africa and Asia.	DANIDA does not work extensively outside of Africa and Asia.	DANIA supports the energy sector though the multilateral mechanisms in the World Bank, ADB, UNDP, and UNEP.
DfID (UK)	DfID works in all regions. Its focus is on the Millennium Development Goals and hence on energy access through sustainable sources. DfID places a strong emphasis on low-carbon growth.	DfID does not have bilateral programs on energy. Its energy program is focused on policy and conducted through multilateral institutions.	Works with a large number of developing countries, and has offices in 64.
FMO (Netherlands)	EMO works in Africa, Asia, Europe, and LCR. FMO works mainly with private sector in local currency, long-term finance, and capacity development.		
JBIC (Japan)	In March 2008, the Japanese government announced loans up to US$5 billion over 2 years through JBIC for environmental projects such as solar and hydro power and public transport, and that it may offer syndicated loans with ADB and WBG. Based on the JBIC Facility for Asia Cooperation and Environment established in 2008, JBIC utilizes its investments and guarantees for environmental projects and ventures in Asia to provide support through mobilization of private capital.	JBIC participates in traditional energy projects with well-established international companies. JBIC supports nuclear power development. JBIC promotes overseas development and acquisition of natural resources that are strategically important to Japan.	Energy investment is a high priority with respect to securing long-term stable supplies. JBIC has representative offices in some developing countries, particularly in Asia.
KfW (Germany)	KfW finances investments and consultancy services in developing countries. Its areas of focus include power supply, particularly		KfW is currently active in 110 countries. Its chief German cooperation partner is GTZ, and it also cooperates with the

Institution	*Areas with significant overlap*	*Areas with limited or no overlap*	*Observations*
	renewable energy, and energy efficiency. DEG is KfW's equivalent of IFC.		European Union on co-financing activities.
NORAD (Norway)	NORAD provides technical assistance. NORAD's areas include improving private sector framework for business (including the Oil for Development program) and the environment. NORAD works with a large number of countries worldwide.	NORAD has no specific emphasis on electricity.	
SIDA (Sweden)	SIDA channels its resources through, amongst others, non-governmental organizations, multilateral cooperation, and the European Union. It supports the power sector and environmental projects. SIDA supports projects in more than 100 countries.		
USAID (USA)			USAID's main areas include environment. It works in 100 developing countries with many field offices. It has strong links with companies and U.S.-based private voluntary organizations

AfDB ≡ African Development Bank, ADB ≡ Asian Development Bank, EBRD ≡ European Bank for Reconstruction and Development, EIB ≡ European Investment Bank, IDB ≡ Inter-American Development Bank, AFD ≡ , UNDP ≡ United Nations Development Programme, AFD ≡ Agence Française de Développement, AusAID ≡ Australian Agency for International Development, CIDA ≡ Canadian International Development Agency, DANIDA ≡Danish International Development Assistance, DfID ≡ Department for International Development, FMO ≡ Nederlandse Financierings-Maatschappij voor Ontwikkelingslanden N.V., JBIC ≡ Japan Bank for International Cooperation, KfW ≡ Kreditanstalt für Wiederaufbau, NORAD ≡ Norwegian Agency for Development Cooperation, SIDA ≡ Swedish International Development Corporation Agency; UNEP ≡ United Nations Environment Programme; USAID ≡ U.S. Agency for international Development

References

Andriamihaja, Noro Aina and Giovanni Vecchi. 2007. “An Evaluation of the Welfare Impact of Higher Energy Prices in Madagascar.” Africa Region Working Paper Series 106. Washington DC: World Bank. http://www.worldbank.org/afr/wps/wp106.pdf.

Antmann, Pedro. 2009. “Reducing Technical and Commercial Losses in the Power Sector.” Draft background paper prepared for the WBG Energy Strategy.

Bacon, Robert and Masami Kojima. 2006. “Coping with Higher Oil Prices.” Energy Sector Management Assistance Program Report 323/06. www.esmap.org/filez/pubs/372007122243_CopingWithHigherOilPrices_323-06.pdf.

———. 2008a. “Coping with Oil Price Volatility.” Energy Sector Management Assistance Program Special Report 005/08. http://esmap.org/filez/pubs/8142008101202_coping_oil_price.pdf.

———. 2008b. “Vulnerability to Oil Price Increases: A Decomposition Analysis of 161 Countries.” Extractive Industries for Development Series #1. http://siteresources.worldbank.org/INTOGMC/Resources/eid1_oil_price_vulnerability.pdf.

Besant-Jones, John. 2006. “Reforming Power Markets in Developing Countries: What Have We Learned?” Energy and Mining Sector Board, Discussion Paper 19. http://siteresources.worldbank.org/INTENERGY/Resources/Energy19.pdf.

Bose, K., M. Shikla, L. Srivastava, and G. Yaron. 2005. “Cost of unserved power in Karnataka, India.” *Energy Policy* 34: 1434–1447.

Castalia. 2006. “Assessment of Value of Unserved Energy.” www.gridnewzealand.co.nz/f326,9427/9427_ip-attach-m-assess-value-unserved-energy-aug-2006.pdf.

Council of European Energy Regulators. 2008. “Fourth Benchmarking Report on Quality of Electricity Supply.” www.energy-regulators.eu/portal/page/portal/EER_HOME/EER_PUBLICATIONS/CEER_ERGEG_PAPERS/Electricity/2008/C08-EQS-24-04_4th%20Benchmarking%20Report%20EQS_10-Dec-2008_co.pdf.

Eberhard, A., V. Foster, C. Briceño-Garmendia, D. Camos, and M. Shkaratan. 2008. “Underpowered: The State of the Power Sector in Sub-Saharan Africa.” Africa Infrastructure Country Diagnostic Background Paper 6. Washington DC: World Bank.

EIA (Energy Information Administration). 2008. “International Energy Outlook 2008.” www.eia.doe.gov/oiaf/ieo/.

———. 2009. “International data.” www.eia.doe.gov/emeu/international/contents.html.

ESKOM. 2008. “Annual Report 2008.” http://financialresults.co.za/eskom_ar2008/info_sheets/005_04.htm,

Gratwick, Katharine and Anton Eberhard. 2008. “Demise of the standard model for power sector reform and the emergence of hybrid power markets.” *Energy Policy* 36: 3948–60. http://ideas.repec.org/a/eee/enepol/v36y2008i10p3948-3960.html.

Grosh M., C. del Ninno, E. Tesliuc and A. Ouerghi. 2008. “For Protection and Promotion: The Design and Implementation of Effctive Safety Nets.” Washington DC: World Bank. http://siteresources.worldbank.org/SAFETYNETSANDTRANSFERS/Resources/For_Protection_and_Promotion_9-08.pdf.

Gwilliam, Ken, Masami Kojima, and Todd Johnson. 2004. “Reducing Air Pollution from Urban Transport. Washington DC: World Bank. www.cleanairnet.org/infopool/1411/article-60133.html.

International Energy Agency (IEA). 2006. *World Energy Outlook 2006*. www.iea.org/textbase/nppdf/free/2006/weo2006.pdf.

———. 2008a. *Energy Technology Perspectives* 2008. Paris: OECD.

———. 2008b. *World Energy Outlook 2008*. Paris: OECD.

IFC (International Finance Corporation). 2009. "Enterprise Surveys." Finance and Private Sector Development vice-Presidency. www.enterprisesurveys.org/ExploreTopics/?topicid=8.

Kojima, Masami and Todd Johnson. 2005. "Potential for Biofuels for Transport in Developing Countries." Energy Sector Management Assistance Program Report 312/05. www.esmap.org/filez/pubs/31205BiofuelsforWeb.pdf.

Kojima, Masami, Donald Mitchell, and William Ward. 2007. "Considering Trade Policies for Liquid Biofuels." ESMAP Special Report 004/07. http://siteresources.worldbank.org/INTOGMC/Resources/Considering_trade_policies_for_liquid_biofuels.pdf.

LaCommare, K.H. and J. H. Eto. 2004. "Understanding the Cost of Power Interruptions to U.S. Electricity Consumers." Lawrence Berkeley National Laboratory, LBNL-55718. http://certs.lbl.gov/pdf/55718.pdf.

Lawton, L., M. Sullivan, K. Van Liere, A. Katz and J. Eto. 2003. "A framework and review of customer outage costs: Integration and analysis of electric utility outage surveys." Lawrence Berkeley National Laboratory, Paper LBNL-54365. http://repositories.cdlib.org/lbnl/LBNL-54365/.

Luiz, Maurer, Mario Pereira, and José Rosenblatt. 2005. "Implementing Power Rationing in a Sensible Way: Lessons Learned and International Best Practice." Report 305/05. Washington DC: World Bank. www.esmap.org/filez/pubs/372007120957_305-05+Final_to_website.pdf.

Maurer, L. 2005. "Implementing Power Rationing in a Sensible Way: Lessons Learned and International Best Practices." ESMAP Report 305/05. www.esmap.org/filez/pubs/372007120957_305-05+Final_to_website.pdf.

Mayorga-Alba, Eleodoro. 2009. "Extractive Industries Value Chain: A Comprehensive Integrated Approach to Developing Extractive Industries." Extractive Industries for Development Series #3 and Africa Region Working Paper Series #125. http://siteresources.worldbank.org/INTOGMC/Resources/ei_for_development_3.pdf.

MIT (Massachusetts Institute of Technology). 2007. "The Future of Coal: Options for a Carbon-Constrained World." http://web.mit.edu.coal/The_Future_of_Coal.

Nalbandian, Hermineé 2009. "Performance and Risks of Advanced Pulverized-coal Plants." *Energeia*, 20. www.caer.uky.edu/energeia/PDF/vol20_1.pdf.

Nordel. 2008. "Annual Statistics 2007." http://195.18.187.215/docs/3/CNPBLKFDAOPDONEFJHGPKAJIPDBW9DBY7G9DW3G71KM/Nordel/docs/DLS/2008-00299-01-S.pdf.

Ouedraogo, F. 2007. "Power Systems Characteristics in Sub-Saharan Africa." Africa Infrastructure Country Diagnostic. Washington, DC: World Bank.

PPIAF (Private Public Infrastructure Advisory Facility). 2008. "New private infrastructure projects in developing countries have started being affected by the financial crisis." http://ppi.worldbank.org/features/Oct2008/2008PPIFinancialCrisisImpact.pdf.

Reuters. 2008. "Oil said to back near to $100 by 2010-2015." December 29.

Singh, Anoop. 2007. "Policy Environment and Regulatory Reforms for Private and Foreign Investment in Developing countries: A Case of the Indian Power Sector." Asian Development Bank Institute, Discussion Paper 64. www.adbi.org/files/dp64.policy.environment.power.sector.pdf.

UK Energy Research Centre. 2007. “The Rebound Effect: An Assessment of the Evidence for Economy-wide Energy Savings from Improved Energy Efficiency.” www.ukerc.ac.uk/Downloads/PDF/07/0710ReboundEffect/0710ReboundEffectReport.pdf.

UN-Habitat. 2007. “Global Report on Human Settlements 2007: Enhancing Urban Safety and Security.” www.unhabitat.org/downloads/docs/GRHS.2007.7.pdf.

Wijayatunga, P. and M. Jayalath. 2008. “Economic impact of electricity supply interruptions on the industrial sector of Bangladesh.” *Energy for Sustainable Development* XII: 5–12.

World Bank. 1999. “Fuel for Thought: An Environmental Strategy for the Energy Sector.” Washington DC: World Bank. http://go.worldbank.org/92RT0XPT30.

———. 2001. “The World Bank Group’s energy program: poverty alleviation, sustainability, and selectivity.” Energy and Mining Sector Board. Washington DC: World Bank. http://siteresources.worldbank.org/INTENERGY/Publications/20269216/energybrochure.pdf.

———. 2003. “Power for Development: A review of the World Bank Group’s experience with Private Participation in the Electric Power Sector.” http://lnweb90.worldbank.org/oed/oeddoclib.nsf/DocUNIDViewForJavaSearch/C82176E133B60EA585256DC600667712/$file/power_for_development.pdf.

———. 2006. “Clean Energy and Development: Towards An Investment Framework.” http://siteresources.worldbank.org/DEVCOMMINT/Documentation/20890696/DC2006-0002(E)-CleanEnergy.pdf.

———. 2008a. *World Development Indicators 2008*. Washington DC: World Bank.

———. 2008b. “Development and Climate Change: A Strategic Framework for the World Bank Group.” http://siteresources.worldbank.org/EXTCC/Resources/407863-1219339233881/DCCSFTechnicalReport.pdf.

———.2009a. Enterprise Survey Database. www.enterprisesurveys.org/portal/.

———.2009b. “Directions for Hydropower: Scaling Up Hydropower for Development.”

———.2009c. “Climate Change and the World Bank Group. Phase I. An Evaluation of World Bank Win-Win Energy Policy Reforms.” http://go.worldbank.org/P79E45L5G0

World Economic Forum. 2009. “Green Investing: Toward a Clean Energy Infrastructure.” www.weforum.org/pdf/climate/Green.pdf.

Yu, W. and M. Pollitt. 2009. “Does Liberalisation cause more electricity blackouts? Evidence from a global study of newspaper reports.” Electricity Policy Research Group, EPRG working Paper 0830. University of Cambridge. www.econ.cam.ac.uk/dae/repec/cam/pdf/cwpe0911.pdf.