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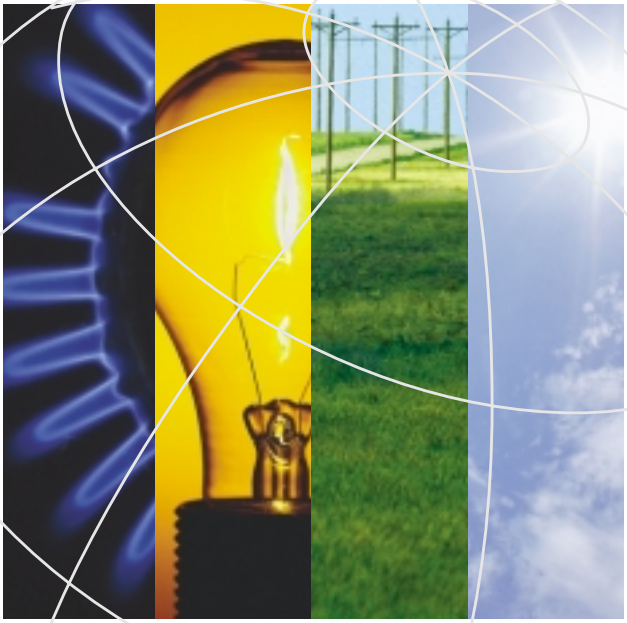
ENERGY & MINING SECTOR BOARD DISCUSSION PAPER SERIES

PAPER NO. 3

SEPTEMBER 2002

Economic Development, Climate Change, and Energy Security – The World Bank's Strategic Perspective

Charles Feinstein



THE WORLD BANK GROUP

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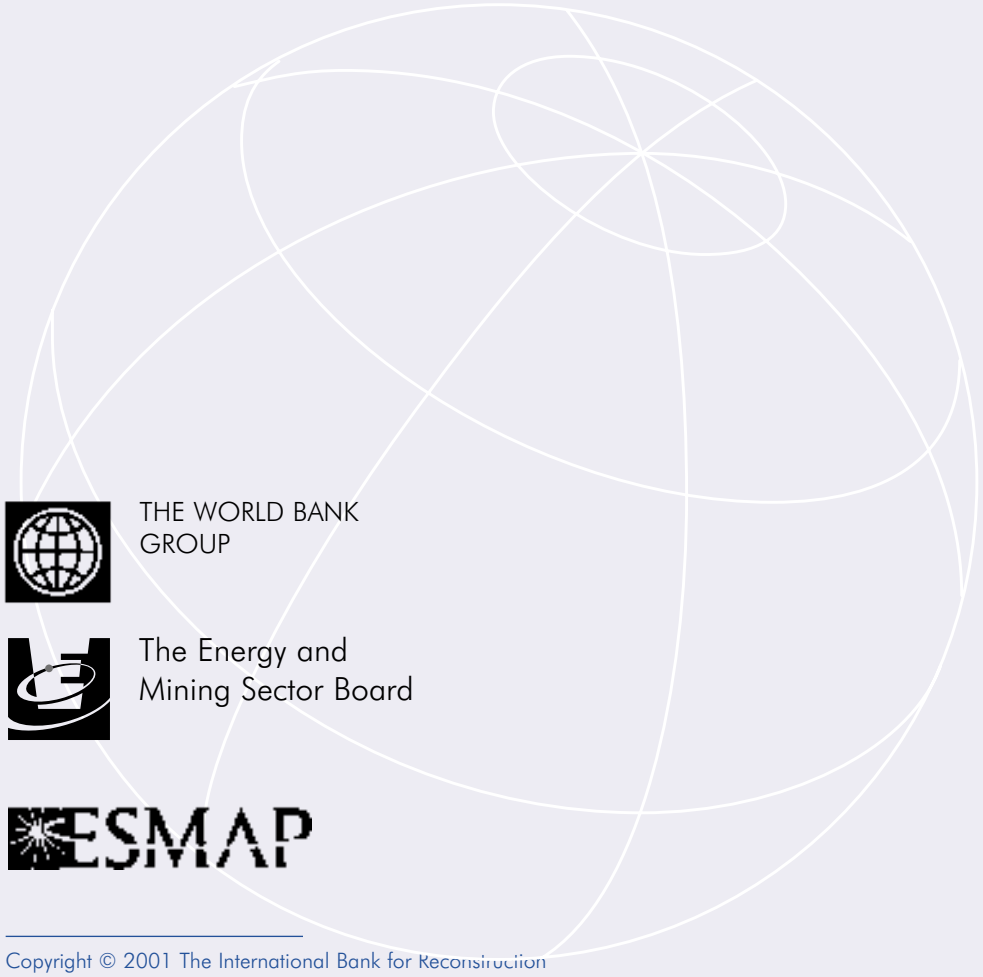

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FOREWORD

This paper is intended as a World Bank Group (WBG) contribution to the growing discourse on the linkages between poverty reduction, the enhancement of energy security, and efforts to address the increasing threat of global climate change. As the paper took shape, it was evident that that the dialogue needed to be extended to a broad range of stakeholders concerned with one or, increasingly, all three of these key aspects of energy and development. The importance of these topics is illustrated by their prominence in the World Summit on Sustainable Development process. Providing modern energy access for rural development and improving the global sustainability of energy supply and use emerged as key themes at the Johannesburg Summit.

Historical experience shows that energy systems evolve only over many decades; however, the transition to a new system is likely to accelerate, given the need for additional energy for basic needs in developing countries, local and global environment concerns, and energy security. Energy is essential for both economic growth and reducing poverty. Energy resources have been an important source of revenue for hydrocarbon exporting countries, but economies that are highly dependent on oil imports and major oil exporting countries both face macroeconomic and fiscal instability from fluctuations in world oil markets and prices. The macroeconomic and fiscal risks can be magnified in developing countries by misdirected energy subsidies and rents, poor governance, and corruption. However, while energy is an essential driver of economic development and poverty reduction, too often it is the cause of environmental degradation (e.g., local air and water pollution, climate change), adversely and disproportionately affecting the health and livelihoods of the poor. Climate change impacts pose particular risks to developing countries because of expectations of greater climate variability in their regions, a greater proportion of climate-sensitive sectors, and the inability of government coffers and institutions to absorb the impacts.

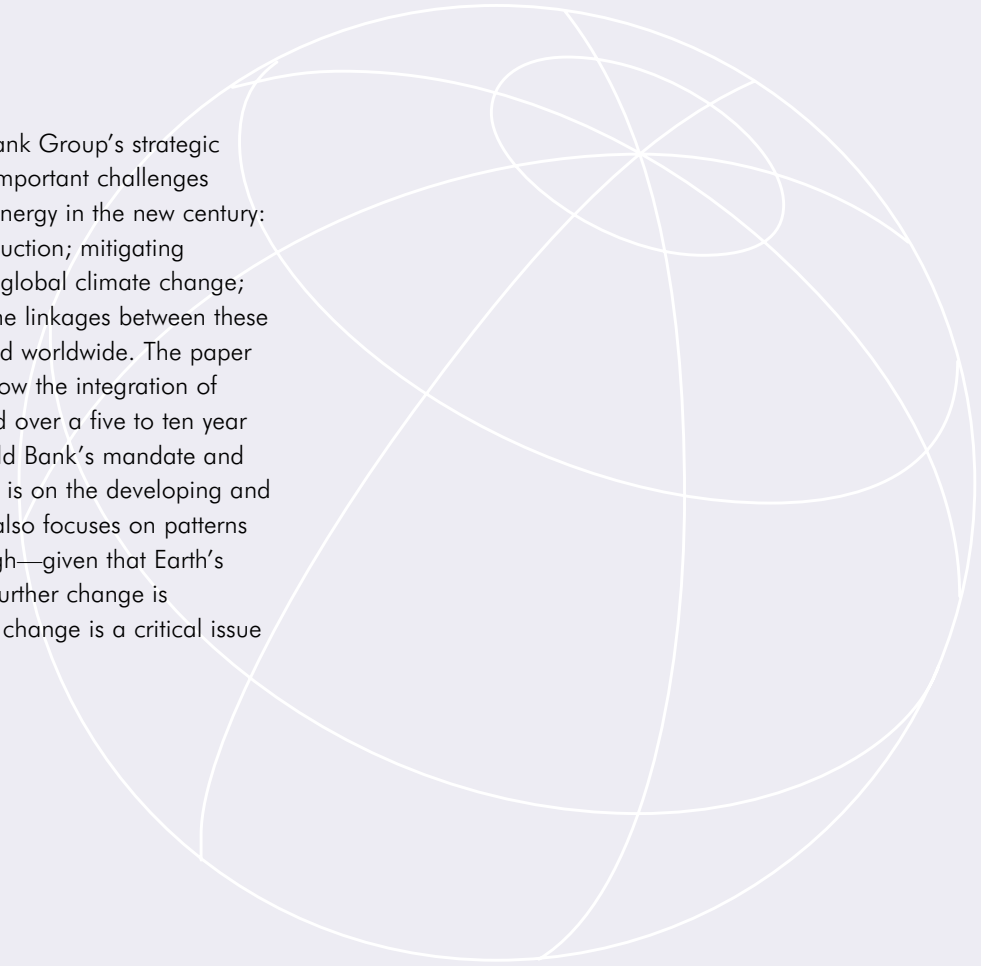
The WBG's energy business is changing in the face of a changing world, and changing in ways that reflect the confluence of this triad of interests. We envisage and support the transition in developing countries from traditional to modern energy for poor households while improving the efficiency and environmental sustainability of the supply and use of energy, increasing the choices of energy services for consumers, and improving macroeconomic and fiscal stability. The WBG's Energy Business Renewal Strategy is anchored in four business areas: (1) activities that have a direct impact on poverty reduction; (2) those that help the energy sector contribute to macroeconomic and fiscal stability; (3) activities that enhance market development, governance, and the participation of the private sector; and (4) those that ensure the environmental and social sustainability of energy services and use.

With more than five decades of experience in developing and transition countries, the WBG plays an important role in supporting the development of sustainable energy markets and institutions. Through its wide range of financial instruments delivered by the World Bank, the International Finance Corporation, and the Multilateral Investment Guarantee Agency, its lending program, its economic and sector work and advisory activities, involvement with the Global Environment Facility, and leadership in carbon financing, the WBG can provide critical leverage for sustainable energy development through public and private partnerships, including nongovernmental organizations, foundations, and the private sector.

JAMAL SAGHIR
Director, Energy and Water
Chair of Energy and Mining Sector Board

INTRODUCTION

This paper describes the World Bank Group's strategic perspective on three particularly important challenges related to the supply and use of energy in the new century: economic growth and poverty reduction; mitigating environmental impacts, including global climate change; and enhancing energy security. The linkages between these themes are increasingly recognized worldwide. The paper provides an institutional view of how the integration of these themes should be addressed over a five to ten year time horizon. Because of the World Bank's mandate and positioning, the paper's emphasis is on the developing and transition economies. The paper also focuses on patterns of energy supply and use, although—given that Earth's climate is already changing and further change is inevitable—adaptation to climate change is a critical issue for developing countries.



SUSTAINABLE ENERGY DEVELOPMENT IN THE EMERGING AND TRANSITION ECONOMIES: KEY DRIVERS

Historically, energy "revolutions" have hardly been sudden or revolutionary, requiring 40–60 years to achieve capital stock replacement and technology and fuel substitution. Nevertheless, desires for growth and poverty reduction, local and global environmental mitigation, and enhancement of energy security are poised to accelerate the pace of the coming energy transition—all the more so as the underlying synergies are recognized and exploited.

Economic Growth and Poverty Reduction

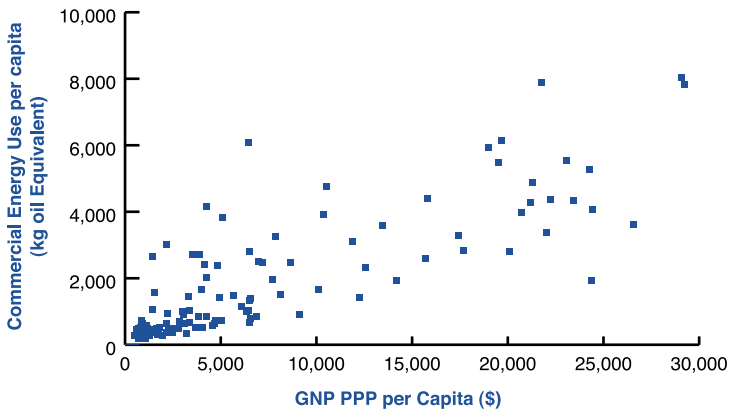
In the present international development context, the Millennium Development Goals (MDGs) frame development assistance efforts and set targets for reductions in poverty, improvements in health and education, and protection of the environment. The goals have been adopted by the World Bank Group (WBG), the International Monetary Fund, the members of the Development Assistance Committee of the Organisation for Economic Co-operation and Development (OECD), and many other agencies. They found a new expression in the Millennium Declaration of the United Nations, adopted by the General Assembly in September 2000. The goals provide a formidable challenge to the international community: to reduce global poverty by half over the next 15 years.

Significantly, however, none of the 21 targets contain a specific reference to energy, although it is well recognized in the energy development community that modern energy is needed to deliver critical services to the poor. Furthermore, many of the goals—such as reducing infant and maternal mortality due to poor health care facilities and increasing information, communications, and technology (ICT) services—cannot be reached if energy services are not provided.

For three-quarters of the world's 2.5 billion truly poor (who live on less than US$2 per day), the central energy issue is access to modern energy.[1] The role of energy services and the span of energy service benefits are only recently becoming understood, ranging from energy for consumptive uses (e.g., cooking, basic lighting, and radio and television), to socially productive uses (e.g., energy for education and health services delivery), to economically productive uses (e.g., motive power for small- and medium-scale enterprises and industry, irrigation, and ICT). The energy-poverty linkage runs two ways: (1) the poverty-exacerbating effects—through household income expenditure,[2] pollution exposure, and the simple drudgery of collecting and transporting traditional fuels—to the lack of access to clean, affordable, and efficient modern fuels; and (2) the role of modern energy in empowering business development, employment, income generation, and more productive social services that lift populations out of poverty and enable economic growth. This concept of energy and poverty is also more responsive to achieving the MDGs.

Viewed from a national growth perspective, there is a strong correlation between energy consumption and economic income. Figure 1 shows the level of energy consumption in kilograms of oil equivalent (kgoe) per person in more than 160 developed and developing countries and the corresponding levels of national income (indicated by gross national product [GNP]). Part of the explanation for this observed correlation is that most economic activity would be impossible without energy. Thus, economic growth that creates jobs and raises incomes relies on additional or more efficient energy use. Most sectors of the economy depend on an adequate and reliable supply of energy.

Figure 1. Energy Consumption and Economic Income



Source: World Development Indicators

[1] For example, the rate of modern energy access in Sub-Saharan Africa is approximately 8 percent, and their per capita conventional energy consumption is less than 1/20th of levels in the industrialized world.

[2] The developing world's poor spend a substantial proportion—an estimated 12 percent of their household income—for energy services. Because of the low efficiency of their energy supply and consumption, this fraction is four times higher than in wealthier households.

In terms of economic management, government borrowing and contingent liabilities or financial guarantees given to investors in energy infrastructure have often been a source of macroeconomic and fiscal instability in developing countries. Likewise, significant budget expenditures are made to support various direct or indirect subsidies of energy consumers. Energy is especially important for macroeconomic and fiscal stability in oil and gas exporting countries such as Mexico, the Russian Federation, Nigeria, Indonesia, Algeria, Venezuela, Vietnam, and Iran. In these countries, energy accounts for a substantial portion of GDP, government revenues, and export earnings. In common with developing economies that are highly dependent on oil imports, the exporters' macroeconomic and fiscal balances are exposed to high risks from fluctuations in world oil markets and prices.

Environmental Protection and Climate Change

Global climate change is perhaps the least quantitatively understood, but also potentially the most devastating, result of modern energy use. Most scientific experts agree that climate change induced by human activity is occurring and that further change is inevitable. *The Third Assessment Report of the Intergovernmental Panel on Climate Change* (IPCC 2001) concludes that "most of the observed warming over the last 50 years is likely to have been due to the increase in greenhouse gas (GHG) concentrations." About 75 percent of the cumulative GHG emissions during the past 150 years have been emitted by industrialized countries.[3] As a result of this energy-led development, their per capita GHG emissions today are five times higher than those of developing countries. The IPCC also concludes that "most less-developed regions are especially vulnerable" to the projected adverse impacts of climate change. To avoid the risks of climate change impacts, developing countries will need to adapt their development paths.

Given the uncertainties surrounding the level and timing of climate change damage, there are multiple possible targets for an upper limit on GHG concentrations in the atmosphere. Multiple time paths of emissions rates are associated with any given long-term stabilization target. Each emissions path is in turn associated with a particular time horizon for action. For example, an aggressive target (450 parts per million atmospheric CO2 concentration) implies an immediate reduction in global emissions (Table 1). Less ambitious targets generally imply first reducing the growth rate in emissions, followed by a time in which allowable emissions reach a peak level and then follow a declining trajectory to the long-term sustainable level.

Table 1. Stabilization of atmospheric concentrations of CO_2 will require emissions reductions globally (IPC 2001)

Stabilization Level	Date for Global emissions to peak	Date for Global emissions to fall below current levels
450	2005-2015	2000-2040
550	2020-2030	2030-2100
650	2030-2045	2055-2145
750	2050-2060	2080-2180
1000	2065-2090	2135-2270

These dates are associated with CO_2 stabilization alone – stabilization of CO_2 equivalent concentrations need to occur even earlier because of the contribution of the non - CO_2 greenhouse gases

Despite the multiplicity of options, one thing is clear: To stabilize atmospheric concentrations of CO2, emissions must be brought below the level of natural absorption of GHG emissions in Earth's carbon cycle—equivalent to a 90 percent cut in the level of *today's* emissions. This is the level to which emissions would eventually need to be returned to meet the United Nations Framework Convention on Climate Change (UNFCCC) goal of "stabilization of greenhouse gas concentrations in the atmosphere at al level that would prevent dangerous anthropogenic interference with the climate system." Dealing with the climate change problem will therefore eventually require a global effort to control GHG emissions. Current emissions from developing countries are growing fast, and by early this century are expected to exceed those of industrialized countries. The fundamental question is: How do we reconcile the requirement for developing countries to meet basic human needs—to date fueled by coal, oil, and gas—with the need to protect the environment? Over the next 10 years, the focus for developing countries is not on achieving GHG emission targets, but rather on incorporating climate change considerations into the development of their energy markets, institutions, and technologies.

Developing countries fully recognize the implications of global climate change and the need for all nations to assume responsibility for protecting the global atmosphere, as reflected in their decision to ratify the UNFCCC.

[3] The 150-year time frame corresponds to the approximate atmospheric residence time of carbon dioxide.

However, because these countries' contribution to the cumulative increase in atmospheric concentrations of GHG emissions has been small relative to that of industrial countries, and because of the urgency of their short-term needs to provide food, energy, and other vital services for the poor, it was recognized that developing countries and economies in transition would be unwilling and unable to invest their scarce resources in measures yielding benefits in the distant future or outside their boundaries. For that reason, based on the principle of common but differentiated responsibility, industrial country parties to the UNFCCC agreed to provide new and additional grant resources to their developing country counterparts and to support the transfer of technology on beneficial terms.

The recent agreements reached on the implementation of the Kyoto Protocol will likely have significant impact on the global energy sector. The agreement on the flexibility mechanisms, including Joint Implementation (JI) and the Clean Development Mechanism (CDM), has established the emerging carbon market. However, the size and growth of that market is uncertain at this time, given the significant allowance for carbon sinks in net emissions accounting, the large excess of "hot air" in the Russian Federation, and the nonparticipation of the United States. It is possible that the demand for carbon offsets from CDM countries will be driven by policies, particularly those of the European Union and its members. For example, the extent to which demand is satisfied internally by using the International Emissions Trading mechanism and the provisions for land-use change and forestry will be decided by these policies. Nevertheless, the long-run benefits of participation for emerging and transition economies, in the form of substantial financial inflows and promotion of locally environmentally beneficial energy sources, will be substantial.

Identifying and exploiting the simultaneous local environmental benefits of addressing global climate change will be key to stimulating developing country interest in GHG emissions mitigation. Most developing countries are much more concerned about local and regional air pollution than GHG emissions. While there are tradeoffs in dealing with global warming and local air quality, there are synergies in many cases—many of these pollutants (e.g. ozone, black carbon) also contribute to global warming. The IPCC has noted that, in some cases, the ancillary benefits of mitigation of climate change can outweigh the costs of reducing GHG emissions because of reductions in local and regional air pollution.

Energy Security

The 1970s oil shocks confronted the developing countries with a new set of energy security issues. Few of the oil importing countries had the necessary foreign exchange reserves to absorb price increases. Concerns about macroeconomic management and fiscal balance—national affordability—rose to the fore. Energy security was enhanced through reliance (sometimes an overreliance) on domestic resources, bilateral energy trading relationships with reliable nearby partners, and access to regional markets. However, vulnerability to significant price fluctuations remains a major energy security concern for both oil and gas exporting countries and net importers of energy products and services.

A second energy security preoccupation in developing countries is the ability to adapt and apply imported energy technologies to their local needs and manage them successfully. In the perception of many developing countries, failure to adapt and manage implies a continuing dependence on foreign technical know-how, a dependence that is usually interpreted as insecurity. Over time, lack of open and transparent markets and good governance also contributes to the degradation and disfunctionality of complex energy technologies. Failure to adapt technologies to local conditions also implies that energy service priorities will be determined on the basis of an exogenous energy technology that cannot meet affordability and the priority social needs of emerging market economies, especially in rural areas.

Third, developing countries have good reason to harbor concerns about the vulnerability of their energy infrastructure to disruption by natural or man-made events. The recent extensive losses of the electric transmission and distribution facilities of Orissa (cyclone) and Gujarat (earthquake) in India stand as a powerful testimony; floods can be equally damaging, and droughts threaten the viability of hydroelectric facilities. In addition, power stations, refineries, pipelines, and transmission lines are early targets in cases of domestic insurrection, civil war, and international conflict.

Finally, in developing countries that export hydrocarbon, the misuse and inequitable distribution of the rents from energy trade can itself be a driver of discontent, domestic instability, and violence, which are all threats to domestic energy markets, private investment flows, and infrastructure. Squandering valuable resource revenues may also result in disinvestment in the very energy production facilities that brought financial riches, ultimately threatening the pace and sustainability of domestic energy resource development.

ENHANCING ENERGY SECURITY IN THE DEVELOPING WORLD

Reducing Vulnerability to External Shocks: Fuel and Source Diversity.

Reducing vulnerability to external shocks through diversifying fuel types and sources is akin to the portfolio diversification well known to investors. Countries thus need to not only evaluate the security of individual supply chains, but also the riskiness of their energy supply portfolio against the vagaries of energy markets. Governments also need to avoid a false sense of security through ill-advised domestic ventures, such as maintaining inefficient local refineries based on imported oil feedstock in preference to rationalized fuel products procurement in regional markets. The contribution of new and renewable resources is also increasingly seen from an energy security perspective. Recent work extending modern portfolio theory to renewables shows that the reduction in risk through the introduction of a modest amount of renewables often outweighs the direct costs of even non-least-cost renewable sources. Significantly, these same analyses indicate that the optimal proportion of renewables is higher than current levels of deployment in many countries.

Moderating End-Use Energy Requirements: Increasing Supply- and Demand-Side Energy Efficiency.

It is clear that the developing world will need to increase its energy consumption to meet economic and social development needs. Nevertheless, energy is typically produced, transported, and used inefficiently in both emerging and transition economies—with, for instance, ratios of gross energy use to economic output (energy/GDP) in some of the former Soviet republics being some 5–10 times higher than in Western Europe and Japan. Globally, it has been estimated that the developing countries could improve their energy efficiency by 10–30 percent, given the right set of policy and market incentives. Such "win-win" energy efficiency measures could reduce energy demand growth at no loss of useful energy services, and free up economic resources in the process. Moderating end-use energy requirements allows a higher proportion of needs to be secured through domestic and renewable sources, and the corresponding reductions in energy imports normally enhance energy security.[4]

Reducing Energy Infrastructure Vulnerability: Distributed Energy.

Centralized energy infrastructure efficiently exploits economies of scale in construction and operation, and when adequately designed and maintained, it has compiled an enviable record of technical reliability and environmental compliance. However, large-scale centralized facilities are also perceived to be vulnerable to large-scale catastrophe and loss. In addition, technological change is redefining the scale at which efficiency and economy can be captured—initially in the form of combined-cycle gas turbines, but in the longer term through efficient microturbines, fuel cells, and sunlight-to-electricity converters as complements to large central facilities.– In parallel, these distributed energy resources provide inherent security advantages through their modularity and geographic diversity. The effect is similar to that overtaking mainframe computers and dedicated communication tie-ups; these are increasingly by-passed by distributed microcomputers linked by the Internet. In this connection, it is interesting to recall that the Internet itself was initially developed as a fault-tolerant, distributed network to provide highly secure communications.

Reducing Political and Social Divisions: Promoting Good Governance and Equitable Energy Sector Rent Distribution.

Mismanagement of energy resources and their uses is a contributor to impoverishment and inequity that breeds unrest and violence and ultimately threatens sustainable energy delivery. This vicious circle takes many forms, including draining of government resources for health, education, and welfare that go instead to subsidize inefficient parastatal energy monopolies;[5] capture of benefits by urban elites at the expense of energy-poor rural or periurban populations, who also may be the hosts of disruptive energy resource extraction; and dissipation of energy-generated rents through corruption and diversion for private gains.

[4] Note that from an energy security viewpoint, countries can become overreliant on a single domestic resource, as shown by the experiences through recent droughts of highly hydro-dependent economies like Brazil, Ghana, Zimbabwe, Kenya, and Colombia.

[5] Subsidies by state governments to state-owned utilities in India, many of whom are politically compelled to sell electricity to the rural sector at fractions of economic cost, amounted to double their level of expenditures on health, half of their expenditures on education, and three times their expenditures on water supply.

INTERLINKAGES AND SYNERGIES

Although in some cases there are tradeoffs, in many cases there are clear synergies between the three principal themes of this paper. A number of the interlinkages have been alluded to earlier, but they warrant restatement and summary.

Between Climate Change and Economic Growth or Poverty

- In developing countries, where human activities are already close to the margin of tolerance for current variations in climate, the impacts of the projected changes are expected to be far reaching, adversely affecting the poorest of the poor. Changes in temperature could have a devastating impact on agricultural output, with attendant consequences for food security. Similarly, changes in precipitation patterns associated with climate change could adversely affect the availability and quality of water, especially in areas where scarcity is already a problem, or sea level rise could displace millions of people living in low-lying areas. Preparing for climate change, and indeed for current climate variability (for instance, storms, floods), is therefore inextricably linked to sustainable poverty reduction.[6]

- Many technologies that represent appropriate means to provide energy services to the rural poor also provide climate change benefits. The toehold represented by these early markets can provide a basis for market expansion, cost reduction, and capacity building for sustainable energy technologies. In addition, the new distributed service delivery means can be provided by a greater number of enterprises, thus promoting competition, private sector entry, and income and employment creation.

- Off-grid renewables (such as wind and solar energy) are often the least-cost option for providing energy services to rural populations. Compared with more expensive options, such as grid extension to dispersed populations, they thus have financial advantages for both rural communities and central governments.

- Poverty reduction measures, such as the dissemination of improved biomass cook-stoves, reduce the time, effort, and expenditure devoted to household fuel supply; lessen exposure to indoor air pollution; mitigate GHG emissions associated with biomass combustion; and decrease pressures on carbon-fixing woodlands.

- Flows of investment and technology motivated by climate change (for example, through the CDM) provide economic surpluses in the form of carbon offset rents, air quality improvements, and other sustainable development benefits to the host partner countries.

Between Climate Change and Energy Security

- Energy efficiency gains, as part of a least-cost climate change abatement strategy, simultaneously reduce energy import requirements and enhance the entry of domestically based substitutes like renewables.

- Shifts to smaller-scale and distributed technologies can be an integral part of an energy security policy based on energy portfolio diversity.

- Many emerging and environmentally beneficial technologies are modular and naturally adapted to distributed energy markets. They enjoy inherent advantages in terms of lower vulnerability to natural and man-made disruptions, including those engendered by climate change itself (e.g., changed rainfall patterns that affect hydro availability and pumping demand, or the potential for increased storm amplitude and frequency).

Between Economic Growth or Poverty and Energy Security

- Public resources are usually inadequate to finance the investments needed to meet the energy needs of the poor. Furthermore, the poor are usually the most vulnerable to the shocks provoked by energy market instabilities because energy already accounts for a high share of their meager cash income, and government social programs that benefit the poor tend to be cut back at times of fiscal stress.

- Lack of efficient energy services to fuel development, poor sector governance, the drain on public resources by poorly targeted energy subsidies, and support to loss-making monopoly energy enterprises are all part of a downward spiral that breeds domestic instability. The results may ultimately rebound as threats to domestic

[6] Key parties needing to prepare include farmers, water supply and coastal zone managers, and urban planners.

energy infrastructure and regional energy market integration. In hydrocarbon-rich developing economies, mismanagement and diversion of energy sector rents serve to exacerbate inequalities and domestic tensions.

ELEMENTS OF WORLD BANK GROUP (WBG) STRATEGY

The WBG has been active in the energy sector for five decades. For a long period, around 25 percent of total investment lending by the World Bank was in the energy sector. Recently however, this proportion has fallen to below 10 percent, despite the clear needs noted in this paper. This change reflects a process, which started in the early 1990s, to bring and keep the World Bank's policies for its energy practice in line with two separate major trends in its operational strategy.

First, recognizing the overall assessment of failure of the public sector to deliver sustainable energy and other services, the 1993 WBG energy policy paper[7] oriented activities toward the liberalization and privatization of infrastructure markets under a sound regulatory framework, which involved a move away from the traditional, integrated, state-owned monopolies whose development the World Bank had previously supported. It also oriented the International Finance Corporation (IFC) and the Multilateral Investment Guarantee Agency (MIGA) to expand their energy sector activities toward a greater penetration and use of private investment flows. The World Bank would therefore support countries to improve sector performance in line with sound commercial practice and regulation, and with appropriate roles for competition and private participation. This policy was further developed in 1996, with the publication of a document on the World Bank's approach to rural energy,[8] and in 2000, when another document[9] set out the World Bank's strategy for the energy sector and the environment.

Second, the WBG reiterated its focus on poverty reduction and sustainable development from the late 1990s onward.[10] Its revised strategy—Energy *Program for Poverty Reduction, Sustainability, and Selectivity*—was presented to the WBG Board of Executive Directors in May 2001 and is focused on ways in which the WBG can use its comparative advantages to exploit the linkages between energy, poverty reduction, and sustainable development. The following summarizes the vision to which we are committed.

The Energy Business Renewal Strategy

The WBG envisages a transition from traditional to modern energy use for poor households that will go hand in hand with (1) efficient and environmentally sustainable supply and use of energy, (2) increased choices of energy services for consumers, and (3) macroeconomic and fiscal stability. In the World Bank's vision, these anticipated outcomes will reinforce the benefits obtained from each of them. They will also directly contribute to poverty alleviation by generating productivity gains that will in turn expand economic opportunities for the poor through increased employment opportunities, and better access to communications, health care, and education. These outcomes will also markedly improve living conditions through better home illumination; energy for health clinics, immunization facilities, and schools; cleaner fuels for indoor cooking and heating; and reduced local and global emissions.

The WBG also envisages that efficient supply and use of energy would improve the economic growth of developing countries by means of the following benefits:

- Consumers would no longer experience frequent and prolonged shortages of liquid fuels and power cuts.
- Industrial enterprises would have a choice of suppliers providing reliable energy services.
- Private ownership and financing would play a dominant role in the energy sector and enable scale-up of investments in sustainable energy services.
- Regulators operating in an objective, transparent, and nondiscriminatory manner would oversee natural monopolies and promote competition in the energy sector. The average CO2 emission intensity of energy production would be reduced from present levels.
- The average energy consumption per unit of GDP would be reduced from present levels.

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[7] World Bank. 1993. *The World Bank's Role in the Electric Power Sector—Policies for Effective Institutional, Regulatory, and Financial Reform* World Bank: Washington, D.C. The same year also saw the publication of a policy paper on energy efficiency and conservation.

[8] World Bank. 1996. *Rural Energy and Development—Improving Energy Supplies for Two Billion People*. Washington, D.C.: World Bank.

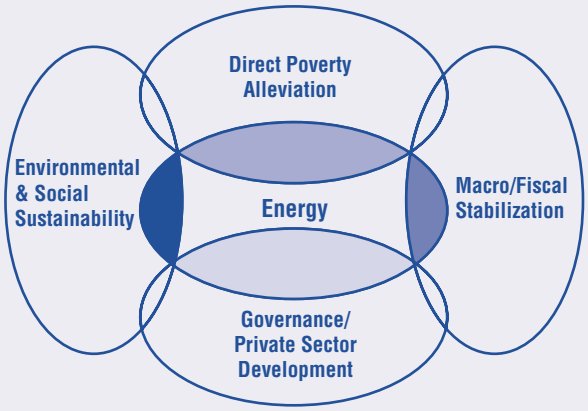
[9] World Bank. 2000. Fuel for Thought: An Environmental Strategy for the Energy Sector. Washington, D.C.: World Bank.

[10] The Comprehensive Development Framework first articulated in 1999 seeks a better balance in policymaking by highlighting the interdependence of all elements of development—social, structural, human, governance, environmental, economic, and financial—and has led to the development of Poverty Reduction Strategy Papers (PRSPs). See http://www.worldbank.org/poverty/strategies/overview.htm#intro.

Realizing the Vision: Four Business Lines

The Energy Business Renewal Strategy is anchored on four business areas (Figure 2: (1) activities that will have a direct impact on poverty reduction; (2) those that will help the contribution of the energy sector to the macroeconomic and fiscal stability of economies; (3) those that will enhance market development, governance, and the participation of the private sector; and (4) those that will ensure the environmental and social sustainability of energy services and uses. Business lines best left to others are investments that do not have a direct, positive impact on any of these four major areas, even if they add capacity, upgrade existing production and delivery facilities (except post-conflict or post-disaster reconstruction), or improve utility operating practices. The strategy proposes that financing, capacity building, advice, and knowledge transfer should be combined to produce the maximum impact.

Figure 2. The WBG Energy Renewal Strategy



Box 1. The WBG's Energy Business Lines

The WBG implements its energy business lines by the following means:

Helping the poor directly by

- facilitating access to modern fuels and electricity
- reducing the cost and improving the quality of energy supplied to low-income households
- ensuring that energy subsidies are targeted at and reach the poor
- promoting energy-efficient, less polluting end-use technologies for traditional fuels
- creating energy service enterprises run by the poor
- supporting energy needed for social services (education, communication, health).

Improving macroeconomic/fiscal balances by

- rationalizing energy taxes
- replacing public investments by private ones
- managing risks associated with contingent public liabilities
- closing loss-making coal mines and oil refineries and financing restructuring costs that fall on government budgets
- enhancing effective payment by all energy users to eliminate operating subsidies to state-owned enterprises
- improving procurement and marketing of imported and exported energy products.

Promoting good governance and private sector development by

- creating objective, transparent, nondiscriminatory regulatory mechanisms
- introducing and expanding competition and cross-border trade
- divesting assets to strategic investors and regulatory markets in a socially responsible and corruption-free way
- catalyzing private investments by liberalizing entry to energy markets
- strengthening the voice of consumers and communities
- strengthening local financial institutions to provide long-term financing for rural energy business.

Protecting the environment by

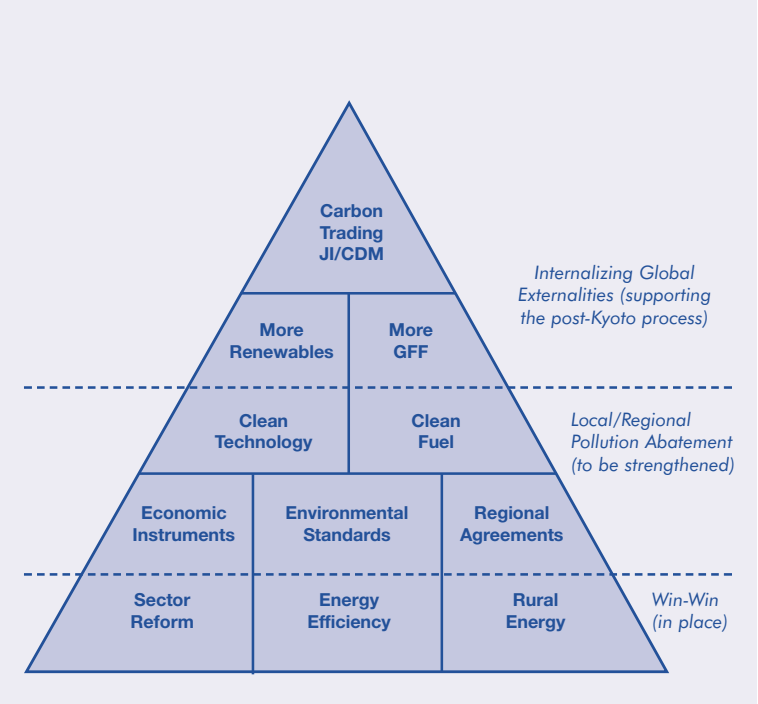
- promoting clean transport fuels and switching from coal to gas
- facilitating environmentally sustainable extraction, production, processing, transport, and distribution of oil, gas, and coal
- strengthening environmental management capacity in the energy sector
- internalizing the cost of environmental degradation as a key economic instrument tied to environmental standards and regional agreements
- removing market and regulatory barriers to renewables and energy efficiency investments for power and also for biomass (e.g., improved cooking stoves for the poor)
- reducing gas flaring and facilitating carbon trading and joint investments to reduce GHG emissions

ENERGY AND ENVIRONMENT STRATEGY

Fuel for Thought: An Environmental Strategy for the Energy Sector identifies three principles to guide the WBG's work on energy and environment: (1) creating a framework for environmentally sound energy development, (2) addressing local and regional environmental impacts, and (3) helping to tackle global climate change. To ensure that these principles become an integral part of the WBG's general business, the sector strategy argues that the Bank Group must (1) do more work further upstream in the project cycle; (2) identify how to bring new methods and technologies into the mainstream of lending operations; (3) improve standards of analysis of pollution problems, particularly better monitoring of projects and communicating the results more effectively; (d) strengthen its capabilities to help address the new challenges of climate change; (e) build new strategic partnerships; and (f) deepen its own skills (Figure 3).

The Energy Business Renewal Strategy draws heavily on the intellectual underpinning provided by *Fuel for Thought* in the energy and environment area. Combined with the growth in the Bank's energy-environmental portfolio (energy and environment now constitutes more than 25 percent of the Bank's energy business, and some 69 percent of Bank energy projects address specific environmental objectives.), these trends are a clear indicator of mainstreaming progress.

Figure 3. Fuel for Thought: Energy and Environment Linkages



THE WORLD BANK GROUP AND RENEWABLE ENERGY

Renewable energy has a special significance for abating global GHG emissions, as the IPCC and other assessments demonstrate that long-run climate stabilization cannot be attained without a large-scale shift to low- and no-carbon energy forms. However, the role of renewable and other alternative energies in the WBG's work in the energy sector is linked to all four of its core business lines. Renewables are often the least-cost solution for off-grid electrification. There are cases where renewables may make a significant contribution to macroeconomic and fiscal balances by substituting for conventional energy. And a country's desire to develop its indigenous renewable resources can also be a driver for promoting good governance of the energy sector.

Renewables now represent a significant proportion of the WBG's energy work. As of mid-2001, the World Bank's loan portfolio consisted of 26 active investment projects for the development and use of renewable energy, representing about US$4 billion of investment costs and financing from the Bank of US$1,425 million, from the Global Environment Facility (GEF) of US$123 million, and from the Prototype Carbon Fund (PCF) of US$2 million. The IFC had US$162 million in investments on its own account, plus a further US$68 million in syndicated loans and US$70 million in GEF funding. MIGA had some 11 contracts outstanding for small hydro and geothermal projects. Looking forward, the WBG currently has 47 projects, at different stages of preparation, in 33 countries.

To accelerate the development of renewables, the WBG is working with clients and partners on a number of initiatives and financing facilities, which are described below. In addition, the World Bank has been involved in active policy dialogue with many client countries through sector reform loans and technical assistance activities. For countries engaging in sector reform, the Bank is assisting with the integration of renewables in energy laws, the preparation of rural and renewable energy strategies, and policy adjustments needed to create a level playing field for renewables.

The *Global Environment Facility (GEF)* is a global partnership in which the Bank has a key role as aan implementing agency as well as a trustee. The GEF helps finance activities that support sustainable measures that minimize climate change damage. These include removal of barriers to and reduction of implementation costs of commercial and near-commercial renewable energy technologies and

reductions in cost of prospective low GHG-emitting technologies—particularly renewables—that are not yet commercially viable. In its May 1999 meeting, the GEF Council endorsed the principles of a World Bank–GEF Strategic Partnership for Renewable Energy. The Strategic Partnership envisions shifting Bank and GEF efforts from an individual project approach to long-term, programmatic pathways, thus providing developing countries with the time and resources required to develop renewable energy markets and technologies in a comprehensive and sustainable way. As an interim target, the WBG proposes US$150 million annually in GEF resources under the partnership for renewable energy projects, leveraged at a minimum of 4:1 with WBG and other sources. To date, major multiyear programs have been approved in China and Uganda, and new strategic initiatives are in the design stage in India and Mexico.

Prototype Carbon Fund (PCF), a global public-private partnership capitalized with US$145 million in OECD government and private sector investment, is helping to accelerate learning about the carbon markets. The PCF supports projects designed to produce emission reductions fully consistent with the Kyoto Protocol and the emerging framework for Joint Implementation and the Clean Development Mechanism. PCF managers expect that the majority of funds will be used on renewable energy and energy efficiency projects identified from Bank, IFC, and third parties.

Energy Sector Management Assistance Programme (ESMAP), a multidonor partnership under the joint umbrella of the United Nations Development Programme (UNDP) and the World Bank and managed by the Bank, is a global technical assistance program that focuses on the role of energy in economic development with the objective of contributing to poverty reduction and economic development, improving living conditions, and preserving the environment. It has been particularly active in developing the intellectual basis for renewable energy investment and in testing new institutional and business models for the delivery of small-scale energy services.

Asia Alternative Energy Program (ASTAE) helps identify and implement commercially viable alternative energy projects and components for Bank lending in the East Asia and Pacific and South Asia regions of the Bank.

Africa Rural and Renewable Energy Initiative (AFRREI) is a multi year partnership with donors intended to help deal with the high transaction costs of rural and renewable energy projects in the Africa region of the Bank.

Specialized IFC-GEF funds, such as the Small and Medium-Scale Enterprise Program, the Photovoltaic Market Transformation Initiative (US$30 million, GEF), and the Renewable Energy and Energy Efficiency Fund (US$265 million in debt, equity, and GEF grant) are all targeted at the private sector interested in undertaking renewables projects, both off- and on-grid.

Solar Development Group (SDG), a WBG partnership with several bilateral donors, U.S. and European charitable foundations, and private sector investors, is aimed at private photovoltaic and PV-related business in developing countries. SDG consists of two related entities: the Solar Development Foundation, a not-for-profit organization offering business development and seed financing, and Solar Development Capital, a US$29 million for-profit private equity fund providing growth capital.

ENERGY, POVERTY REDUCTION, AND CLIMATE CHANGE: AN ACTION AGENDA

For a considerable time to come, access to fossil fuels in developing countries offers a considerable advancement over traditional fuels in terms of economic growth, health improvements, and cost-effectiveness for the world's poorest. The provision of energy for productive and social uses in developing countries must be a priority, and the lack of a cost-effective renewable option in the near term must not be a barrier to meeting these needs. But in many cases, especially in rural and distributed applications, renewable energy technologies—such as wind, solar, small hydro, and modern biomass—make eminent sense and are the least-cost option.

Going forward, the WBG and partners face a number of challenges to fulfill their energy access and environment mandates. As previously asserted in this paper, many paths to the achievement of these poverty reduction and environment goals will additionally reinforce energy security.

The first challenge is providing a framework for building private sector and entrepreneurial skills, which are often in short supply in client countries. Second, poor rural and peri-urban households have only limited capacity to invest and to service debt. There is limited international experience that can be called upon for developing financing and risk mitigation instruments that could best meet the needs of these populations. Third, there is a clear need to better integrate energy access and environmental considerations in the sector reform process.

THE ACTION AGENDA

The following action agenda for energy development assistance, based on the lessons of the WBG's experience to date, is proposed to promote sustainable energy-related outcomes that will support the broader mission of poverty reduction.

Energy Access

A key need is to integrate rural and periurban modern energy access into the energy sector reform dialogue. The private sector is the main engine for scaling up service provision, generating income in rural areas, attracting innovation, and promoting competition. Thus, as governments withdraw from the direct provision of energy services, it is critical to work toward removing barriers to entry while developing an enhanced environment for the private sector in providing energy solutions for the rural and peri-urban poor. Beyond this leveling of the playing field, evidence increasingly suggests that incentives will be required to motivate the private sector to invest in service provision to often remote and underdeveloped areas where the poor reside. Subsidies to enhance access should be well targeted at the poor and subsidize the capital costs of initial provision of service and not ongoing consumption and maintenance.

Productive/Social Uses

Energy assistance programs to the developing world need to be realigned around the theme of integrating energy services (with emphasis on lighting, motive power, telecommunications, heat supply, and modernized cooking) with income-generating and social uses to make the critical link to direct poverty reduction. This will imply expansion of energy applications identification efforts outside the energy sector and into other high-value social and productive sectors, such as education, health, water supply, communications, and agriculture/rural development.

Environment

Environmental concerns must be integrated into the energy sector reform dialogue. Despite the critical role of the private sector and civil society in minimizing the environmental impacts of energy production and use, governments must continue to play key roles by ensuring that appropriate environmental standards are set, monitored for compliance, and enforced through a combination of regulations, economic instruments (e.g. taxes and pollution charges), and market-based mechanisms. This will in turn require a strengthened environmental role for energy sector regulators, with concomitant needs for institutional strengthening and capacity building.

Technology Markets

The WBG is promoting market-pull and market aggregation mechanisms to facilitate market entry of new, more efficient, and less polluting technologies. Several support mechanisms being adopted in OECD countries (e.g., Renewable Portfolio Standards, Non-Fossil Fuel Obligations) offer alternatives to less sustainable practices in developing countries for promoting entry of new technologies.

Public-Private Partnerships

The WBG is expanding support for dedicated investment vehicles and new forms of public-private partnerships. A number of promising new public-private investment vehicles have recently been launched (e.g., the Renewable Energy/Energy Efficiency Fund) and should be supported in order to demonstrate their full potential. Facilities such as the SDG mobilize both "hard" capital for investment and "soft" concessional funds from governments and foundations to finance needed business development and business advisory assistance.

Global Carbon Markets

The WBG is promoting the development of an efficient and equitable international carbon market to finance energy efficiency and renewable energy technologies in developing countries. In particular, there is a need to establish appropriate project certification and emissions verification rules for the CDM that are consistent with the requirements of assessing multiple installations of small-scale or distributed energy systems.

PLAYERS AND ROLES

The magnitude of the poverty and sustainable energy challenge requires bringing new skills and resources to bear from a variety of actors. Envisioned roles are outlined in Table 3.

CONCLUSION

Until recently, energy for development, energy security, and climate change have been pursued as separate themes, each attracting its own constituencies. However, as this paper has attempted to illustrate, there are many points of intersection between the three agendas, and the case for each can be strengthened through reference to the others. For example, energy security provides an important rationale for actions that, through fuel diversification, form the starting point for moderating growth in GHG emissions and combating climate change. Remote areas in the developing world, where provision of conventional energy services is expensive or simply unavailable, are among the most feasible early market opportunities for renewable energy as a key class of technologies for climate change mitigation. A growing number of geopolitical analysts are pointing out the linkages between underdevelopment, domestic unrest, and global security; misallocation of energy resources can be an important contributor to a lack of economic opportunity and disenchantment.

Developing countries have long been aware of the relationships, and have a more acute daily awareness of the interdependencies. Developing and transition economies have a different concept of energy security from that in the industrialized world, and it is fundamentally grounded in the implications for development of the macroeconomic and fiscal consequences of volatile energy markets (for energy importers and exporters alike). Added to this top-level worry are perceptions of a dependence (or overdependence) on imported energy technologies, as well as concerns about the vulnerability of energy systems to natural disasters (floods, droughts, earthquakes, storms) and man-made calamities (regional conflicts, poor management, corruption). Finally, many poor developing countries already believe that they are beginning to suffer the early effects of changing climate driven by energy-related emissions, and thus they already think of climate change as closely linked to development sustainability. Energy security can be enhanced in the developing world by:

- lowering the vulnerability to external shocks through fuel and source diversification
- reducing the need for net additions to energy supplies through supply- and demand-side energy efficiency measures
- lessening energy infrastructure risks through distributed energy systems
- reducing political and social divisions through good governance and equitable energy sector rent distribution.

Through the Energy Business Renewal Strategy, energy access and environmental sustainability are now established as cornerstones of WBG energy development assistance. Going forward, the World Bank Group and its partners face a number of challenges to fulfill these mandates that will, in addition, reinforce energy security. The WBG looks forward to continuing and extending its partnerships in these important areas of mutual interest.

Table 3. The WBG's Energy Business Lines

Players	*Emerging roles*
Governments	• Liberalizer of energy markets • Policymaker and regulator
Consultants and advisers	• Providers of technical expertise • Generators of knowledge
Consumers	• Greater say in the development of energy markets • Arbiters of energy service quality
Strategic investors	• Mobilizers of investment resources for private supply of energy services • Key actors for developing competition in energy markets • Catalysts for developing domestic capital markets
Multilaterals and bilaterals	Focus on comparative advantages: • World Bank on sector policy reforms and macro/fiscal stability • Regional multilaterals on project lending • Bilaterals on supporting public interventions
NGOs	• Advocates for disadvantaged groups • Promoters of public policy issues • Supporters of alternative strategies for meeting energy policy objectives • Data gathering and empirical analysis
Equipment suppliers and entrepreneurs	• Technology innovators • Partners with strategic investors

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