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Comments may be submitted to energystrategy@adb.org by 27 July 2007.

Asian Development Bank

ABBREVIATIONS

ADB	–	Asian Development Bank
CO ₂	–	Carbon dioxide
CNG	–	Compressed natural gas
DIS	–	Deferred Investment Scenario
DMC	–	developing member country
ESCO	–	energy service company
EBRD	–	European Bank for Reconstruction and Development
GDP	–	gross domestic product
GHG	–	greenhouse gas
IEA	–	International Energy Agency
IPCC	–	Intergovernmental Panel on Climate Change
LNG	–	liquefied natural gas
LPG	–	liquefied petroleum gas
MDB	–	multilateral development bank
MDG	–	Millennium Development Goals
MTS II	–	Medium-Term Strategy II
OECD	–	Organisation for Economic Co-operation and Development
OED	–	Operations Evaluation Department
PDMC	–	Pacific developing member country
PRC	–	People's Republic of China
RE	–	renewable energy
R&D	–	research and development
WAPS	–	world alternate policy scenario
WEO	–	World Energy Outlook

WEIGHTS AND MEASURES

btoe	–	billion tons of oil equivalent
mtoe	–	million tons of oil equivalent
TWh	–	tera watt hour

NOTE

In this report, "\$" refers to US dollars.

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INTRODUCTION

The energy demand in Asia and the Pacific region is increasing rapidly due to the unprecedented economic growth in the region. According to the International Energy Agency, primary energy demand in the developing Asia will grow from 2.9 billion tons of oil equivalent (btoe) in 2004 to 5.8 btoe in 2030. This growth is not sustainable if most of this energy will have to be met by fossil fuels. Increased fossil fuel consumption will significantly increase greenhouse gas (GHG) emissions and result in dangerous levels of global warming.

It is widely known that the global warming is caused by increased GHG emissions largely from the excessive use of fossil fuels. Significant changes in climate behavior are being observed, some of which have serious consequences worldwide. With better understanding of this phenomenon, many economies have adopted policies to reduce the projected energy demand, however, much more needs to be done to reverse the current trend of GHG emissions.

The volatility of international oil prices places an extra and disproportionate burden on developing countries. Oil supply and price instability have led to increased focus on energy security, reduced oil consumption and subsidies, and promoted use of indigenous sources of energy. For these measures to be successful, a comprehensive and coordinated approach is necessary. This encompasses policy decisions, legal and regulatory framework, energy conservation and efficiency, reduction in fossil fuel use, increase in use of renewable sources of energy, and market orientation towards sustainable development.

For Asia and the Pacific region, there are other compelling issues that also merit attention, namely, the increasing energy demand and providing access to modern forms of energy to all. At present, about one billion people in the region do not have such access.

From the outset, the Asian Development Bank's (ADB) interventions in the energy sector have been geared towards addressing the changing needs of the sector. Initially, the focus was on assisting capacity addition programs in the electricity subsector. Interventions were also made in the oil and gas subsectors, largely limited to sustainable development such as gas flaring reduction, installation of gas pipelines, and hydrocarbon management. Subsequently, ADB shifted its focus to energy sector reforms, governance, and efficiency improvement.

ADB's energy sector operations have been evaluated as appropriate, timely, and generally successful. Building on previous experience, coupled with the regional sector knowledge, the new energy strategy will focus on addressing the challenges the sector faces today: meeting energy security and transition to a low carbon economy toward achieving the ADB's overarching poverty reduction objective. The strategy will build upon three key pillars: (i) meeting the energy demand in a sustainable way, (ii) providing modern energy access to all, and (iii) addressing sector reforms and governance.

This paper provides an overview of the issues involved in the sector, the options available, financing needs and ADB's Energy Strategy.

I. BACKGROUND

1. The Asian Development Bank (ADB) has been involved in the energy sector of its developing member countries (DMCs) since 1969. The first Energy Policy,¹ issued in 1981, focused on overcoming the crisis caused by the oil price shocks and placed considerable emphasis on the development of energy infrastructure and indigenous energy sources, promoting efficiency, and creating markets conducive to foreign investments in DMCs. The second Energy Policy² paper, released in 1995, noted that with increased investments, the power sectors of the DMCs were becoming unmanageable and inefficient mainly due to the dual role of the government, both as a policy maker and monopoly owner. This paper recognized the changing needs of the sector and recommended balanced infrastructure investment and development of financially robust and efficient sector operations. It suggested full recovery of costs, reduction of subsidies, establishment of independent regulatory mechanisms, and tariff fixation based on transparent tariff principles. The paper further recommended corporatization and commercialization of government-owned utilities, entry of the private sector through a variety of routes, and development of regional trade in energy. Other recommendations included enhanced focus on demand side management, environmental protection, rural electrification, and renewable energy (RE) development

2. The Energy Policy was reviewed in 2000.³ This review confirmed that the existing framework was appropriate and sound. However, taking into consideration ADB's revised operational priorities and changing needs of the DMCs, the review recommended the development of independently regulated and privatized energy markets which would lead to more efficient uses of energy, lower costs, and increased private investments. The recommendations encouraged more emphasis on (i) reducing poverty by creating energy infrastructure for sustainable economic growth, and increasing access to energy for the poor, particularly in rural areas; (ii) increasing private sector involvement by restructuring the energy sector and creating an enabling environment for private investors; (iii) addressing regional/global environmental impacts, especially acid rain problems, supporting clean energy and the Kyoto Protocol⁴ mechanisms for greenhouse gas (GHG) abatement, and financing RE projects; and (iv) promoting regional cooperation. Within the framework of these basic principles, the 2000 Review supported a wide range of initiatives such as power sector restructuring, private sector participation, social development, subsidy rationalization, sector governance, information technology, environmental protection, energy efficiency, and capacity building. The 2000 Review further called for a reassessment after 5 years. ADB has reviewed the 1995 energy policy and its 2000 Review as per priorities established under Medium Term Strategy II (MTS II).

¹ ADB. 1981. Role of the Bank in the Energy Sector in the Region. *Working Paper No. 2*. Manila.

² ADB. 1995. *Bank Policy for the Energy Sector*. Manila.

³ ADB. 2000. *Energy 2000: Review of Energy Policy*. Manila.

⁴ The United Nations Framework Convention on Climate Change (UNFCCC) established in the Conference of Parties (COP) as its supreme body with the responsibility to oversee the progress toward the aim of the Convention. At the first session of the COP in Berlin, Germany, it was decided that post-2000 commitments would only be set for Annex I Parties. During the third COP in Kyoto, Japan, a legally binding set of obligations for 38 industrialized countries and 11 countries in Central and Eastern Europe was created to return their emissions of GHG to an average of approximately 5.2% below their 1990 levels over the commitment period 2008–2012. This is called the Kyoto Protocol to the Convention.

II. CHANGING CONTEXT

A. Energy Demand Outlook

3. The world's primary energy demand⁵ is projected to increase by more than 53% from current levels to 2030, an annual average growth of about 1.7%. In 2030, the total energy demand will be 17 billion tons of oil equivalent (btoe). This is based on a scenario wherein it is assumed that no further government policies are introduced beyond those adopted by mid-2005. This scenario, prepared by the International Energy Agency (IEA) and referred to as the Reference Scenario, suggests that more than two-thirds of the increase in world energy use will come from developing countries where economic and population growth rates will continue to be significant. Fossil fuels will account for more than 83% of the projected increase in primary energy demand of which oil will continue to remain the major component of the primary energy mix. Natural gas demand will grow mainly due to increased preference for gas-based electricity generation. However, coal will continue to be the predominant source for electricity generation. Shares of nuclear power and hydropower will remain generally constant at 5% and 2.3%, respectively. The share of biomass-based energy consumption is expected to actually reduce due to increased use of modern fuels in rural regions of developing countries. The share of other renewable sources, excluding large hydro and biomass, will be about 6.6% of the global primary energy demand in 2030.

Table 1: World Primary Energy Demand in the Reference Scenario (mtoe)

Sector	1980	2004	2010	2015	2030	2030 share	2004–2030 ^a
Coal	1,785	2,773	3,354	3,666	4,441	25.9%	1.8%
Oil	3,107	3,940	4,366	4,750	5,575	32.6%	1.3%
Gas	1,287	2,302	2,686	3,017	3,869	22.6%	2.9%
Nuclear	186	714	775	810	861	5.0%	0.7%
Hydro	148	242	280	317	408	2.9%	2.0%
Biomass and waste	765	1,176	1,283	1,375	1,645	9.6%	1.3%
Other renewables	33	57	99	136	296	1.9%	6.6%
Total	7,261	11,204	12,389	14,402	17,095	100%	1.6%

^a Average annual growth rate.

Source: International Energy Agency, World Energy Outlook 2006.

4. The world's energy resources are adequate to meet the projected growth in energy demand as indicated in the Reference Scenario, but these sources are not evenly distributed geographically. A large portion of the increased projected demand will be attributable to the emerging economies, mainly in the People's Republic of China (PRC) and India. Investments of over \$20 trillion will be required worldwide. Coupled with this large investment is the projected increase in GHG emissions.⁶ Clearly, these demand projections have unsustainable implications on the environment. Another issue that merits consideration is the implications if adequate investments are not made by the oil producing countries. The market will also be impacted by

⁵ International Energy Agency. 2006. *World Energy Outlook 2006*. Paris.

⁶ Energy-related carbon dioxide emissions are estimated to be 52% higher in 2030 than in 2003.

the likely changes in oil use policies by the oil consuming countries. To assess these risks, the IEA developed two other likely scenarios: a world alternative policy scenario (WAPS) and a deferred investment scenario (DIS).⁷

Table 2: World Primary Energy Demand in 2030 under Various Scenarios
(mtoe)

Sector	Reference Scenario	Alternative Scenario	Deferred Investment Scenario^a
Coal	4,441	3,512	3,551
Oil	5,575	4,995	5,068
Gas	3,869	3,370	3,639
Nuclear	861	1,070	772
Hydro	408	422	369
Biomass and waste	1,645	1,703	1,690
Other renewables	296	373	278
Total Global Energy Demand	17,095	15,405	15,367

^a World Energy Outlook 2005.

Source: IEA. 2006. World Energy Outlook 2006. Paris.

5. The WAPS takes into consideration the benefits of adopting new policies that are being considered by oil consuming countries; these include reducing demand, change in fuel use pattern to address the problems related to high oil prices, and environmental mitigation and energy security objectives. Under this scenario, demand growth for oil and gas will be lower; carbon dioxide (CO₂) emissions will be less than the levels projected under the Reference Scenario, but the increase will still be about 30% by 2030. Under the WAPS, the proposed government policies primarily address energy security and environmental concerns. As a result, in 2030, global energy demand will be 10% less than as estimated under the Reference Scenario. Oil and gas demand will also be 10% less. Coal use will fall by 23%. The reduction in coal use will be mainly due to lower power generation demand and use of more efficient technologies. The share of renewables, excluding biomass, will be higher than the Reference Scenario by 26%. The DIS assumes that investments by the oil producing countries will be deferred for whatever reason, which could result in further increase in oil prices, reduced demand, and uncertainties. World energy demand will be reduced by about 900 mtoe when compared to the Reference Scenario. Oil and gas production will fall by 30% and 46% respectively in 2030. Higher oil prices will encourage improvements in end-use efficiency and faster development of biofuels. In case of other sectors, demand under DIS will generally be the same as that projected under the Reference Scenario.

6. In developing Asia⁸, the projected primary energy demand is expected to grow from 2,916 mtoe to 5,796 mtoe with PRC and India accounting for a major share. Much of the increase in energy demand will be due to the projected rapid economic and population growths. Industrialization, urbanization, and the replacement of noncommercial biomass by commercial fuels will also contribute to the increase in demand. Other factors will be increased economic activities, improved living standards, and increased consumption by households. A review of the

⁷ International Energy Agency. 2005. World Energy Outlook 2005. Paris.

⁸ Developing Asia include Afghanistan, Bangladesh, Bhutan, Brunei, Cambodia, Fiji, French Polynesia, India, Indonesia, Kiribati, Democratic People's Republic of Korea, Lao PDR, Macau, Malaysia, Maldives, Mongolia, Myanmar, Nepal, New Caledonia, Pakistan, Papua New Guinea, Philippines, PRC, Samoa, Singapore, Solomon Islands, Sri Lanka, Thailand, Tonga, Taipei, China, Viet Nam, and Vanuatu.

demand trends in developing Asia, according to fuel types, shows that coal will continue to dominate with a share of 47% in 2030, followed by oil at 25.6% and natural gas at 9%, compared to 45%, 24.5%, and 7%, respectively in 2004. Oil demand is dominated by the PRC, where the demand will rise to 15 million barrels per day (mbd) in 2030 compared to the total Asian oil demand of about 29 mbd in 2030. Electricity demand will grow the fastest in India at 5.4% per year during 2004–2030, followed by the PRC at 4.9% per year. Developing Asia will account for more than three-fourths of the increase in coal-fired generation over the period. The PRC will account for 55%, India 15%, and the rest of Asia, 7%. Hydropower output is projected to increase in developing Asia, as most of the potential is yet to be exploited. Of the \$20 trillion investments required world wide for the energy sector, developing Asia will account for more than \$6 trillion. PRC alone will need about \$3.7 trillion in investments.

B. Energy Security

7. Recent volatility in the energy market, especially the oil market, has encouraged oil importing countries to address the need for a comprehensive approach to energy security concerns including short-term risks to economic growth. Many economies in the Asia and Pacific region are experiencing high economic growth rates which encourage increased energy consumption. Energy, mainly oil, is a significant import component with supply sources restricted to the politically volatile Middle Eastern region. Since energy independence is not likely, there is a need to explore long term cooperative options at the international level to ensure production and use of energy within reasonable costs and in a sustainable manner. Extensive use of fossil fuels generate larger volumes of greenhouse gases. Recent studies⁹ suggest certain steps to address energy security, the first of which is to reduce energy consumption by aggressively pursuing efficient use of energy. This can be achieved to various degrees by improved efficiency of vehicles, improved urban planning, increased use of new and renewable sources of energy, adopting alternate fuels, and placing greater emphasis on demand side management. The second option is diversifying energy portfolio, including facilitating international trade, cross border investments, transparency, and cooperative commercialization. Another challenge is managing market volatility; maintaining reserve stock is an option but it is useful for only a limited duration. The challenges in addressing energy security are numerous, and hence there is a need for an appropriate macroeconomic policy framework that focuses on comprehensive plans to mitigate energy supply risks.

C. Climate Change

8. There is greater recognition that the threat of climate change is real and increasing. The continuing and accelerating emissions of GHG, and its close link to average global temperature, are likely to result in significant changes in mean climate and its intraseasonal and interannual variability, both globally and in Asia. GHG emissions are, for the most part, the product of human activities, primarily from the burning of fossil fuels and to a relatively smaller extent, from the changes in land-use especially deforestation. The equilibrium that existed for several centuries between various sources and sinks of CO₂ has been considerably disturbed because of industrialization, urbanization and the four-folds increase in world population in the 20th century. Climate models predict that land regions of Asia will experience an annual mean warming of about 3°C in the decades of the 2050s and up to 5°C in the decade of the 2080s as a result of future increases in atmospheric concentration of GHG¹⁰.

⁹ Energy Security Issues. 2005. The World Bank: Washington, DC.

¹⁰ United Nations Environment Programme and World Meteorological Organization. 2007. Intergovernmental Panel on Climate Change. *Climate Change 2007: The Physical Science Basis. Summary for Policymakers*. Geneva.

9. The impacts of rapid climate change are expected to be profound in Asia and the Pacific region. From the Himalayan highlands to the rich tropical forests of Southeast Asia, and the Pacific Islands, many natural ecosystems are vulnerable to climate change and some will most likely be irreversibly damaged. The poorest people within the large populations of both sub-Saharan Africa and South Asia are most vulnerable to the effects of climate change.¹¹ Scientists have observed abnormal weather patterns recently, including more intense tropical storms, more severe and frequent droughts and floods, accelerated melting of glaciers and rises in sea level, higher frequency of forest fires, shortage of freshwater, threatened crop production and aquaculture, higher incidence of heat-related and infectious diseases, enhanced risk of loss of life and properties, among others. Global economic damage from the negative impacts of climate change is projected by the insurance industry at hundreds of billions of dollars each year. The Intergovernmental Panel on Climate Change (IPCC) estimates that if atmospheric CO₂ concentrations were to double from pre-industrial levels, the average global warming is likely to be in the range of 2 to 4.5 degrees Celsius (°C), and the “developing countries are expected to experience larger percentage losses, global mean losses could be 1-5% GDP for 4 °C of warming.”¹² These would severely hinder long-term global and regional efforts to create a more healthy, prosperous and sustainable world.

10. The international community has been calling for drastic measures that would significantly reduce and stabilize the concentration of GHG levels in the atmosphere. Some of the options identified are to take global measures on transforming the way energy is used; promoting research and development; financing the transition to cleaner energy; managing the impact of climate change; and tackling illegal logging. The present predicament is not due to recent developments but the continuous unsustainable use of energy for many decades. With significant economic growth of the emerging economies, energy use will continue to increase briskly unless significant mitigation measures are taken. There is a need for collective global action. The world must strive to achieve a scenario better than IEA’s WAPS to control CO₂ emissions.

11. Recent studies¹³ show that CO₂ emissions can be maintained at today’s level of around 400 parts per million, as long as there are firm policy decisions. The first step is energy conservation and efficiency. Options are numerous. In 2002, oil accounted for about 43% of global carbon emissions, coal for 37%, and natural gas accounted for the remainder. Most of the oil consumption was for transportation. Hence, efficiency in transportation is clearly a priority area. Manufacture and use of more efficient vehicles, biofuel development, and improved urban planning can mitigate the production of GHG to a large extent. Improved efficiency in coal fired electricity generation and opting for alternate cleaner sources will reduce carbon emissions significantly. Residential and commercial buildings account for a significant component of electricity demand today. Efficient lighting, space heating and cooling equipment, and other efficient appliances will address energy efficiency and conservation to a large extent. Industrial energy use also needs to be made more efficient. Other options for stabilizing carbon levels include improving power systems efficiency, both on the supply and demand sides, harnessing alternate sources of clean energy, developing nuclear power development, and exploring long term options like carbon capture and storage.

¹¹ Stern Review: The Economics of Climate Change (2006), p. 55.

¹² United Nations Environment Programme and World Meteorological Organization. 2007, Intergovernmental Panel on Climate Change. *Climate Change 2007: Impacts, Adaptation and Vulnerability*

¹³ Socolow, R, and S. Pacala. 2006. *A Plan to Keep Carbon in Check*. Scientific American. September. New York.

12. Many countries have announced policies to address global warming issues. Implementing these would be a challenge. Substantial efforts will be needed from both the developed and developing world. All countries need to focus first on energy conservation and improving energy efficiency. Many carbon emission reducing technologies are available and research is continuing. These technologies have to be transferred to the developing countries and be integrated with the markets for carbon emission reduction credits from EE and RE projects. On the other hand, developing economies, in their drive to meet the increasing energy needs, need to avoid excess consumption, wastage, and unsustainable energy use. While planning capacity addition due consideration needs to be given to alternate efficient options. These activities would require supporting policy decisions, enabling legislation, and finance. Financing requirements, which are substantial, will have to be sourced from internal sources, transfers through emissions trading, multilateral sources, and the private sector. Suitable transparent regulatory frameworks will attract more private investment in energy to supplement the government's efforts.

13. The mitigation measures, however, cannot prevent the climate changes that will occur in this century because of today's atmospheric concentration of GHG. Adaptation will be needed to reduce vulnerability to climate change. A high population density and relatively low income level will result in low adaptive capacity and high vulnerability. The less developed countries and the poorest sections of society are likely to suffer most from climate change. Early action is needed to develop adaptive capacity, starting with information dissemination, assessment of adaptation needs, identify priority investments, mainstream adaptation, organize resources, and focus on regional partnerships.

D. Energy Access

14. Access to modern and reliable energy services is essential for sustainable human development, economic growth, improved quality of life, and better delivery of education and health services. Though access to energy was not identified as a Millennium Development Goal (MDG), studies¹⁴ have shown that the MDG targets cannot be met without modern energy services. It is clear that access to energy is a critical element in reducing poverty. In the absence of energy services, the rural poor have to resort to the use of traditional biomass, such as wood, charcoal, dung, and waste material for cooking and heating. According to IEA, about 2.5 billion people in 2004 in developing countries continue to rely on traditional biomass to meet their energy needs. The PRC and India account for a larger share with 700 million and 565 million respectively. Though efforts are being made to step up energy access, it is estimated that the number of people without access to modern forms of energy will increase to 2.7 billion in 2030 as these ongoing efforts will be offset by population growth.

15. Extensive use of traditional biomass, especially in improperly ventilated rooms, can result in higher incidence of health-related problems, such as bronchial diseases and reduced productivity. According to a World Health Organization study,¹⁵ every year almost 1.6 million people die due to the effects of such pollution. Majority of those affected are women and children. Further, the time and energy spent in collecting, storing, and using traditional fuels is a considerable drain on human productivity which could otherwise be spent on more economical or intellectual tasks. Access to modern fuels and electricity are essential for economic

¹⁴ Modi, V., S. McDade, D. Lallement, and J. Saghir. 2006. *Energy Services for the Millennium Development Goals*. Emergency Sector Management Assistance Programme, United Nations Development Programme, UN Millennium Project: New York and Washington, DC. The World Bank.

¹⁵ World Health Organization. 2006. *Fuel for Life: Household Energy and Health*. Geneva.

production and social development. Coal and kerosene are the most common fuels that poor rural people generally graduate to, but use of such fuels is either unsustainable or unsafe. Modern fuel sources such as liquefied petroleum gas (LPG), natural gas, and electricity are better options. LPG is a preferred option but inadequate distribution systems and high costs hinder its widespread use, especially in remote rural areas. Use of improved modern cooking stoves, which can be used with a variety of biomass in an efficient manner, is an option for rural areas. The other preferred option is electricity, which is indispensable for a range of activities such as lighting, refrigeration, and running of motorized household appliances. Electricity access of a number of countries in Asia and the Pacific region is shown in Table 3.

Table 3: Electricity Access in Asia in 2005

Country	Electrification Access (%)	Population without Electricity (millions)	Population with Electricity (millions)
Afghanistan	7.0	27.0	2.0
Bangladesh	32.0	96.2	45.3
Bhutan	36.0	0.5	0.3
Brunei	99.2	0.0	0.4
Cambodia	20.1	10.9	2.7
China, People's Republic of	99.4	8.5	1,302.1
India	55.5	487.2	607.6
Indonesia	54.0	101.2	111.8
Lao PDR	45.0	3.1	2.6
Malaysia	97.8	0.6	24.7
Maldives	100.0	0.0	0.3
Mongolia	64.1	1.0	1.8
Myanmar	11.3	45.1	5.7
Nepal	33.0	18.1	8.9
Pakistan	54.0	71.1	83.5
Philippines	80.5	16.2	66.8
Singapore	100.0	0.0	4.3
Sri Lanka	75.0	5.0	14.7
Taipei, China	99.2	0.2	22.9
Thailand	99.0	0.6	64.1
Viet Nam	84.2	13.2	70.3
Total	73.0	905.7	2,442.8

Note: Data for Bhutan, Lao PDR, and Maldives are based on staff estimates. For Pacific DMCs, the electrification rate is assumed to be around 50% to 60%. In Central Asian economies, the electrification rate assumed is more than 95%. Source: World Energy Outlook 2006, International Energy Agency, Paris.

16. These details show that a significant number of people do not have access to electricity and that there is a need to increase investments to provide modern and sustainable energy services to all including electricity. Many DMCs have launched time-bound schemes. Several technical options are available, such as grid extensions, mini grids, and off-grid systems based on RE sources. Funds required for extending energy services to the entire unserved population

by 2030 is about \$20 billion per year.¹⁶ Availability of such funds is challenging, hence, achievement of the energy access targets will be difficult. Many DMCs have achieved substantially high electrification access mainly due to implementation of time-bound strategic programs. PRC, Bangladesh, India, Philippines, and Sri Lanka are among the DMCs that have accelerated rates of new connections.¹⁷ In PRC and Sri Lanka, government efforts were much better planned, hence the significant achievement. It should be noted that electricity connections without quality supply, especially during peak periods, will not provide the desired benefits. Hence, such initiatives should be implemented in a comprehensive manner to ensure that the target population actually benefit from such schemes. The World Summit on Sustainable Development in the Johannesburg Plan of Implementation called for the international community to “take joint actions and improve efforts to work together at all levels to improve access to reliable and affordable energy services for sustainable development sufficient to facilitate the achievement of the MDGs”. Multilateral institutions, bilateral agencies, financial institutions, especially those dealing with microfinance, and the private sector will have to provide substantial support to the governments’ efforts in this area.

E. Investment Outlook

17. According to IEA¹⁸ estimates, the global energy market will grow by two-thirds by 2030, or a 1.7% annual demand growth. It translates to an annual investment of over \$20 trillion (2005 dollars) for energy supply infrastructure during the period 2005 to 2030, of which power sector will account for \$11 trillion or 56% of total investment. Oil and gas sectors will account for more than \$4 trillion each, while the coal sector will require about \$560 billion. One third of the investments in new power plants in OECD countries will be in renewable sources. The IEA report further states that the world’s energy sources are sufficient to meet projected demand but mobilizing investment resources will be a challenge. Though large in absolute terms, the estimated investment requirement is only about 1% of global GDP¹⁹. This percentage however varies, lower in OECD countries and higher in others.

18. With the rapid increase in energy demand, developing countries will absorb almost half of the global investment estimates. PRC, alone, will need to invest \$3.7 trillion to meet its energy demand. Financial resources at a global level are sufficient to finance this projected energy investment. For example, domestic savings is about 23% of global GDP whereas the energy investment needs are projected at only 1% of the projected global GDP. This ratio however varies substantially among regions. PRC, with a share of domestic savings of around 40% would require an average annual energy investment of about 2.4% of GDP. India with domestic savings of 30% will require annual average energy investments of about 2.2%. Even where domestic savings are larger than energy investment forecasts, the energy sector will have to compete with other priority sectors for the financial resources. This is especially true in case of many developing countries where the domestic investment exceeds domestic savings as percentage of GDP.

19. The shortfall between investment requirements and domestic savings allocated to the energy sector will need be met by foreign investment. Foreign debt has its own advantages and disadvantages, it may be available on better terms but over dependence on foreign capital without matching increase in foreign earnings can have other macroeconomic impacts;

¹⁶ International Energy Agency. 2006. *World Energy Outlook 2006*. Paris.

¹⁷ World Bank. 2006. *An Investment Framework for Clean Energy and Development: A Progress Report*. Washington, D.C.

¹⁸ International Energy Agency. 2006. *World Energy Outlook*. Paris.

¹⁹ International Energy Agency. 2003. *World Energy Investment Outlook*. Paris.

countries with large external debt will have difficulties in sourcing additional financing. Further, foreign investment is influenced by the state of the host countries' financial markets and the banking sectors; better developed, transparent, and regulated financial markets generally attract more investments. Innovative financing vehicles will need to be developed by multilateral and bilateral funding agencies to help meet the financing gap. Carbon funds and clean energy funds are some options available and need to be pursued especially for the support of clean energy development. The Global Environmental Facility and some other innovative funds support environmental and clean energy initiatives; these have to be scaled up with more grants from the developed countries. Procedures also need to be streamlined to improve access to such funds in a timely manner.

III. ADB EXPERIENCE

A. ADB's Energy Sector Operations

20. ADB's energy sector operations began in 1969 and generally reflected the development and needs of the power sector of the DMCs. Funding peaked in the early 1990s but declined thereafter for a number of years. Technical assistance support continued to increase steadily over the past 15 years. From 1998, the focus was realigned to address power sector reforms and restructuring, and increased support for transmission systems enhancement. A number of reasons contributed to this shift, one of which is the worsening financial situation of the power utilities, most of which were vertically integrated, with the government playing the dual role of policy maker and monopoly owner. Further, due to the economic slowdown, demand for new capacity had declined. Meanwhile, DMCs had also developed capacity to implement new generation capacity through the private and public sectors. This provided a window of opportunity for ADB to increase its focus on sector reforms, restructuring, independent regulatory mechanisms with licensing and tariff fixing authority, commercialization, creating enabling markets for the private sector and systems improvement, as well as loss reduction. These reform-related operations needed a thorough analysis of the existing situation and extensive stakeholder consultations. Studies were launched to provide guidance to ADB and DMCs on the better options for energy sector development. The reform roadmaps were based on consensus and extensive consultations. With the development of power sector reforms, the private sector's interest was enhanced, and ADB's private sector group supported a number of generation projects successfully.

21. ADB's oil and gas sector operations started in the early 1990s with significant support in the initial years. Thereafter, operations were sporadic with limited interventions due to increased focus on other sectors and due to the graduation of the sector towards market-oriented operations. However, since 2002, ADB has increased its operations in this sector, especially in the cleaner gas sector, by financing pipelines, storage facilities and distribution systems. The private sector group of ADB has also embarked aggressively in the gas sector, especially since 2004. Nevertheless, the share of the oil and gas sectors in ADB's operations remains low. Lately, however, interest in these sectors has increased in some of the DMCs due the increase in international prices and the need to explore indigenous sources. Hence, it is expected that ADB's interventions will increase especially in the gas sector. ADB power sector support was consistent with the existing energy policies. Recent energy trends, extensive use of fossil fuels, and the resultant projected global warming, suggest a need to focus on development of cleaner energy especially in electricity generation.

22. Tables 4 and 5 provide details of ADB lending for the energy sector.

Table 4: ADB's Lending to the Power Sector (1996–2005)
(\$ million)

Sector	1996 to 2000	2001 to 2005
Public Sector		
Generation	152	73
Sector development	1,496	1,449
Hydropower	512	26
Renewable energy	158	161
Transmission and distribution	1,766	1,520
Total	4,084	3,229
Private Sector	123	314

Source: Asian Development Bank database.

Table 5: ADB's Lending to the Oil and Gas Sectors (1996-2005)
(\$ million)

Sector	1996-2000	2001-2005
Public		
Gas Pipelines	150.0	5.0
Transport Sectors	-	72.6
Total	150.0	77.6
Private		
Gas Pipelines	-	625.0
LNG	-	75.0
Transport Sectors	-	2.6
Total	-	702.6

Source: Asian Development Bank database

B. Evaluation of ADB's Energy Operations

23. In its evaluation of the Energy Policy, ADB's Operations Evaluation Department (OED)²⁰ observed that ADB has followed a dynamic path in developing its energy policies and operations keeping pace with the development and needs of the sector in the changing environment, economic and political. To a large extent, ADB's energy projects have addressed poverty reduction indirectly through increased economic opportunities and better facilities. ADB's focus on governance, sector reform, regional cooperation, private sector involvement, corporatization, and systems improvement were evaluated as relevant. ADB's projects and TA designs were appropriate. Of the projects that were evaluated by OED, 98% were rated partly or fully satisfactory. OED observed that the project management and technical skills of the executing agencies were taken into consideration while designing projects. Consultative approach, analysis of baseline studies, comprehensive policy dialogue, establishment of clear road maps, and tranche-based assistance did result in effective implementation and overall

²⁰ ADB.. Draft *Evaluation of ADB's Energy Policy 2000 Review*. As of 30 March 2007, Manila.

sector improvement. The study concluded that the ADB Policy was highly relevant and responsive to changing needs in the energy sectors of the majority of DMCs. However, OED has also opined that analysis of alternatives in project identification and selection has been a shortcoming in ADB's operations.

24. The evaluation observed that ADB provided significant support by way of regular interaction, swift response to project needs, and efficient processing. OED further observed that project processing and implementation were constrained by the compliance requirements that lead to a high transaction cost; dissatisfaction has been expressed repeatedly by a number of DMCs. Accordingly, OED rated ADB's performance as less than effective but could improve.

25. ADB's energy policy has clearly influenced a number of the major sector reforms in which ADB has participated, for example in Bangladesh, Philippines, Pakistan, India, and Sri Lanka. There has been a two-way flow of knowledge. ADB's inputs in policy reform determined the programs, the ensuing discussions with member countries and other development partners in general, and the World Bank in particular, led to an evolving consensus on power sector restructuring, which in turn, contributed to ADB's energy policy mainstreaming. The energy sector reforms have enjoyed varying degrees of success. The key variable in each country has been the level of internal support for the reform program. One common lesson that emerges from power sector reforms is that they take many years, and in many case, far longer than originally expected. Progress is sometimes slow and there are setbacks.

26. Though some DMCs have graduated and do not need ADB's further public sector support for energy projects, most DMCs will require continued ADB assistance. Sustainability of the lending will depend on demonstrated positive impacts, capacity to meet clients' emerging needs and development of relevant skills of ADB staff. However, competition and a smaller lending base means ADB will have to develop products and policies which are client driven. To retain its relevance, ADB also needs to ensure that its staffing skills match clients' changing needs.

27. In its conclusion, the evaluation report has identified a number of issues that need to be considered in developing a new energy strategy, these focus mainly on two key areas: energy efficiency and good governance. OED stressed the need for ADB's continued involvement in the region's energy sector focusing mainly on sector reform, regulatory mechanism, commercialization, supporting the development of private sector participation, coordination with development partners, addressing environmental and social issues, enhanced focus on energy efficiency, flexible financial covenants, regional trade, and use of long term multi-tranche financing facilities.

IV. OTHER MULTILATERAL BANK'S EXPERIENCE

A. The World Bank

28. The World Bank energy operations evolved with the changing needs and development of its member countries. Starting with its first loan in 1949, energy operations accounted for more than 20% of the World Bank Group's²¹ annual commitments. Its assistance includes a

²¹ The World Bank Group includes International Bank for Reconstruction and Development (IBRD) and the International Development Association (IDA), and the affiliates International Finance Corporation, Multilateral Investment Guarantee Agency, and International Centre for Settlement of Investment Disputes.

number of instruments such as loans, credits, guarantees, technical assistance, advisory work, equity participation, syndication of commercial bank financing, investment funds, and political risk coverage. The World Bank Group also developed a number of programs for the energy sector such as the Energy Sector Management Assistance Program, the Global Environment Facility, the Asia Alternative Energy Group, the Clean Coal Initiative, the Regional Program on Traditional Energy Sector and the Solar Development Corporation. These programs were tailored to deliver technical assistance supplementary to traditional instruments. Most of these programs had multilateral support and contributions. In the early 1990s, the World Bank reviewed its energy operations and based on the experience gained, developed its energy policy,²² which set out a number of guiding principles focusing on the power sector. These principles, also applicable for the oil, gas, and coal sector operations, were (i) client countries must take explicit steps to reform and restructuring, (ii) regulatory process must be established, (iii) encourage energy efficiency and private sector participation, and (iv) avoid highly polluting or poorly performing clients; and (v) encourage transfer of clean energy technologies. In addition, the World Bank focused on rural energy, sustainable transport issues, clean energy, and environment.

29. Results have been mixed.²³ Regulatory agenda implementation has been slow, including tariff rationalization and phasing out of subsidies. Supply side efficiency programs were partly successful suggesting ambitious targets and lack of commitments. Slow pace of privatization also contributed to underachievement. End use efficiency activities were not successful due to non-implementation of commitments and lack of energy audits. However, projects focusing on curbing pollution showed better results. During the latter part of the 1990s, the World Bank's focus on RE increased. Overall, the World Bank's attempts to stimulate private sector participation has yielded expected results through reforms, and development of clean technologies contributed to improved environmental mitigation.

30. In 2006, the World Bank adopted a clean energy and development strategy²⁴ which outlined a two-track approach, namely, to develop an investment framework which complements ongoing activities, and developing and applying technologies to address climate change. Specific focus will be on (i) energy for development and access for the poor with special attention to Sub-Saharan Africa; (ii) transition to a low-carbon economy; and (iii) adaptation. Over the longer term, the World Bank proposes to undertake a climate risk management approach.

B. European Bank for Reconstruction and Development

31. During the 2000–2005 period, European Bank for Reconstruction and Development (EBRD) has committed more than €4 billion to the energy sector.²⁵ Electric power generation (21%), oil and gas extraction (20%), and electric power transmission (17%), comprised a major portion of EBRD's lending. EBRD also scaled up its financing for energy efficiency projects. In parallel, EBRD continued to engage in policy dialogue to promote its strategic objectives, viz., economic transition and environment. In general, reforms have advanced smoothly because of clean and transport regulatory framework. Similarly, private sector participation has increased. Accession to the European Union (EU) and the need to comply with requirements has facilitated reforms. Again, EBRD's results have been mixed but the right direction is being followed.

²² World Bank. 1993. *The World Bank's Role in the Electric Power Sector*. Washington, D.C.

²³ World Bank. 2000. *Fuel for Thought. An Environmental Strategy for the Energy Sector*. Washington, D.C.

²⁴ World Bank. 2006. *Clean Energy and Development: Towards an Investment Framework*. Washington, D.C.

²⁵ European Bank for Reconstruction and Development. 2006. *Energy Operation Policy*. London.

Energy efficiency is a key focus of EBRD and considerable progress has been achieved but much more will be needed to reach EU standards.

32. Countries outside the EU have progressed slowly. In fact, EBRD's reform implementation process in CIS countries to be a challenge. Regulatory independence is low and tariffs are not based on costs. Privatization within the CIS region has been extensive. EE and RE development continues to find low priority. Taking into consideration the development in the energy sector in Europe, the EU developed a revised strategy—Energy Operations Policy 2006—to address (i) competitiveness and efficiency, (ii) enhanced investment, (iii) energy security, (iv) climate change, and (v) natural resource development. To meet these objectives, EBRD has set a number of priorities; namely, promote energy efficiency, advance the reform agenda, promote renewable energy and carbon trading, exploit energy reserves in a sustainable way, promote energy trade, and enhance nuclear safety.

V. MAIN ISSUES AND OPTIONS

33. ADB'S Medium Term Strategy II (MTS II) identified energy as a core operational sector in driving our poverty reduction agenda. Accordingly, ADB needs a strategic approach for assisting DMCs in increasing their focus on promoting clean energy and sustainable development. Asia and the Pacific Region, like the rest of the world, is experiencing considerable environmental stress and hence the need to emphasize not just growth but environmentally sustainable growth.²⁶ MTS II further recommended that ADB should be selective in addressing environmental issues specific to the sectors where ADB is actively engaged and has the knowledge to be effective. Accordingly, the energy strategy has to focus firmly towards environmental sustainability as Asia's current approach of increasing the supply of low-cost fossil fuel-based energy is unsustainable. MTS II further directs ADB to focus on low carbon technologies, energy efficiency and development of RE. Energy access is an essential input to meet the MDG goals and efforts have to be made to address this aspect. MTS II also focuses on addressing governance issues, which is a key component in energy sector development.

34. The climate change issue is a challenging one. ADB has made significant progress in implementing the Clean Energy and Environment Program (the Program) to assist DMCs in building energy-efficient and low carbon economies. A key component of the Program is the Energy Efficiency Initiative (EEI) launched in 2005 to expand ADB's operations in clean energy to at least \$1 billion annually by 2008. In this regard, establishment of the Clean Energy Financing Partnership Facility²⁷ was approved on 24 April 2007 to help deploy new cleaner technology in the DMCs, provide credit enhancement mechanism to finance a large number of clean energy and energy efficiency projects, and provide technical assistance to the DMCs in the areas of clean energy and energy efficiency. Another innovative financing facility under the Carbon Market Initiative, which will provide upfront co-financing, technical assistance, and carbon credit marketing support for projects with carbon emission reduction potential, was launched on 1 May 2007. In the following sections various sectoral issues and options have been analyzed to provide a rationale of a more focused strategy that will address the climate change issues as well assist DMCs in meeting their energy needs.

²⁶ The March 2007 report of the Eminent Persons Group also proposes promoting environmentally sustainable growth as one of the three strategic directions for ADB, with particular attention on managing climate change, making efficient use of energy and greater reliance of clean and renewable energy

²⁷ A number of donor countries expressed interest in contributing to the facility.

A. Energy Efficiency

35. Energy efficiency (EE) is the most cost effective source for reducing the energy gap, carbon emissions, and reliance on expensive hydrocarbon imports. Studies have shown that adoption of proper and effective energy conservation measures can reduce energy demand by 20%.²⁸ EE can be achieved through many ways such as energy discipline—switching off appliances when not in use or required, manufacture and use of energy efficient equipment, reduction of systems losses, proper energy planning and management, efficient transport planning, use of alternate fuels and renewables, and cogeneration. The scope is immense and requires public as well as private sector support. With increasing oil prices, CO₂ emissions, threats to the climate, and energy security, EE assumes a larger role and should have a higher priority than other energy sources. Benefits from EE are long term, and can be exploited faster and at a lower cost. EE contributes to reduced fossil fuel consumption, improved public health, induces commercial savings, and contributes to achievement of the MDGs. To achieve these, EE plans have to be developed in a comprehensive manner. Both supply and demand side efficiencies need to be addressed. Addressing the supply side is easier, for example, adopting more efficient technologies, systems improvement, and management. Demand side efficiency, i.e., improvement on the consumer's side of the energymeter, requires more concerted efforts and policy support.

36. While improving EE is important in all sectors, ADB proposed Sustainable Transport Initiative, slated to be launched later in 2007, will develop further programs for the transport sector. Under the energy strategy, ADB will pay greater attention to EE activities in the power, heat, and gas subsectors. In addition to support for EE projects, ADB will promote labeling procedures for appliances and equipment, develop minimum energy performance standards, facilitate financing of EE projects through innovative and dedicated funds, and equally important, raise awareness. Such support should be targeted and measurable so as to clearly assess the degree of benefits achieved.

B. Renewable Energy

37. In 2004, renewable sources of energy accounted for 13% of the global total primary energy demand,²⁹ with combustible renewables³⁰ having a major share of 10.4%. The RE sources include biomass (renewable combustibles and waste), hydropower, solar, wind, ocean, and geothermal energy (including geothermal heat pump systems) and hydrogen. Biomass is currently the largest RE source due to its extensive noncommercial use in developing countries mainly for cooking and heating. Biomass accounts for about 80% of the total renewable sources followed by large hydro accounting for 17%; the share of other forms of renewables is minimal. According to IEA estimates, the share of other renewables in the total primary energy demand is expected to increase to only 2% by 2030, with most of the growth occurring in the OECD countries. In this document, renewable sources of energy will include only small and mini hydro, solar, wind, geothermal, ocean sources, biomass (other than the present noncommercial use), and hydrogen.

²⁸ ADB. 2006, Report of the Energy Efficiency Initiative, Manila

²⁹ International Energy Agency. 2006. *Renewables Information*. Paris.

³⁰ Combustible renewables and waste include solid biomass and animal products, gas/liquid from biomass, industrial and municipal waste.

38. Most DMCs import oil to meet energy needs. With the increase in oil prices, the foreign currency expenditure on energy imports in some cases has crowded out other essential imports. Furthermore, the outlook is insecure as the bulk of oil production is concentrated in the conflict prone Middle Eastern region. This creates a need to enhance energy security, which requires a number of measures, such as, efficient energy use and diversification of energy sources. RE has a significant role as it can diversify the source of supply for incremental energy demand. Production of electricity from such sources is clean, sustainable, and generates none or little GHG. Thus, considering its diverse benefits, electricity generation from RE sources needs to be actively pursued. The main challenge that has hindered RE development has been its high cost. However, with larger markets and economies of scale, RE equipment prices have fallen over the past few years and are almost cost competitive with fossil fuel technologies, especially when life cycle and environment advantages and income from carbon credits are considered. In fact, many technologies in RE are, or in the near future likely to be economical compared to some fossil fuels. Further, if global concerns on CO₂ emissions trigger imposition of carbon taxes, then greater research and development (R&D) is likely to shift towards RE, bringing costs down further.

39. Development of RE sources is especially beneficial in rural areas where such projects can contribute to agricultural productivity, health, education, communications, small business enterprise, and quality of life. About one billion people of the Asia and the Pacific region do not have access to modern forms of energy. This can be addressed largely through cost effective renewable sources like modern cooking systems using biomass and small electricity grids. Operational costs are low as input costs unlike fossil fuels are not subject to fluctuating prices. Furthermore, grid extension is not required which saves transmission costs. Thus, there is a need to frame suitable policies that encourage development of RE for which long-term support is needed. Some DMCs already have aggressive policies in place which require a certain minimum share of renewables in the electricity grid within a fixed time frame. Implementation of these policies needs timely support.

40. However, there is a limit to the reliability of power that is available from RE sources. Hydropower is dependent on water availability, wind and solar on climatic conditions. RE lacks the reliability needed for grid operations until such time that energy storage devices, such as fuel cells, are commercially available. It is generally accepted that a grid can accept about 10% to 20% capacity from RE though a number of technical challenges hinder expanded use of RE in the grid.³¹ Renewable sources from sun, wind, tide, and waves are currently not suitable to directly provide either base load or peak load power when needed. Energy storage is also a problem that discourages RE use in stand alone systems. Weather uncertainties require a back up redundancy, the level of which is under debate. Some believe that 100% backup is necessary but RE protagonists refute this assessment. Solar power is suitable for heating purposes but its potential for electricity generation is limited due to interruptions associated with unfavorable weather and night time, resulting in a low capacity factor. Solar photovoltaic cells are more suitable, provided battery storage facilities are built in. Wind turbine operation is restricted within a limited range of wind velocity. Like solar, consumers depending on wind power require alternate backup provisions to ensure power supply at times of unfavorable weather. Research is ongoing on developing systems that can be adopted within the grid system without any additional redundancy so that contribution of solar and wind power can be significantly increased.

³¹ Renewable Energy and Electricity. 2007. *Nuclear Issues Briefing Paper 38*. Uranium Information Center. Melbourne.

C. Fossil Fuels

41. Oil consumption trends closely follow the growth of the gross domestic product (GDP). Primary oil demand is expected to grow over the projection period under the Reference Scenario from 84 million barrels per day (mb/d) in 2005 to 116 mb/d in 2030, an annual average increase of around 1.6%. Oil demand will continue to grow more quickly in the DMCs. PRC's oil use is expected to rise by 3.4% per year from 2002 to 2030. In the rest of developing Asia, oil demand will rise at 2.9% to 3.0% per year. The transport sector will account for more than half of the primary oil consumption. This is mainly due to increased demand for road transport fuels. Recently, oil prices rose dramatically to \$70 per barrel before settling down recently within a range of \$55-\$65 per barrel. Experts speculate that such prices are not sustainable and market fundamentals could drive prices down. However, oil prices tend to be volatile and certain factors or a combination of factors could help maintain high oil prices for some time. These factors include less than required investments in supply infrastructure, strong demand pressures, shortage of production, and geopolitical factors.

42. According to an IEA study,³² a sustained high oil price will encourage reduced consumption and encourage switching to other fuels. Higher prices will also induce changes in consumer behavior, such as reduction in waste, use of fewer energy services, and promotion of more energy efficient technologies. Magnitude of these effects will however vary among regions though developing countries are likely to experience reduced demand. Since oil imports have a significant effect on the fiscal balance, it is critical to address this issue over a longer timeframe. Some available options are to conserve or reduce energy consumption, explore and invest in alternate and renewable fuel sources, energy efficient technologies, effective transport planning, introduction of fuel efficient engines for transport vehicles, and possibly implement larger vehicle use taxes. Though availability of oil is concentrated in the Middle Eastern region, a number of DMCs have discovered oil within their geographical boundaries. Such indigenous sources will help stem the foreign exchange outflow to some extent. A few DMCs with large demand growth are also aggressively exploring joint ventures outside the region for oil exploration. Careful and transparent management of such resources will be necessary.

43. The Energy Policy provided extensive guidance on ADB's approach to hydrocarbon extraction. In case of oil, the Policy recommended that ADB should not fund development projects as oil was an internationally-traded commodity with established private sector involvement. However, it allowed ADB to consider selective assistance to develop marginal and already proven oil fields subject to economic soundness. Recently, with oil price fluctuations, a number of DMCs are actively exploring and development of domestic oil fields. There has been some success. Though the government and private sector are actively involved in oil prospecting, ADB support in management of such sources, oil extraction, refining, transportation and distribution, including support in developing tariff policy and accountability, will greatly enhance economic development.

44. The consumption of natural gas, the fossil fuel with the least emissions, is expected to increase globally over the 2004-2030 period in the Reference Scenario from 2.8 trillion cubic meters (tcm) in 2004 to 4.7 tcm in 2030, a demand growth of 2% per year. Investment requirements worldwide will be around \$3.9 billion. While North America and Europe will be the largest market, the demand rate will be higher in developing Asia than global average. The power sector will account for more than half the increase in global primary gas demand. Emerging technologies such as gas-to-liquid plants are expected to be a significant market for

³² International Energy Agency. 2006. *World Energy Outlook 2006*. Paris.

gas. Proven gas reserves amount to 180 tcm in 2005, which is sufficient to meet the projected demand for 64 years at current rates. Gas trade continues to operate on a regional basis with pipeline transportation as the most favored option. Nevertheless, trade in liquefied natural gas (LNG) is expected to increase with Asian economies addressing the increased LNG trade by leasing bulk carriers, setting up LNG terminals, and developing associated facilities. Gas market outlook is also favorable due to increased preference of replacing gasoline with compressed natural gas for motor vehicles for environmental mitigation purposes, especially in urban areas and also for heating purposes. An issue of concern, however, is the regular increase in gas prices. Gas-based power plants may not be competitive if the current increasing trend in gas price continues.

45. In case of natural gas, the Energy Policy recommended that though prospecting is a speculative activity and should be the responsibility of entrepreneurs, ADB should play a major role in funding natural gas development, extraction, processing, transportation and distribution networks, and regional trade. As in case of oil, interest in oil continues to be a priority for many DMCs and ADB should continue to pursue active support for oil development and use, especially, facilitating regional trade.

46. According to IEA's World Energy Outlook 2006, in the Reference Scenario coal will continue to be a major source of energy with a share of about 26% in 2030. Coal demand will increase primarily due to the increased energy needs of developing Asia, particularly PRC and India, which both have abundant indigenous reserves of coal. Coal demand will also increase in North America, Britain, Germany, Indonesia, and Vietnam where newer coal-based power plants are planned. Sectorally, power generation will account for about 80% of the world coal demand. Also, demand for coking coal, used mainly by the iron and steel industries, is expected to rise at a rate of 0.9%.

Table 6: World Coal Demand by Sector

Sector	Demand (%)	
	2002	2030
Residential	3	1
Industry	16	12
Power generation	69	79
Others	12	8
Total	100	100
	(4,791 million tons)	(7,029 million tons)

Source: Energy Information Administration (US Department of Energy), and International Energy Outlook 2004 (IEA)

47. Renewed interest in coal-based power plants is attributable to a comparatively stable market. Another reason for the increased interest in coal is energy security due to its indigenous availability. Proven reserves are enormous and widely dispersed, unlike oil and gas. Other positive features are that coal is easy to transport and store and is not affected by weather changes. However, coal and its use have a number of serious environmental implications. Among the fuels used to generate electricity coal has the highest CO₂ emission. Though emission standards for other pollutants are in place, inconsistency in application and enforcement are issues that need considerable capacity building. To address sustainable use of coal, the current options are to pursue new techniques for mining and coal preparation, and efficiency improvements. Coal mine safety is another issue that will require greater attention

with higher coal production; investments in the extraction and use of coal bed methane and other combustible gases will make mines safer and reduce the emissions of highly potent GHG.

48. While acknowledging that coal is the primary energy source in the larger DMCs, the Energy Policy stressed that ADB should not directly finance coal mine development except where it is for captive use by a thermal power plant, and economically superior to other coal supply options. The Policy further recommended that ADB support should be restricted to promoting environmentally sound mining facilities and clean coal technologies, policy assistance to enable restructuring, and privatization. Recently, however, with the increased need of coal for power generation, indigenous coal mine development is receiving renewed interest. Clean development methods (including waste coal utilization that has a low heat content), coal mine safety, coal bed methane extraction and environmental safeguards in coal extractions have received priority. As coal is abundantly available in the Asian region, coal mining activity will increase in the DMCs for reasons of energy security and cost. It is also argued that coal mining will generate jobs, economic development of the local population, and increased revenue for the country. However, in coal mine development, there are much larger associated environmental and social issues that will have to be addressed carefully. For example, coal burning is a major source of GHG which contributes significantly to increase in global warming. Coal mining, especially open cast mining, a commonly adopted technique, is associated with a number of negative impacts. These are dust pollution, deforestation, land degradation, gas emission, groundwater contamination, industrial and waste water, waste management, coal burning, noise, and other construction-related negative impacts. Other impacts are on the local population, involuntary resettlement, inappropriate disposal of excavated soil, improper back-filling after mining activities are completed, which can be as long as 20 to 25 years. While ADB support could be seen as a catalyst for encouraging and developing good practices, especially with regard to enforcing stricter environmental and social standards and adopting efficient technology, this needs to be weighed against the current controversies around increase fossil fuel extraction issues, and ADB's commitment to clean and renewable energy.

D. Power Generation and District Heating

1. Coal-based Power Plants

49. Large parts of Asia and the Pacific region continue to suffer from electricity shortages. DMCs are seeking various options to meet the projected increase in electricity demand such as coal, natural gas, nuclear, hydropower (large, small and micro), and renewable sources. Coal-based power plants have been the preferred option by some DMCs, mainly due to large availability of indigenous coal and hence vital for energy security concerns. These power plants are, however, a major source of pollutants such as oxides of nitrogen, sulfur, and carbon, particulate matter, heavy metals, and GHG. Therefore, such capacity addition programs need to be implemented in an environmentally sustainable manner by adopting cleaner technologies such as atmospheric fluidized bed combustion, supercritical and ultra-supercritical technologies, and flue-gas desulphurization facility, which contribute to reduced emissions as compared to conventional technologies. Decision to install coal-based power plants should be made after carefully assessing the least cost options and alternatives such as focusing on more efficient sources, as such plants, once built, will continue to pollute the atmosphere throughout their operating life of 30 to 40 years.

50. A large number of existing coal-based plants have been operating for a number of years and need retrofitting to improve efficiency and operating life, and remain in compliance with

current higher environmental standards. Such projects will be cost effective and will reduce generation of pollutants in addition to improving efficiency. In the future, as and when new technologies like pressurized fluidized bed combustion, integrated gasification combined cycle, carbon capture and storage (or sequestration) are technically proven, such technologies should be adopted. To achieve this, developed and developing countries need to collaborate on long-term technology transfer agreements, if necessary with the active support and coordination of bilateral and multilateral financing institutions.

2. Oil and Gas-based Power Plants

51. Oil is a major source of power generation in most Pacific DMCs (PDMCs), some mainland DMCs like Cambodia, and for captive use by the industrial sector. Oil imports form a large component of the import expenses of these countries who remain vulnerable to the price fluctuations in the oil market. In most PDMCs, oil consumption for power is more than that for transportation. Oil-based power generation continues to be a technically viable solution for providing electricity in remote areas, island communities, and sparsely populated areas, but PDMCs need to reduce their dependence on imported oil by developing alternate renewable sources of energy. Price considerations and pollution aspects will be partly mitigated with such an energy mix. DMCs like Cambodia need to develop energy trade with neighbors or explore other least cost energy options to reduce its dependence on imported oil. Industrial use of diesel sets for captive generation is mainly to secure energy supply. This can be addressed only when sufficient generation capacity is available to meet the demand of the industrial sector or through appropriate captive power policies.

52. The power sector will account for more than half the increase in the global primary gas demand. The share of gas-fired generation is expected to grow from 20% to 23% by 2030. Many DMCs have plans to install gas-based combined cycle turbines to meet part of the base load demand and simple open cycle turbines for peak load. Gas turbines are more environmentally friendly than coal-based plants and need shorter construction and start up periods. Integration into the grid is also swifter. Open cycle turbines are useful for mini-grid or off-grid power systems. On the downside, gas prices are increasing and gas turbines will face competition from coal based plants. Use of LNG for gas turbines is also an option, but insufficient infrastructure is a bottleneck.

3. Hydroelectric Power Plants

53. As indicated previously in this paper, world primary energy demand is projected to grow by more than 53% from 2004 to 2030. The IEA estimates that the share of hydropower in global energy generation will drop from 16% in 2004 to 14% in 2030. However, its growth will still be 2% annually with hydropower output increasing from 2,809 TWh in 2004 to 4,749 TWh in 2030. In the OECD countries, the best sites have been exploited and further increase is constrained due to environmental concerns. Hence, most of the increase in hydropower development will be in developing countries where there is substantial untapped hydroelectric potential. Only 31% of the economic potential worldwide has been exploited by 2004. Within Asia, large hydropower development is planned in PRC, India, Lao PDR, Nepal, Pakistan, Viet Nam, and some of the Central Asian DMCs.

54. Hydropower development has a number of benefits. It is renewable, though there are opinions that large hydropower is not to be considered as a renewable source of electricity, highly efficient, clean, substantially reliable, and flexible. It is an essential component for grid management and extremely useful for meeting peak load demands. Hydropower saves

consumption of scarce fossil fuels and the dams can prevent floods and provide water for irrigation purposes. It comes in a variety of sizes, such as large, small, mini, and micro and each has its own niche. Large hydropower can be reservoir type or run-of-river type.

55. Large hydropower plants, especially those based on reservoirs, come with a price. These projects are complex and environmentally and socially sensitive. Some of the effects on the ecosystem are fish migration blockage, loss of terrestrial ecosystems, loss of biodiversity including rare and endangered species, changes in downstream aquatic and riparian ecosystems, reduced sediment inflow, downstream increasing estuary and shoreline erosion, decreased flood dependant fisheries, and threats to public health. According to scientific studies,³³ large reservoirs produce significant amounts of GHG, like carbon dioxide and methane due to the submergence of vegetation and forest land. This largely depends on the extent of plantation that is flooded due to the reservoirs and the size of the reservoirs. Coupled with the environmental concerns are the associated socioeconomic issues such as involuntary displacement, loss of livelihood and support systems, loss of traditional way of life, increase in health risks, low economic returns to the affected communities, displacement or loss of physical and cultural assets, reduced farm and domestic water supply, influx of migrants and population growth, and straining of local institutions and service providers. These environmental and social impacts are interrelated and the effects of these impacts can result in considerable attrition. Inappropriate management of these issues can further exacerbate their impacts. Another negative aspect of large hydropower projects is the long construction period compared to other types of power projects. Therefore, implementation of large hydropower projects will require acceptable and proper mitigation strategies, adequate disclosure and consultation with the affected people, and environmental safeguards including policy dialogue, and proper acceptable resettlement and economic rehabilitation of affected people. It should be ensured that the required environmental and social safeguards are implemented and monitored in a sustainable manner.

56. Many hydropower projects are located in the relatively higher reaches to take advantage of the head difference within short distances. In such cases, high-head run-of-river hydropower plants are the preferred option as these do not involve huge storage reservoirs. Ecological aspects need to be carefully addressed in case of such projects. Pumped storage plants are another option that needs to be pursued; these plants help economically meet the high grid demand during peak periods. Small, mini and micro hydropower are considered as renewable sources of energy and hence for the purposes of this document are being discussed under the section on RE.

4. Nuclear Power Plants

57. Due to the uncertainties linked with nuclear power development, future demand assessments vary. According to the IEA, the share of nuclear power in electricity will decline from 16% to about 10% by 2030, with a limited capacity addition and high rate of retirement forecast. Nevertheless, recent trends indicate that nuclear power will play an increasing role in the total energy mix in Asia. Some countries in the region have announced policies to accelerate nuclear power development for electricity generation. Nuclear power does not generate significant GHG emissions, and hence can make a contribution in reducing global warming. Nuclear power generation is suitable for large-scale base load power plants which are the core of electricity grids. Since 1990, significant development has taken place in nuclear

³³ United Nations Environment Programme. 2001. Dams and Development: A New Framework for Decision Making 2000. Geneva.

fission technology. With the unstable oil and gas market and the global warming effects of fossil fuels, nuclear power is increasingly becoming an option that some DMCs are pursuing.

58. Nevertheless, in spite of its sustainable and operational benefits, nuclear power development faces a number of barriers, such as public concerns related to nuclear proliferation, waste management, safety issues, high investment costs, long lead time, and commercial acceptability of new technologies. Overcoming these barriers is difficult and open public debate will be required to convince the public on the benefits of nuclear power. Advanced designs seek improvements in three principal areas: cost reductions, safety enhancements (use of passive safety features), and proliferation resistance.³⁴ MDBs have traditionally avoided financing nuclear power plants. In the context of nuclear issue in the former Soviet Union states, the EBRD's current energy policy³⁵ includes financing safety measures of nuclear plants, decommissioning and environmental rehabilitation, and promoting an efficient nuclear regulatory framework.

59. The 1995 Energy Policy, while recognizing the development of nuclear power generation, indicated concerns on such operations and waste disposal methods. Past accidents at Chernobyl in the former Soviet Union in 1986 and at Three Mile Island in United States in 1979 contributed to public fear and a general lack of public understanding of the technological complexities. Other concerns expressed were related to technology transfer, procurement limitations, proliferation risks, fuel availability, environment, and safety aspects. Based on these concerns, the Energy Policy recommended noninvolvement in financing nuclear power generation.

60. Since then significant technological advances have taken place. Safety standards have improved. International supervision and improved waste management has resulted in increased interest in exploring nuclear power generation. Some countries aggressively pursued nuclear power as a measure of energy security, whereas, some decided to phase out existing facilities. Nuclear power is also a low carbon source of electricity. Hence, energy security and global warming concerns have renewed interest in nuclear power. Some countries which had phasing out policies are now reviewing the options. The factors that may influence a policy change, as mentioned earlier, are energy security, fuel supply security, stability of fuel prices, and climate change benefits. A few DMCs such as PRC, India, Pakistan, and Viet Nam are actively pursuing nuclear power.³⁶ Many member countries in the region such as Japan, Korea, and Taipei, China already have nuclear power development policies in place. Clearly, though worldwide nuclear power's share is expected to reduce, nuclear power development in Asia is expected to grow.

61. However, due to concerns related to nuclear technology, procurement limitations, proliferation risks, fuel availability, and environmental and safety concerns, ADB will maintain its current policy of non-involvement in the financing of nuclear power generation.

³⁴ International Atomic Energy Agency. 2006. Nuclear Power and Sustainable Development. Vienna

³⁵ European Bank for Reconstruction and Development. 2006. *Energy Operations Policy*. London.

³⁶ Armenia also has an operating nuclear power plant that supplies over 35% of the power demand.

5. District Heating

62. DMCs in the Central Asia region, Mongolia, and the northern provinces in PRC have extensive demand for space heating and hot water. Heating is needed by residential and institutional buildings, which can be provided either through stand-alone systems or a centralized district heating system. Each system has its own niche. District heating systems are potentially energy efficient and hence a cost effective way to meet the demand.³⁷ There are several heating technologies and the choice largely depends on the economic availability of the fuel. Currently, large district heating systems that were installed 30 to 40 years back continue to operate on obsolete and inefficient technologies. In some cases, more than 40% of the heat in the fuel is lost during generation, transmission and end-use.³⁸ Together with such inefficiencies, there is also lack of adequate policies and regulations. It is necessary to recognize that district heating is important for the well being of the population. Therefore, as in case of other energy sectors, there is a need for enabling legislative framework to establish independent regulatory mechanisms to encourage private sector participation and financing, decentralization, and transparent tariff and subsidy mechanism.

63. District heating being largely fossil fuel-based is a major source of GHG. Hence, it requires cost effective and sustainable solutions. For the centralized district heating systems, the fuel sources are diverse, coal, oil, gas, and solid wastes. The combined heat and power plant uses the waste heat from steam turbines which significantly increases the overall thermal efficiency and reduces GHG emissions per unit of energy delivered. Cities that also have piped gas supply can also opt for decentralized heating. There are RE options that can reduce the fossil fuel use, namely, solar panels for water heating, and geothermal heat pump system that use shallow ground heat. Again, consumer patterns differ, such as urban, including residential, commercial, industrial, and educational; and rural communities, also with similar consumer patterns but at a much smaller scale. Therefore, cost effective systems have to be developed to ensure adequate heating supply in a sustainable way. For example, multi fuel boilers can be designed to achieve higher efficiencies. In all cases, there is a need to improve building designs and insulation systems to reduce heating requirements. Rural areas with decentralized or smaller heating grids can be developed; where feasible, RE sources can be used to augment the system and reduce fuel consumption.

E. Regional Cooperation

64. Regional cooperation in energy is considered one of the effective ways to address energy security. ADB assisted the project for export of natural gas from Indonesia to Singapore and the output from the ADB-funded hydropower project in Lao PDR are being sold to Thailand. Energy exchange between neighboring countries is also an efficient way of energy use. Many DMCs have abundant natural resources which can be effectively traded in the large energy markets in neighboring countries; thus, benefiting all parties. ADB has been instrumental in forging subregional collaboration and networks quite effectively. Options are immense. For example, natural gas within Central Asia and from Central to South Asia; and from Bangladesh to India. Electricity can be supplied from Nepal and Bhutan to India; from Kyrgyz Republic and Tajikistan to Afghanistan and Pakistan; from Kazakhstan, Myanmar and Mongolia to PRC; from Lao PDR and Cambodia to Thailand; between India and Sri Lanka, between the Greater

³⁷ Climate Institute. *District Heating System, Climate Change Initiative*. Available: <http://www.climate.org/climate.main.html>

³⁸ World Energy Council. 2003. *Towards Local Energy System: Revitalizing District Heating and Co-generation in Global and Eastern Europe*. London.

Mekong Subregion countries (including Southern PRC). Building consensus and negotiations for bankable projects has been the main challenges. ADB needs to continue to be engaged in fostering such energy trade as it is well positioned to play a catalytic role.

F. Power Sector Reform and Restructuring

65. In the 1980s, a worldwide trend began in both developed and developing countries to restructure the power sector and establish independent regulators. The motivation in developed countries was mainly the expected improvement in sectoral efficiency through competition, while in the developing countries it was augmentation of scarce public resources with more private sector financing. MDBs, including ADB, actively supported the restructuring and regulatory reform efforts in DMCs that were seeking private sector participation in the power sector. This included, among others, unbundling the power sector, creating an independent regulatory mechanism, introducing competition in power generation, and in some cases, privatization through sale of assets. Such reforms and establishment of independent regulatory institutions have encouraged private sector participation and access to commercial financing. Independent regulation has been instrumental in separating short term political objectives from tariff setting and enabling the power sector to operate more commercially.

66. Progress has however been slow due to delays in enabling legislation, insufficient consultations with stakeholders, apprehensions regarding tariff increase, and lack of time bound roadmaps. The unbundling of the power sector involved separating government responsibilities for power sector policy from the regulation of the industry to ensure a fair balance between the interests of investors and consumers. It also involved splitting power sector monopolies into generation, transmission, and distribution companies. Many DMCs have pursued reform policies with varying degrees of success. There has been little progress in Sri Lanka; but Philippines, India, Pakistan, and Bangladesh are all at advanced stages in the unbundling process. PRC has separated most of the power generation into five large national companies and established a regulatory commission. Some countries in Central Asian Region (Azerbaijan, Kazakhstan, and Kyrgyz Republic) and Mongolia have also established separate regulatory bodies. A number of provinces in India have unbundled the sector, but more needs to be done to make them fully commercial. In Pakistan, the regulator is performing in an independent and transparent manner and is helping to create a better commercial structure for private sector investments. Progress in the Philippines has been mixed—interest in privatization has been limited, the wholesale electricity market competition started in mid-2006, and the transmission and distribution tariffs are being regulated. In addition, the risk of judicial review has diminished the regulator's effectiveness.

67. Restructuring and competition have had mixed results internationally. Unbundling the sector and privatization is one approach, which was partially successful in some cases and failed in others. Transformation from government run organizations to a completely private sector operation is a difficult transition and not necessarily the most efficient path. Risks are numerous and hence such reform initiatives need careful assessment, political will, tariff rationalization, enabling legislation, improved corporate and financial management, and independent regulatory mechanisms, which are often difficult to ensure. Therefore, reforms should be designed and sequenced carefully on a case-to-case basis. Further, concerns regarding new investment in capacity have weakened the resolve for a fully competitive wholesale and retail electricity market. There are very few countries that have fully deregulated the electricity business and others are moving cautiously.

G. Pacific DMCs

68. Pacific DMCs (PDMCs) are more susceptible to oil price fluctuations than most other countries. Since these economies typically deploy diesel sets for power generation, oil accounts for a significant component of their import bills. Some PDMCs have alternate power sources using renewable technology such as mini- and micro-hydropower, wind and solar, however, it is not significant. Thus, to address energy security, the PDMCs have to be encouraged to adopt new and renewable sources of electricity in a large scale. This will reduce oil imports, and, on an extremely small scale, reduce GHG emissions. The existing oil-based power plants would ensure the reliability, whereas renewable energy sources can provide energy when available and thereby reduce the oil consumption. Use of biomass for electricity generation is also an option that can be considered, particularly when the island also has a palm tree-based industry. In addition to capacity addition, there is a need to develop and implement EE policies to rationalize demand. Management structures, as appropriate, and tariff guidelines have to be developed, capacity building has to be addressed. Thus a comprehensive package for power sector support including systems improvement, will have to be developed for each PDMC.

69. PDMCs, like other island economies such as Maldives, the archipelagoes, and low lying areas of many larger DMCs are going to be effected by climate change and global warming. A rise in sea levels, as predicted by a number of scientific studies, will submerge portions of the land mass. Some islands may disappear entirely. Therefore, in addition to mitigation measures for global warming, the PDMCs need to adapt to likely future changes. To ensure attention to these issues, it is proposed that a comprehensive energy sector package also address adaptation, particularly in case of PDMCs.

VI. THE STRATEGY

70. The emerging issues and options discussed in the preceding chapters require a realignment of ADB's operation in the energy sector to place greater focus on addressing challenges the sector faces today: meeting energy security and transition to a low carbon economy. ADB's energy strategy will have three pillars: (i) meeting the energy demand in a sustainable way, (ii) energy access for all, and (iii) energy sector reform and governance.

71. ADB's energy sector operations will be continuously aligned with the enhanced poverty reduction strategy and MTS II. Also, all ADB investments in the energy sector will promote sound and internationally accepted environment, involuntary resettlement, and indigenous people planning and implementation practices ensuring that affected persons are safeguarded from impoverishment risks and development programs for these persons are incorporated and implemented.

A. Meeting the Energy Demand in a Sustainable Way

1. Energy Efficiency and Renewable Energy

72. Harnessing energy efficiency is one of the most effective ways of meeting energy demand, while addressing global warming challenges. ADB has placed emphasis on both supply side and demand side efficiency. To this end, ADB has initiated the Clean Energy and Environment Program (CEEP) in 2005 to help its DMCs build energy efficient and low carbon economies. On the demand side, more than 50% of the energy is consumed by the industrial sector. There is enormous scope to address efficient use of energy, especially the highly energy

intensive industries such as cement, steel, and fertilizer. Spearheaded by the CEEP, ADB will scale up its operations for this sector by collaborating with industry associations, domestic banks, and specialized energy efficiency agencies and energy service companies (ESCOs). Assistance will be in the form of technical assistance in identifying EE options and preparing bidding documents, financial assistance, and guarantees. Commercial establishments and residential load accounts for another 30% of the total energy demand. Addressing this sector will require firm regulatory actions. ADB will assist DMCs in framing enabling legislation and efficiency standards that will require manufacture and use of energy efficient equipment and goods, especially consumer goods, including setting up labeling authorities.

73. On the supply side, new and renewable sources of energy are options that need to be pursued. Studies have shown that with current technologies, renewable sources can form a significant component of the electricity grid, to the extent of almost 10% to 20%. This is more than five to ten times the current share. RE is clearly an option for off-grid community-based electricity supply. Even with back-up requirements, use of RE sources will reduce fossil fuel consumption. Many DMCs, like PRC and India, have renewable policies in place and have targets for RE development. ADB's support for renewable sources of electricity is to will be increased substantially. At present, most ADB projects in this sector focus on small and mini hydropower plants. Support for other sources has to be also enhanced in the future.

74. Financial sustainability of EE and RE projects improves with additional revenue from Clean Development Mechanism (CDM), i.e., the sale of Certified Emission Reductions (CERs). ADB will continue to provide assistance to DMCs in designing projects which are eligible for CERs and also provide technical assistance to underwrite the transaction costs for CDM registration.

2. Power Subsector

75. ADB will engage with DMCs to address their electricity demand needs in a sustainable and planned manner. When sector wide interventions are planned, it would be based on integrated resource planning principles which recommend an analysis of demand load profiles and efficiency options together with addition to the supply side. Based on these plans, ADB will help develop energy sector roadmaps for DMCs having substantial electricity sector investments and identify project pipelines accordingly, with adequate flexibility.

76. Meeting the electricity needs of the region will require large capacity additions. Current estimates indicate that coal based generation will have a larger share. ADB's interventions will be to assist DMCs in developing clean energy and more efficient power plants. Retrofitting old existing power plants that need efficiency improvements will be given priority. In addition, ADB will help improve demand side efficiencies and encourage RE sources, such as wind, solar, photovoltaic, improved biomass, mini and small hydropower, run-of-river hydropower, pumped storage, geothermal, ocean-based sources, and waste-to-energy.

77. ADB will also selectively support large hydroelectric power plants requiring seasonal storage reservoirs with multipurpose benefits. However, such financing will be based on enhanced economic benefits and compliance with ADB's social and environmental safeguards requirements. Such projects may be for domestic or regional benefits.

78. Coal-based power plants, while meeting the critical electricity needs, generate GHG and a number of other pollutants. ADB will encourage DMCs to adopt available cleaner technologies, such as fluidized bed combustion, supercritical and ultra supercritical boilers, and flue gas

desulphurization. ADB will also assist DMCs in collaborating with developed countries for transfer of new and better technologies that are under development. It will selectively support coal-based power projects only if cleaner technologies are adopted and adequate mitigation equipment and measures are incorporated in the project design. Again, some DMCs that are dependent on oil-based power supply or import from neighboring countries, may propose to install small-sized coal-based power plants by sub-critical boiler technology using imported or indigenous coal. Such diversification will improve power system reliability and energy security, and may even be the least-cost option. In the interest of economical and developmental needs, such base-load power plants, if found justified after due diligence, will be supported for countries with small-sized grids.

79. Gas-based power generation is expected to continue as a preferred option in the long term due to its comparative benefits such as domestic availability of gas, easier transportation through pipelines from extraction sources (both within and outside the countries' boundaries), favorable installation costs, faster installation time, quick start facilities, multifuel operability, and environmentally more friendly than coal-based power plants. Accordingly, ADB will continue to support financing of gas-based power plants, subject to techno-economic viability.

80. Oil-based power generation is the backbone of the energy sector in most island economies. Though ADB will encourage adoption of RE sources for power generation, oil-based power plants will continue to be a major component of the electricity grids. Hence, ADB will continue to finance modern small oil-based power plants for island economies.

81. Huge capacity addition in power generation will require substantial investments in transmission and distribution facilities. Many existing lines are obsolete and require upgrading. ADB will continue with its policy to support installation of modern transmission and distribution systems to efficiently transmit the electric power from the generation facilities to the consumers, including of upgrading of existing systems.

82. Due to concerns related to nuclear technology, procurement limitations, proliferation risks, fuel availability, and environmental and safety concerns, ADB will maintain its current policy of non-involvement in the financing of nuclear power generation.

83. Many DMCs need to extend the heating systems, in addition to retrofitting existing obsolete systems. ADB will assist DMCs in identifying and installing modern and energy efficient technologies such as combined heat and power systems. There are more efficient technologies such as combined heat, power, and cooling systems which should be supported. Where viable, the use of RE (e.g., solar and geothermal heat pump) would also be encouraged. In addition, ADB will assist in the establishment of independent regulatory mechanisms to address transparency in the management of the heating sector including tariff setting and targeted subsidies.

3. Hydrocarbon Subsector

84. Recent oil and gas price increases have adversely affected fiscal position and made DMCs feel less secure. Many DMCs are now considering ways to reduce the import burden by resorting to exploring indigenous sources of oil and gas. Some success has been achieved. As oil and gas are internationally traded commodities with established private sector interest for its development, ADB will continue its policy not to finance exploratory projects. However, ADB will continue to provide assistance in refining, transportation, and distribution of petroleum products. Distribution projects will include setting up compressed natural gas (CNG) networks for

transportation and gas for domestic use such as cooking and heating. On the management side, ADB will assist in establishing a policy environment that encourages private sector participation, greater competition and independent and transparent regulation. ADB will also assist DMCs in preparing and managing hydrocarbon database, skills enhancement, and financial management.

85. Coal is a major source of energy for electricity and heat; several DMCs will aggressively pursue coal mine development. Again, as coal is an internationally traded commodity, ADB will maintain its previous policy not to directly finance coal mine prospecting. However, ADB will actively promote environmentally and socially sound mining practices, extraction and use of coal for power generation, coal bed methane extraction and use, coal gasification, adoption of clean coal technologies, waste coal utilization, and transportation.

4. Regional Cooperation

86. Regional cooperation can play a critical role in ensuring energy security in a sustainable manner. Subregional power trade can be an effective way of meeting energy demand while maximizing the scarce natural resources. By utilize different peak times of neighboring countries, regional power trade can reduce the need for building new power generation plants in each country. As demonstrated in the Greater Mekong Subregion, ADB can play a pivotal role in promoting effective regional cooperation in the energy sector. ADB needs to will continue to be engaged in identifying and implementing regional projects and programs that promote regional energy trade with economic and environmental benefits for the whole region.

B. Energy for All

87. As indicated previously, more than one billion people of the region do not have access to modern forms of energy which is a key requirement to meet the MDG goals. Access to modern forms of clean energy is a critical element in reducing poverty in our DMCs. Therefore, ADB will actively engage with DMCs and other aid agencies in addressing unmet energy needs of the people within a targeted timeframe. ADB will support sustainable rural electrification efforts of the DMCs which are designed to provide electricity and a sustainable economic potential to the rural population. In addition, ADB will design projects that will provide modern cooking stoves which can be operated using a wide range of fuels, including biomass. Such projects will be extended to both rural and urban poor. Funds for these projects can be channeled through intermediaries such as microfinance institutions, government departments tasked with such activity, or through approved civil society organizations. For the urban poor who do not have access to energy, this issue will be tackled along with ADB's urban development projects which may include such components.

88. Special focus will be on remotely located communities that are less likely to be connected to the electricity grid in the near future. ADB will develop small-scale demonstration projects which can be replicated in other locations, such as remote mountain villages or island communities. Such projects will be packaged into larger projects costing around \$5 to \$10 million, and if feasible, will be piggy backed to main energy sector projects as a special energy access component. DMCs with electrification rates less than 70% will be targeted initially.

C. Energy Sector Reforms and Governance

89. ADB supported the restructuring and regulatory reform efforts in DMCs that were seeking private sector participation in the power sector (see paras. 65-67)..Although progress has been slow due to delays in enabling legislation, insufficient consultations with stakeholders,

apprehensions regarding tariff increase, and lack of time bound roadmaps, ADB will continue to assist DMCs in the restructuring and reform of the energy sector through technical assistance and project support. Reforms take a long time and ADB's continued association is critical to ensure that all sections of society, especially the consumers, are benefited. Private sector participation will be encouraged. Capacity development and knowledge sharing are important elements of effectively promoting sector reforms and governance. In this connection, ADB will provide technical assistance support to the regulators in operationalization of the regulatory authority, tariff and subsidy analysis, licensing procedures, demand analysis, and all other activities needed to aid regulators in performing effectively.

90. In addition to adopting reforms and restructuring, assistance will be extended to DMCs that are establishing competitive electricity markets for benefit of the consumers. These markets need a certain level of maturity of the sector before they can be successfully launched. ADB will provide support for research, legislation, technology development, and the regulatory frameworks needed for establishing such markets.

VII. IMPLEMENTATION ARRANGEMENTS

91. Regional and Sustainable Development Department and the Energy Community of Practice will support ADB's operation departments in implementing the strategy, while maintaining an oversight role.