



Policy Paper

June 2009

Energy Policy

ABBREVIATIONS

ADB	–	Asian Development Bank
CO ₂	–	carbon dioxide
CDM	–	Clean Development Mechanism
DMC	–	developing member country
EBRD	–	European Bank for Reconstruction and Development
EITI	–	Extractive Industry Transparency Initiative
EU	–	European Union
GDP	–	gross domestic product
IEA	–	International Energy Agency
IED	–	Independent Evaluation Department
LNG	–	liquefied natural gas
LPG	–	liquefied petroleum gas
MDB	–	multilateral development bank
MDG	–	Millennium Development Goal
OECD	–	Organisation for Economic Co-operation and Development
PRC	–	People's Republic of China
RSDD	–	Regional and Sustainable Development Department

WEIGHTS AND MEASURES

btoe	–	billion tons of oil equivalent
C	–	Celsius
mb/d	–	million barrels per day
mtoe	–	million tons of oil equivalent
tcu	–	trillion cubic meters

NOTE

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

Vice President	U. Schäfer-Preuss, Knowledge Management and Sustainable Development
Director General	X. Yao, Regional and Sustainable Development Department (RSDD)
Director	W. Um, Sustainable Infrastructure Division, RSDD
Energy Committee	S. Chander (chair), A. Terway (co-chair), A. Jude, A. Guha, T. Jung, T. Kimura, R. Stroem, M. Tsuji, S. Tumiwa
Team leader	J.I. Kim, Principal Energy Specialist, RSDD
Team member	P. Calcetas, Senior Sector Officer, RSDD

TABLE OF CONTENTS

	Page
I. INTRODUCTION	1
II. SUMMARY OF THE REVIEW	2
III. THE ENERGY POLICY	3
IV. POLICY IMPLEMENTATION	4
A. Promoting Energy Efficiency and Renewable Energy	5
B. Maximizing Access to Energy for All	6
C. Promoting Energy Sector Reforms, Capacity Building, and Governance	8
D. Implementation Arrangements	9
V. RECOMMENDATION	10
APPENDIXES	
1. Policy Analysis	11
2. Results Framework for ADB's Energy Policy Implementation	36

I. INTRODUCTION

1. Rapid economic growth in developing Asia has been generating high level of demand for energy. According to the International Energy Agency (IEA), while the current global financial crisis is constraining short-term economic performance, primary energy demand in developing Asia is projected to almost double between 2006 and 2030. This growth is not sustainable if most of this energy has to be met by fossil fuels. Increased fossil fuel consumption will significantly increase greenhouse gas emissions. Scientists have documented a rise in atmospheric temperature and other significant climate changes, some of which have serious consequences for Asia and the Pacific. Therefore, addressing energy efficiency and climate change is a fundamental challenge to achieve sustainable development.

2. Meanwhile, the recent volatility in fuel prices has encouraged developing countries to focus on energy security, reduction of oil consumption, and development of indigenous energy sources. This has led to a rise in the use of coal, increasing global greenhouse gas emissions. Another major issue is meeting energy demand and providing access to modern forms of energy to all. About 1 billion people in Asia and the Pacific lack such access.

3. The Asian Development Bank (ADB) has been providing assistance to its developing member countries (DMCs) in the energy sector for the last 40 years, focusing on electricity sector expansion programs; interventions in the oil and gas sectors; institutional capacity building; and power sector reforms, governance, and efficiency improvements. ADB adopted its first energy policy in 1981, which sought to overcome the crisis caused by the oil price shocks of the 1970s.¹ It emphasized (i) developing energy infrastructure and indigenous energy sources, (ii) promoting efficiency, and (iii) creating markets conducive to foreign investment in DMCs.

4. The second energy policy paper, released in 1995, noted that, as investment in the power sectors of DMCs increased, they were becoming unmanageable and inefficient, mainly because of the dual role of the government as both policy maker and monopoly owner.² This second policy paper recognized the changing needs of the sector and recommended balanced infrastructure investment and the development of financially robust and efficient operations. Other recommendations included more emphasis on demand-side management, environmental protection, rural electrification, and renewable energy development.

5. A review of the Energy Policy in 2000 confirmed that the existing framework was appropriate and sound.³ However, taking into consideration ADB's revised operational priorities and the 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 more private investment. It recommended that the next review be undertaken in 2005 to ensure that ADB's energy operations are properly aligned with the needs of its DMCs.

6. In 2008, ADB completed the second review of its 1995 Energy Policy. This paper has been prepared to seek Board approval of the proposed updates to the policy in light of the review's findings, regional and global economic developments, and ADB's adoption of the long-

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 the Energy Policy*. Manila.

term strategic framework 2008–2020 (Strategy 2020).⁴ It also outlines the implementation of ADB's Energy Policy.

II. SUMMARY OF THE REVIEW

7. The Regional and Sustainable Development Department (RSDD) began the review of the Energy Policy in 2006 in consultation with energy experts in the operations departments. ADB's Energy Committee has also been involved in preparing the paper. In addition to the internal consultations, Management commissioned a 60-day external consultation process, which yielded a wide range of views from governments, civil society organizations, industry, academe, and other stakeholders.

8. The scale of energy use in Asia and the Pacific now and in the foreseeable future is expected to have far-reaching consequences. In developing Asia, the projected primary energy demand is expected to grow from 3,227 million tons of oil equivalent (mtoe) in 2006 to 6,325 mtoe by 2030, with the People's Republic of China (PRC) and India accounting for major shares. Projected rapid economic and population growth will drive much of the increase in energy demand. Industrialization, urbanization, and the replacement of noncommercial biomass fuels by commercial fuels will also contribute to the increase in demand.⁵ Other factors will be increased economic activities, higher living standards, and greater consumption by households. Higher demand for energy from developing Asia has prompted concerns about energy security. Long-term cooperative options need to be explored internationally to ensure production and use of energy at reasonable costs and in a sustainable manner.

9. Higher demand for energy must also be met in a socially, economically, and environmentally sustainable manner. As is now generally recognized, the threat of climate change is real and increasing. The accelerating emissions of greenhouse gases, and their close link to average global temperature, are likely to result in significant changes in the mean climate and its seasonal and annual variability, both globally and in Asia. Climate change models predict that, unless drastic measures are taken now, land regions of Asia will experience an annual mean warming of about 3° Celsius (C) in the decade of the 2050s and up to 5°C in the decade of the 2080s as a result of future increases in greenhouse gas concentrations.⁶

10. The impacts of rapid climate change are expected to be profound in Asia and the Pacific. From the Himalayan highlands to the rich tropical forests of Southeast Asia, and in the Pacific islands, many natural ecosystems are vulnerable to climate change and some will probably 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.⁷ Scientists have observed abnormal weather patterns and impacts recently, including (i) more intense tropical storms, (ii) more severe and more frequent droughts and floods, (iii) accelerated melting of glaciers and rises in the sea level, (iv) higher frequency of forest fires, (v) shortages of freshwater,

⁴ ADB. 2008. *Strategy 2020: The Long-Term Strategic Framework of the Asian Development Bank 2008–2020*. Manila.

⁵ Developing Asia, as defined by the IEA, includes Afghanistan; Bangladesh; Bhutan; Brunei Darussalam; Cambodia; the People's Republic of China; Fiji Islands; French Polynesia; Hong Kong, China; India; Indonesia; Kiribati; Democratic People's Republic of Korea; the Lao People's Democratic Republic; Malaysia; Maldives; Mongolia; Myanmar; Nepal; New Caledonia; Pakistan; Papua New Guinea; the Philippines; Samoa; Singapore; Solomon Islands; Sri Lanka; Thailand; Tonga; Taipei, China; Viet Nam; and Vanuatu.

⁶ Intergovernmental Panel on Climate Change (IPCC). 2007. *IPCC Fourth Assessment Report: Summary for Policymakers of Working Group I Report—The Physical Science Basis*. UK: Cambridge University Press.

⁷ Stern, Nicholas. 2006. *Stern Review: The Economics of Climate Change*. London: Treasury Office of the Government of the United Kingdom and Northern Ireland.

(vi) threatened crop production and aquaculture, (vii) higher incidence of heat-related and infectious diseases, and (viii) greater risk of loss of life and property.

11. Access to modern and reliable energy services remains essential for sustainable human development, economic growth, higher quality of life, and better delivery of education and health services. Though access to energy was not identified as a Millennium Development Goal (MDG), studies have shown that MDG targets cannot be met without modern energy services. Access to energy is essential to reducing poverty.⁸ In the absence of energy services, the rural poor must resort to the use of traditional biomass sources—such as wood, charcoal, dung, and waste materials—for cooking and heating. The IEA estimates that 2.5 billion people in developing countries continued to rely on traditional biomass to meet their energy needs in 2004; more than half of them are in the PRC (700 million) and India (565 million).⁹ Use of modern fuels and electricity in households will also address gender bias by increasing productivity and reducing indoor pollution.

12. A review of the current constraints, the outlook, and the emerging energy issues in Asia and the Pacific found that the 1995 Energy Policy continues to provide a sound basic framework for addressing the needs of DMCs. Policy elements on energy efficiency, energy and the environment, rural energy development, structural reform, and regional cooperation remain especially relevant. A detailed assessment of key policy issues was conducted, taking into account the 1995 Energy Policy, its 2000 review, the findings of this review, and priorities established in Strategy 2020 (Appendix 1).

III. THE ENERGY POLICY

13. In response to the challenges described in paras. 8–11, and to reflect the review's findings, feedback from stakeholders, the lessons learned, and policy analysis, the 1995 Energy Policy is being updated. The 2009 Energy Policy is congruent with Strategy 2020, enabling energy operations to be aligned with ADB's overall strategy emphasizing energy security, facilitating a transition to a low-carbon economy, universal access to energy, and for achieving ADB's vision of a region free of poverty.

14. The objective of the 2009 Energy Policy is to help DMCs provide reliable, adequate, and affordable energy for inclusive growth in a socially, economically, and environmentally sustainable way. It will emphasize energy efficiency and renewable energy; access to energy for all; and energy sector reforms, capacity building, and governance.

15. To achieve these objectives, policy implementation will be based on the following principles:

- (i) Support for energy efficiency improvements and renewable energy projects will be prioritized and broadened to reach as many sectors in as many ways as possible. This will (a) ease growth in fossil fuel demand and upward pressure on energy prices, (b) improve energy security, and (c) reduce emissions of greenhouse gases.
- (ii) Efforts to provide energy services for inclusive economic growth will be wide-ranging, and programs to extend energy services to communities and groups will

⁸ Modi, V., S. McDade, D. Lallement, and J. Saghir. 2006. *Energy Services for the Millennium Development Goals*. New York: Emergency Sector Management Assistance Programme, United Nations Development Programme, United Nations Millennium Project, and World Bank.

⁹ IEA. 2006. *World Energy Outlook 2006*. Paris.

- be accelerated. Because MDG targets cannot be met without access to modern energy services, access to energy is essential to reducing poverty.
- (iii) Effective regional cooperation in the energy sector will be promoted to strengthen energy security.
 - (iv) Energy sector reforms, capacity building, and governance will be emphasized to increase investment and efficient use of resources. Private sector participation (and public-private partnerships) will be encouraged to enhance energy sector efficiency through competition, and to increase investable resources, but not as the end objective of reforms.
 - (v) All energy sector investments will comply with ADB safeguards policies regarding the environment, involuntary resettlement, and indigenous peoples to ensure that affected persons are protected from impoverishment risks and development programs for such vulnerable groups are incorporated and implemented.
 - (vi) ADB will not be involved in financing nuclear power generation.
 - (vii) Since coal and oil are internationally traded commodities with established commercial interests, ADB will not finance coal mine development except for captive use by thermal power plants, and oil field development except for marginal and already proven oil fields.
 - (viii) As a regional knowledge bank, ADB will promote superior knowledge management and dissemination of good practices and lessons learned. ADB will also support advocacy and assistance to DMCs in technology transfer and deployment.
 - (ix) ADB will collaborate with a range of development partners, including international development agencies, multilateral and bilateral institutions, the private sector, nongovernment organizations, community-based organizations, and philanthropic foundations.
 - (x) Specific situations will be identified in each DMC for planning and designing interventions, especially for the Pacific DMCs, given their limited energy resources and unique vulnerability.
 - (xi) Policy implementation will be monitored by a results framework (para. 49).

IV. POLICY IMPLEMENTATION

16. In line with the objectives of the 2009 Energy Policy, policy implementation has taken into account emerging issues and options, lessons learned from past operations, and the experiences of other development partners including the World Bank. It has also been supported by an examination of issues related to fossil fuels, power generation and district heating, power sector reforms and restructuring, regional cooperation, and the special needs of the Pacific DMCs. This policy implementation is also a coherent expression of important elements of Strategy 2020 that prioritize energy-related objectives and identify the institutional capabilities needed for the future within a changing regional, global, and technological context.

17. For more efficient implementation, ADB will seek further collaboration with a wider range of development partners. To mobilize necessary funds and modalities for new initiatives for the energy sector, such as the Energy Efficiency Initiative and Carbon Market Initiative, a financing partnership facility and trust funds have been set up. In addition, funds have been mobilized to cofinance specific projects and initiatives. ADB will also collaborate closely with global climate change initiatives such as the Climate Investment Funds to help its DMCs move toward a low-carbon economy.¹⁰ ADB will (i) continue to seek commitments for cofinancing models, (ii) share

¹⁰ The Climate Investment Funds were initiated by the governments of Japan, the United Kingdom, and the United States to help DMCs transform into low-carbon and climate-resilient economies.

knowledge and experience, and (iii) coordinate efforts with a range of development partners. Given the huge investment requirements for the energy sector in Asia and the Pacific, as well as the need to maximize economic efficiency, ADB will also strengthen the role of the private sector, and enhance the synergy of ADB's public and private sector operations.

18. To help DMCs move toward a low-carbon economy, ADB will provide assistance for mainstreaming climate change mitigation activities in DMCs, such as (i) financing greenhouse gas abatement projects, (ii) conducting upstream analysis of options for meeting power sector expansion, (iii) incorporating carbon footprints of the projects, and (iv) providing support to build technical capacity to identify and evaluate low-carbon development strategies.

19. Policy implementation is guided by three pillars emphasized in the Energy Policy: (i) promoting energy efficiency and renewable energy; (ii) maximizing access to energy for all; and (iii) promoting energy sector reform, capacity building, and governance.

A. Promoting Energy Efficiency and Renewable Energy

20. Harnessing energy efficiency is one of the most effective ways to meet energy demand, while addressing global warming. Increasing the efficiency of energy use and supply will yield more service value from each primary energy unit consumed, as well as produce large environmental and economic benefits. Energy efficiency is essential to (i) ease growth in fossil fuel demand and upward pressure on energy prices, (ii) improve energy security, and (iii) reduce emissions of greenhouse gases.

21. Improving energy efficiency by examining both demand-side and supply-side alternatives is a priority of ADB. Additional efforts will be made under the policy to decrease the demand through energy efficiency initiatives—including the 3Rs of reduce, reuse, and recycle—and increases in system efficiencies. While there are many opportunities to improve energy efficiency, the increasing demand for power in the region will require significant investment in new generation capacity. Thus, while energy efficiency initiatives and renewable energy should have a priority, this should not be at the expense of "turning off the lights."

22. ADB will expand its operations in the industry sector by collaborating with industry associations, domestic banks, and specialized energy efficiency agencies and energy service companies. ADB will assist in identifying energy efficiency options and preparing financial assistance and guarantees. To address commercial and residential energy needs, which account for 30% of total energy demand, ADB will assist DMCs in framing enabling legislation and efficiency standards that require the manufacture and use of energy efficient equipment and goods, especially consumer goods. This may also include establishment of labeling authorities.

23. With the increased viability of new and renewable sources of energy because of technical advances and the option for off-grid, community-based electricity supply, ADB will seek out renewable energy projects for financing. To increase the use of clean energy in DMCs, ADB will facilitate wider deployment of clean energy technologies by raising awareness, promoting policy and regulatory incentives to encourage their use, and promoting financing packages that share risks and lower costs. Considering the global interest in biofuels, ADB will support further studies to assess the costs and benefits of sustainable biofuels development, particularly on food security, the net energy balance of crops, and environmental impacts. Where the benefits indicate it is appropriate, ADB will support their development.

24. The financial sustainability of energy efficiency and renewable energy projects improves with additional revenue from the Clean Development Mechanism (CDM), i.e., the sale of certified emission reductions. The ADB Carbon Market Initiative provides up-front financing and continuous technical support to developers and sponsors of projects with greenhouse gas mitigation benefits that can qualify as eligible CDM projects under the Kyoto Protocol. ADB will continue to provide assistance to DMCs in designing projects that are eligible for certified emission reductions.

25. ADB will promote the expansion of policies that encourage the development of renewable energy. The objective is to create a framework that makes investing in renewable energy commercially viable. In addition, ADB will assume greater—but thoroughly assessed—risks and act as a catalyst for investments that the private sector might not otherwise be willing to make. ADB will help facilitate direct private sector investments that support inclusive growth and improve the environment.

26. Given the enormity of the challenges of energy security and climate change, ADB has strengthened its institutional commitment and launched a strategic approach with the Clean Energy and Environment Program. This program includes several initiatives to help DMCs increase their use of renewable energy and energy efficiency technologies. ADB can play a catalytic role in advancing the clean energy agenda in Asia and the Pacific. ADB's target to increase its clean energy investments to \$1 billion a year starting from 2008 was achieved in 2008, establishing a platform to increase the target to \$2 billion per year from 2013.¹¹ While this is only a fraction of the region's needs, this contribution will catalyze significant additional resources from other sources.

B. Maximizing Access to Energy for All

27. MDG targets cannot be met without modern energy services. Access to energy is essential to reducing poverty. In accordance with the 2009 Energy Policy and Strategy 2020's inclusive growth development agenda, policy implementation will actively engage DMCs and other bilateral and multilateral development partners to address the lack of access to energy. ADB will support DMCs' sustainable rural electrification efforts designed to provide electricity to all, especially to the rural population.

28. ADB will focus especially on remote communities that are less likely to be connected to the electricity grid in the near future. ADB will develop small-scale demonstration projects that can be replicated in other locations, such as remote mountain villages or island communities. Such projects will be packaged into larger bankable-size projects and, if feasible, will be added to main energy sector projects as a special energy access component.

29. Regional cooperation can play a vital role in ensuring energy security in a sustainable manner. Subregional power trade can help meet energy demand while maximizing scarce natural resources. By utilizing different peak times of neighboring countries, regional power trade can reduce the need to build 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 on energy.

¹¹ This includes all ADB's investments that will result in lower greenhouse gas emissions, such as renewable energy, energy efficiency, and cleaner fuels projects.

30. ADB will continue to identify and implement projects and programs that promote regional energy trade with economic and environmental benefits for the entire region. ADB will promote a policy framework that enables regional trade of electricity and gas, as well as infrastructure to enhance regional cooperation and trade in the energy sector. ADB will also focus on removing barriers to greater cooperation and trade in the energy sector, seeking ways to address regulatory, currency, and trading risks, as well as political uncertainty.

31. ADB will work with DMCs to address their electricity demand in a sustainable and planned manner. ADB will encourage the utilities to incorporate into their energy planning the key elements of integrated resource planning and enhance demand for low-carbon investments.¹² When sectorwide interventions are planned for DMCs, ADB will help develop energy sector road maps that have substantial electricity sector investments and identify project pipelines with adequate flexibility.

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

33. To meet the electricity needs of the region, large capacity additions will be required for which coal-based generation will grow. ADB will encourage DMCs to adopt available cleaner technologies, such as fluidized bed combustion, supercritical and ultra-supercritical boilers, and flue gas desulfurization. As new technologies—such as integrated gasification combined cycle and carbon capture and storage (or sequestration)—are shown to be technically feasible and economically viable, ADB will support their deployment in DMCs to increase their financial viability. ADB will also assist DMCs in collaborating with developed countries on long-term technology transfer agreements for new and better technologies under development. It will selectively support coal-based power projects if cleaner technologies are adopted and adequate mitigation equipment and measures are incorporated into the project design. Some DMCs with smaller size grids that depend on oil-based power supply or imports from neighboring countries may need to install coal-based power plants using subcritical boiler technology. Such diversification will improve power system reliability and energy security, and may be the least-cost option. In the interest of economical and developmental needs, ADB will support such base-load power plants, if found to be justified after due diligence. Assistance will also be extended to retrofit existing power plants that need to improve efficiency.

34. ADB will continue to support financing natural gas-based power plants, because of their environmental benefit.

35. Although ADB will encourage the adoption of renewable energy sources for power generation, oil-based power plants will continue to be a major component of the electricity grids in some island economies. Hence, ADB will continue to finance modern, small, oil-based power plants for island communities, remote areas, and sparsely populated areas where other options are not feasible.

36. Huge capacity addition in power generation will require substantial investments in transmission and distribution facilities. ADB will continue to support installation of modern

¹² Integrated resource planning is a least-cost planning process that (i) treats supply addition options and demand-side management options the same, and (ii) incorporates and internalizes environmental costs and benefits more fully than in conventional least-cost analyses.

transmission and distribution systems to transmit electricity efficiently from generation facilities to consumers, including upgrading of existing systems to reduce technical losses and enable competition when open access is permitted by law.

37. Many DMCs need to extend their 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. Where viable, the use of renewable energy (e.g., solar and geothermal heat pumps) will be encouraged to complement existing district heating systems.

38. ADB will continue its policy of not financing any oil and gas field exploration projects because of the associated risks. As oil is an internationally traded commodity with established private sector involvement, ADB will not, in general, fund oil field development projects. If necessary, ADB will consider assistance to develop marginal and already proven oil fields, if such a development is economically sound. ADB will provide support for refining, transportation, and distribution of petroleum products. ADB will continue to provide assistance for gas field development, and transportation and distribution of gas. ADB will also provide policy assistance to (i) promote a policy environment that encourages private sector participation, greater competition, and independent and transparent regulation in oil and gas sectors; and (ii) assist DMCs in preparation and management of databases on hydrocarbon resources, skills enhancement, and financial management.

39. Since coal is a major source of energy for electricity and heat, several DMCs will aggressively pursue coal mine development. As coal is an internationally traded commodity, ADB will maintain its current policy of not directly financing coal mine development except for captive use by power plants. This is the case when a substantial part of the production of thermal coal is tied to long-term fuel supply contracts, or administrative allocation, for power plants. ADB will not finance when a coal mine is envisaged to be developed to sell thermal coal to the open markets or is linked through international trading channels to power generation in another country because the transaction will be considered market-based.

40. ADB will support (i) safety in coal mines, (ii) environmentally and socially sound mining practices and efficient use of coal for power generation, (iii) carbon capture and storage (or sequestration) once technologically viable, (iv) coal bed methane extraction and use, (v) coal gasification, (vi) coal scrubbers, (vii) waste coal utilization, and (viii) efficient coal transportation over land and sea. ADB will also support safety and efficiency improvements in the transportation of oil and liquefied natural gas (LNG), including oil and LNG terminals, storage facilities, pipelines, and marine transportation.

C. Promoting Energy Sector Reforms, Capacity Building, and Governance

41. ADB will align its energy operations on reforms, capacity building, and governance by continuing to help DMCs restructure and reform their energy sectors through technical assistance and project support for regulating natural monopolies and introducing competition where feasible. It will build on the lessons from previous sector reforms. As reforms can take a long time, ADB's continued association is needed to ensure that all sections of society, especially consumers, benefit. Private sector participation will be encouraged, particularly public-private partnerships. However, privatization will not be the target or the end objective of ADB's sector reform activities; instead, it will be one of the options available to enhance energy sector efficiency and increase investable resources. Sector reforms, including privatization or corporatization, will be designed and sequenced carefully on a country-by-country basis in a transparent manner.

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

43. ADB will encourage DMCs to adopt tariff structures that promote energy conservation and penalize peak-hour and peak-season consumption, and consumption with poor power factor and load factor. Cross-subsidies from one class of consumers to another should be minimized; lifeline rates to consumers with very low monthly consumption could be an acceptable compromise. Subsidies, if any, should be made transparent, quantifiable, targeted, and capable of being phased out in the medium term by designing appropriate social safety nets. ADB will similarly assist in the establishment of independent regulatory mechanisms to address transparency in the management of the heating sector, including tariff setting and targeted or direct subsidies.

44. Capacity development is an important element of effectively promoting sector reforms and governance. Human resource development is a long-term investment in the effectiveness of the energy sector. ADB will provide technical assistance to regulators as well as utilities to bring into operation the regulatory authority, tariff and subsidy analysis, licensing procedures, demand analysis, and all other activities needed for regulators to perform effectively. In addition, ADB will provide technical assistance on capacity development relevant to whole areas of energy operations, such as energy planning, demand forecast, financial management, operations and maintenance of assets, and economic assessment.

45. ADB is promoting wider knowledge production and sharing through regional knowledge hubs. These hubs are positioned to become a strong support to strengthen the capacity of Asia and the Pacific to generate innovative concepts and promote science, technology, and management development related to clean energy. ADB will be an advocate for and assist DMCs in technology transfer in energy efficiency, renewable energy, and cleaner technologies through demonstration projects for deployment.

46. ADB will help DMCs prepare and implement energy projects, emphasizing accountability, participation, predictability, and transparency—the basic elements of good governance. ADB endorsed the Extractive Industry Transparency Initiative in 2008 and became a supporting organization to enhance revenue transparency in ADB-assisted energy extractive projects. ADB will promote greater transparency in procurement and improvements in corporate and financial management. ADB will support the appropriate division of regulatory responsibilities among policy, regulatory, and operational roles within a particular national context, and across different levels of government. Where possible, ADB will promote regulatory cooperation and skills development. ADB will prioritize regulation of natural monopolies and more competition in other segments of the energy sector. ADB will support reforms that improve the governance and efficiency of public enterprises operating in the energy sector, and where appropriate, increase competition and efficiency. If requested by a DMC, ADB will support the privatization of public enterprises and assist with the transparent transition of such enterprises from government to private ownership.

D. Implementation Arrangements

47. RSDD will support ADB's operations departments in policy implementation, and the Energy Committee will provide technical oversight with RSDD's secretariat support.

48. ADB will assist DMC governments in developing an implementation plan for its energy sector and regional cooperation strategy based on policy dialogue. This may be in conjunction with the development of the country partnership strategy and regional cooperation strategy and program, or in a separate planning process, whichever is most appropriate for the individual country and subregion.

49. A framework that includes a set of simple and implementable directional indicators for ADB to monitor the progress of the policy implementation is in Appendix 2. The framework identifies broad outcomes to be achieved and the proposed contribution of ADB to the realization of those outcomes. However, since each country will decide its own strategy and policy options, it is difficult to indicate targets for overall ADB policy implementation in the energy sector. The indicators for each pillar in the framework will be monitored during preparation of biennial energy sector reports and continuously fine-tuned in consultation with the concerned departments.

50. Policy implementation requires adequate human and financial resources. The skills mix and technical capacity must be enhanced in energy efficiency and renewable energy development in close consultation with the Energy Committee and the Budget, Personnel, and Management Systems Department. Further, when the number of energy projects rises, an increase in staff positions with energy specialization will be required. Financial resources will be required to implement the policy, including preparation of country energy sector road maps. These requirements would be met by reprioritization of available budget funds, trust funds under the Energy Efficiency Initiative, the Clean Energy Financing Partnership Facility, and technical assistance sources.

V. RECOMMENDATION

51. The President recommends that the Board approve the 2009 Energy Policy, as described in paras. 13–15, and endorse the Energy Policy Implementation as set out in paras. 16–46, which taken together will replace the 1995 Energy Policy and the 2000 Review of the 1995 Energy Policy.

52. The policy objective and principles are expected to remain valid for a considerable period of time. Therefore, the next policy review will be undertaken only if and when circumstances warrant.

POLICY ANALYSIS

1. The proposed changes to 1995 Energy Policy¹ of the Asian Development Bank (ADB) and the decision to realign policy implementation are based on an overview of the changes affecting Asia and the Pacific, with a focus on energy-related developments and strategic concerns. They are supported by reviews of ADB's experience in the energy sector and the relevant experience of other multilateral development banks (MDBs). A detailed assessment of key policy issues was also conducted, taking into account the 1995 policy, the 2000 review,² the findings of this review, and priorities established in the long-term strategic framework 2008–2020 (Strategy 2020).³

A. The Energy Sector: An Overview

2. The demand for energy in Asia and the Pacific is increasing rapidly, driven by unprecedented economic growth. According to The International Energy Agency (IEA), primary energy demand in developing Asia is expected to grow from 3.2 billion tons of oil equivalent (btoe) in 2006 to 6.3 btoe in 2030.⁴ This growth is not sustainable if most of this energy has to be met by fossil fuels. Higher fossil fuel consumption will significantly increase greenhouse gas emissions.

3. It is widely known that global warming is caused by greenhouse gas emissions, largely from the heavy use of fossil fuels. Significant changes in climate are being observed, some of which may have serious consequences worldwide. Many economies have adopted policies to reduce their projected energy demand. However, much more needs to be done to reverse the current trend of increasing greenhouse gas emissions.

4. The volatility of international oil prices places an extra and disproportionate burden on developing countries. Oil supply and price instability have led to a sharper focus on energy security, lowering oil consumption and subsidies, and greater 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 frameworks, energy conservation and efficiency, optimum use of fossil fuels, greater use of renewable energy, and market orientation towards sustainable development.

5. In Asia and the Pacific, other compelling issues also merit attention: increasing energy demand, and the challenge of providing access to modern forms of energy to all. About 1 billion people in the region currently do not have such access.

6. ADB has been involved in the energy sector of its developing member countries (DMCs) since 1969. ADB's first energy policy, issued in 1981, focused on overcoming the crisis caused by the oil price shocks.⁵ It emphasized (i) developing energy infrastructure and indigenous energy sources, (ii) promoting efficiency, and (iii) creating markets conducive to foreign investment in DMCs.

¹ ADB. 1995. *Bank Policy for the Energy Sector*. Manila.

² ADB. 2000. *Energy 2000: Review of Energy Policy*. Manila.

³ ADB. 2008. *Strategy 2020: The Long-Term Strategic Framework of the Asian Development Bank 2008–2020*. Manila.

⁴ IEA. 2008. *World Energy Outlook 2008*. Paris.

⁵ ADB. 1981. *Role of the Bank in the Energy Sector in the Region*. Working Paper No. 2. Manila.

7. The second energy policy paper (footnote 1), released in 1995, noted that as investment in the power sectors of DMCs increased, they were becoming unmanageable and inefficient, mainly because of the dual role of the government as both policy maker and monopoly owner. This second policy paper recognized the changing needs of the sector and recommended balanced infrastructure investment and development of financially robust and efficient operations. It suggested full recovery of costs, reduction of subsidies, establishment of independent regulatory mechanisms, and tariffs based on transparent principles. The paper further recommended corporatization and commercialization of government-owned utilities, private sector participation, and the development of regional trade in energy. Other recommendations included enhanced focus on demand-side management, environmental protection, rural electrification, and renewable energy development.

8. The 1995 Energy Policy was reviewed in 2000 (footnote 2). This review confirmed that the existing framework was appropriate and sound. However, taking into consideration ADB's revised operational priorities and the changing needs of the DMCs, the review recommended the development of independently regulated and corporatized energy markets, which would lead to more efficient uses of energy, lower costs, and more private investment. It recommended 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 involvement by restructuring the energy sector and creating an enabling environment for private investors; (iii) addressing regional and global environmental impacts, especially acid rain problems, supporting clean energy and the Kyoto Protocol⁶ mechanisms for greenhouse gas abatement, and financing renewable energy projects; and (iv) promoting regional cooperation. Within the framework of these basic principles, the 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 called for a reassessment after 5 years.

9. ADB's energy sector operations have also been evaluated by the Independent Evaluation Department (IED), which found they are appropriate, timely, and generally successful (paras. 29–30). The results of the evaluation suggested that ADB's support for the energy sector should be driven by two key policy considerations: energy efficiency and good governance.

B. Energy Demand Outlook

10. The world's primary energy demand is projected to increase by 45% from 2006 to 2030, an annual average growth rate of about 1.6% (footnote 4). In 2030, the total energy demand will be 17.0 btoe, based on a scenario that assumes no further government policies are introduced beyond those adopted by mid-2008. This scenario, prepared by the IEA and referred to as the reference scenario, suggests that about 87% of the increase in world energy use will come from countries not in the Organisation for Economic Co-operation and Development (OECD). In these non-OECD countries, economic and population growth rates will continue to be significant. Fossil fuels will account for more than 79% of the projected increase in primary energy demand,

⁶ The United Nations Framework Convention on Climate Change established the Conference of Parties (COP) as its supreme body with the responsibility for overseeing progress towards 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 emission of greenhouse gases to an average of approximately 5.2% below their 1990 levels over the commitment period of 2008–2012. This is called the Kyoto Protocol to the Convention.

with oil remaining the major component of the primary energy mix. While natural gas demand will grow (mainly because of the increasing preference for gas-based electricity generation), coal will continue to be the predominant fuel source for electricity generation. The share of nuclear power (5.3%) and hydropower (2.4%) will remain generally constant. The share of biomass-based energy consumption is expected to decline because of increased use of modern fuels in rural regions of developing countries. The share of other renewable sources, excluding large hydropower and biomass, will be about 2.1% of the global primary energy demand (Table A1.1).

Table A1.1: World Primary Energy Demand in the Reference Scenario
(million tons of oil equivalent)

Item	1980	2000	2006	2015	2030	2030 share (%)	2006–2030 (%) ^a
Coal	1,788	2,295	3,053	4,023	4,908	28.8	2.0
Oil	3,107	3,649	4,029	4,525	5,109	30.0	1.0
Gas	1,235	2,088	2,407	2,903	3,670	21.6	1.8
Nuclear	186	675	728	817	901	5.3	0.9
Hydropower	148	226	261	321	414	2.4	1.9
Biomass and waste	748	1,045	1,186	1,375	1,662	9.8	1.4
Other renewables	12	55	66	158	350	2.1	7.2
Total	7,223	10,034	11,730	14,121	17,014	100	1.6

^a Average annual growth rate.

Source: International Energy Agency. 2008. *World Energy Outlook 2008*. Paris.

11. 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. To meet growing energy demand, investments of more than \$26.3 trillion (in 2007 US dollars) will be required worldwide, and greenhouse gas emissions are projected to increase.⁷ These demand projections have unsustainable environmental implications. To assess the implications for the energy sector of efforts to put the world onto a different trajectory for greenhouse gas emissions, the IEA developed two stabilization scenarios for the output of greenhouse gases of 550 and 450 parts per million CO₂-eq in 2030.

12. In the 550 policy scenario, global energy-related CO₂ emissions peak in 2025 and then decline slightly to 33 gigatonnes in 2030—19% lower in 2030 than in the reference scenario. The total energy demand in 2030 is 9% lower than in the reference scenario. The role of renewable energy—mainly wind—expands, while the demand for coal falls 27% and the demand for both gas and oil declines by 8%. In the 450 policy scenario, emissions fall sharply after 2020, as a result of much stronger and broader policy action. The total energy demand in 2030 is 16% lower than in the reference scenario. Hydropower, biomass, and other renewables are deployed faster in power generation, accounting for 40% of total electricity generation worldwide in 2030. Global energy-related CO₂ emissions peak in 2020 at 32.5 gigatonnes and then decline to 25.7 gigatonnes in 2030 (Table A1.2). While the 550 policy scenario could be achieved through the widespread deployment of existing carbon-efficient technologies, further technological progress will greatly facilitate and lower the costs of meeting it. The 450 policy scenario can only be achieved through expanded research, development, and demonstration and deployment of technologies. The 550 policy scenario requires an additional investment of \$1.2 trillion on power plants and \$3 trillion in energy efficiency relative to the reference scenario.

⁷ Energy-related carbon dioxide emissions are estimated to be 45% higher in 2030 than in 2006.

The 450 policy scenario requires further power plant investments of \$2.4 trillion in addition to those in the 550 policy scenario.

**Table A1.2: World Primary Energy Demand in 2030
Under Different Climate Policy Scenarios**
(million tons of oil equivalent)

Item	Reference Scenario	550 Policy Scenario	450 Policy Scenario
Coal	4,908	3,575	2,381
Oil	5,109	4,689	4,308
Gas	3,670	3,383	2,950
Nuclear	901	1,086	1,364
Hydropower	414	456	555
Biomass and waste	1,662	1,826	2,119
Other renewables	350	468	683
Total	17,014	15,483	14,361

Source: International Energy Agency. 2008. *World Energy Outlook 2008*. Paris.

13. In developing Asia,⁸ the projected primary energy demand is expected to grow from 3,227 mtoe in 2006 to 6,325 mtoe by 2030, with the People's Republic of China (PRC) and India accounting for a major share. Much of the increase in energy demand will be because of projected rapid economic and population growth. Industrialization, urbanization, and the replacement of noncommercial biomass fuels by commercial fuels will also contribute to the increase in demand. Other factors will be increased economic activities, higher living standards, and greater consumption by households. A review of the demand trends in developing Asia according to fuel types shows that coal will continue to dominate, with a share of 51% in 2030 (compared with 49% in 2006), followed by oil at 24% (23% in 2006), biomass and waste at 10% (17% in 2006), and natural gas at 9% (7% in 2006). Oil demand will be dominated by the PRC, where the demand will rise to 16.6 million barrels per day (mb/d) in 2030—more than half the total Asian oil demand of about 30.8 mb/d in 2030. Electricity demand is expected to grow the fastest in India (5.7% per year) between 2006 and 2030, followed by the PRC (4.6% per year). Hydropower output is projected to increase in developing Asia, as most of the potential is yet to be exploited. Of the \$26.3 trillion in investment required worldwide for the energy sector, developing Asia will account for more than \$7.4 trillion; the PRC alone will need about \$4.2 trillion in investment.

C. Energy Security

14. 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, including short-term risks to economic growth. Many economies in Asia and the Pacific are growing rapidly, which results in higher energy consumption. Oil supply is heavily dependent on the politically volatile Middle East. Since energy independence is not likely, long-term cooperative options need to be explored at the international level to ensure production and use

⁸ Developing Asia, as defined by the IEA, includes Afghanistan; Bangladesh; Bhutan; Brunei Darussalam; Cambodia; the People's Republic of China; Fiji Islands; French Polynesia; Hong Kong, China; India; Indonesia; Kiribati; Democratic People's Republic of Korea; the Lao People's Democratic Republic; Malaysia; Maldives; Mongolia; Myanmar; Nepal; New Caledonia; Pakistan; Papua New Guinea; the Philippines; Samoa; Singapore; Solomon Islands; Sri Lanka; Thailand; Tonga; Taipei, China; Viet Nam; and Vanuatu.

of energy at reasonable costs and in a sustainable manner. Extensive use of fossil fuels generates large volumes of greenhouse gases. Recent studies suggest that to address energy security, energy consumption must be reduced by aggressively pursuing efficient energy use.⁹ This can be achieved to varying degrees by (i) improved vehicle efficiency, (ii) better urban planning, (iii) more use of new and renewable energy sources, (iv) use of alternate fuels, and (v) greater emphasis on demand-side management. Another approach is diversifying the energy portfolio and enhancing regional cooperation, including facilitating international trade, and cross-border investments. Managing market volatility is a challenge; maintaining reserve stock is an option but it is useful for only a limited duration. Because the issues in addressing energy security are numerous, an appropriate macroeconomic policy framework is needed that focuses on comprehensive plans to mitigate energy supply risks. Nuclear power is also set to stage a comeback, especially in the OECD countries and ADB's larger DMCs.

D. Climate Change

15. As is now generally recognized, the threat of climate change is real and increasing. The accelerating emissions of greenhouse gases, and their close link to average global temperature, are likely to result in significant changes in mean climate and its seasonal and annual variability, both globally and in Asia. Greenhouse gas emissions are, for the most part, the product of human activities—primarily the burning of fossil fuels and, to a lesser extent, the changes in land use (especially deforestation). The equilibrium that existed for several centuries between various sources of greenhouse gas emissions and CO₂ sinks has been considerably disturbed because of industrialization, urbanization, and the fourfold increase in world population in the 20th century.¹⁰ Climate change models predict that land regions of Asia will experience an annual mean warming of about 3° Celsius (C) in the decade of the 2050s and up to 5°C in the decade of the 2080s as a result of future increases in greenhouse gas concentrations.¹¹

16. The impacts of rapid climate change are expected to be profound in Asia and the Pacific. From the Himalayan highlands to the rich tropical forests of Southeast Asia, and in the Pacific islands, many natural ecosystems are vulnerable to climate change and some will probably 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.¹² Scientists have observed abnormal weather patterns and impacts recently, including (i) more intense tropical storms, (ii) more severe and more frequent droughts and floods, (iii) accelerated melting of glaciers and rises in sea level, (iv) higher frequency of forest fires, (v) shortages of freshwater, (vi) threatened crop production and aquaculture, (vii) higher incidence of heat-related and infectious diseases, and (viii) greater risk of loss of life and property. The insurance industry projects hundreds of billions of dollars in global economic damage from climate change each year. The Intergovernmental Panel on Climate Change estimates that if atmospheric CO₂ concentrations were to double from pre-industrial levels, the average global temperature is likely to rise by 2.0–4.5°C: “while the developing countries are expected to experience larger percentage losses, global mean losses could be 1–5% of the gross domestic product (GDP) for 4°C of warming” (footnote 11). These changes would severely hinder long-term global and regional efforts to create a healthier, more prosperous, and sustainable world.

⁹ World Bank. 2005. *Energy Security Issues*. Washington, D.C.

¹⁰ In 2006, per capita energy-related carbon dioxide emissions in developing Asia was 2.4 tons compared with the world average of 4.3 tons.

¹¹ Intergovernmental Panel on Climate Change (IPCC). 2007. *IPCC Fourth Assessment Report: Summary for Policymakers of Working Group I Report—The Physical Science Basis*. UK: Cambridge University Press.

¹² Stern, Nicholas. 2006. *Stern Review: The Economics of Climate Change*. London: Treasury Office of the Government of the United Kingdom and Northern Ireland.

17. The international community has been calling for drastic measures to significantly reduce and stabilize the concentration of greenhouse gas levels in the atmosphere. Some of the options identified are to (i) take global measures to transform the way energy is used, (ii) promote research and development, (iii) finance the transition to cleaner energy, (iv) manage the impact of climate change, and (v) tackle illegal logging. The present predicament was not caused by recent developments, but the continuous unsustainable use of energy over many decades. With significant economic growth of the emerging economies, energy use will continue to increase briskly unless mitigation measures are taken. Collective global action is needed.

18. The first step towards stabilizing atmospheric greenhouse gas concentration is to promote energy conservation and efficiency. Options are numerous. In 2006, oil accounted for about 39% of global carbon emissions, coal for 41%, and natural gas for the remaining 20% (footnote 4). Since most of the oil consumption was for transportation, efficiency in transportation is clearly a priority area. Manufacture and use of more efficient vehicles, sustainable biofuel development, and better urban planning can mitigate the production of greenhouse gases to a large extent. Greater efficiency in coal-fired electricity generation and opting for cleaner fuel sources will reduce carbon emissions significantly. Residential and commercial buildings account for a significant component of electricity demand today. Efficient lighting, heating and cooling equipment, and other appliances will also address energy efficiency and conservation. Industrial energy use also needs to be made more efficient. Other options for stabilizing carbon levels include improving the efficiency of power systems (both on the supply and demand sides), using alternate sources of clean energy, developing nuclear power, and exploring long-term options such as CO₂ capture and storage.

19. Many countries have announced policies to address climate change issues. Implementing these will be a challenge, and substantial efforts will be needed from the developed and developing world. All countries need to focus first on energy conservation and improving energy efficiency. Many technologies are available for reducing carbon emissions, and research is continuing. These technologies have to be transferred to developing countries and be integrated with the markets for carbon emission reduction credits through energy efficiency and renewable energy projects. Developing economies, in their drive to meet increasing energy needs, need to avoid excess consumption, waste, and unsustainable energy use. While planning capacity addition, energy-efficient options should be seriously considered. These activities will require supporting policy decisions, enabling legislation, and finance. Financing requirements, which are substantial, will have to come 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 government efforts.

20. However, mitigation measures cannot prevent the climate changes that will occur in this century because of today's atmospheric concentration of greenhouse gases; adaptation is needed to reduce vulnerability to climate change. High population density and low income levels will result in low adaptive capacity and high vulnerability. The less-developed countries and the poorest sections of society are likely to suffer the most from climate change. Early action is needed to develop adaptive capacity, starting with disseminating information, assessing adaptation needs, identifying priority investments, mainstreaming adaptation, organizing resources, and promoting regional partnerships.

E. Energy Access

21. 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), studies have shown that MDG targets cannot be met without modern energy services.¹³ Access to energy is essential to reducing poverty. In the absence of energy services, the rural poor must resort to the use of traditional biomass sources—such as wood, charcoal, dung, and waste material—for cooking and heating. The IEA estimates that 2.5 billion people in developing countries continued to rely on traditional biomass to meet their energy needs in 2004; more than half of them were in the PRC (700 million people) and India (565 million people).¹⁴ Efforts are being made to improve energy access. However, because population growth will offset these efforts, the number of people without access to modern forms of energy will increase to an estimated 2.7 billion in 2030.

22. Access to modern fuels and electricity is essential for economic production and social development. At the household level, it also helps in addressing gender bias and reducing indoor pollution. Extensive use of traditional biomass, especially in improperly ventilated rooms, can result in higher incidence of health problems, such as bronchial diseases, and lower productivity. A World Health Organization study found that every year almost 1.6 million people—the majority of them women and children—die because of the effects of such pollution.¹⁵ Further, the time and energy spent in collecting, storing, and using traditional fuels is a considerable drain on human productivity that could otherwise be spent on more economical or intellectual tasks. Poor rural people most commonly graduate from biomass to coal and kerosene, but the use of these 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. More modern cooking stoves can be used efficiently with a variety of biomass sources, making them a viable option for rural areas. The other preferred option is electricity, which is indispensable for lighting, refrigeration, and running of motorized household appliances. Table A1.3 shows electricity access in various Asia economies.¹⁶

¹³ Modi, V., S. McDade, D. Lallement, and J. Saghir. 2006. *Energy Services for the Millennium Development Goals*. New York: Emergency Sector Management Assistance Programme, United Nations Development Programme, United Nations Millennium Project, and World Bank.

¹⁴ IEA. 2006. *World Energy Outlook 2006*. Paris.

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

¹⁶ For Pacific DMCs, the electrification rate is assumed to be about 50%–60% and varies significantly among countries (e.g., Samoa is 95%, Fiji Islands 60%, and Papua New Guinea is 10%). In Central Asian economies, the electrification rate is assumed to be more than 95%.

Table A1.3: Electricity Access in Asia in 2005

Member	Electrification Access (%)	Population without Electricity (million)	Population with Electricity (million)
Afghanistan	7.0	27.0	2.0
Bangladesh	32.0	96.2	45.3
Bhutan	36.0	0.5	0.3
Brunei Darussalam	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 People's Democratic Republic	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, the Lao People's Democratic Republic, and Maldives are based on ADB staff estimates.
Source: International Energy Agency. *World Energy Outlook 2006*. Paris.

23. Many DMCs have launched schemes to provide modern and sustainable energy services, including electricity, to all. Bangladesh, the PRC, India, the Philippines, and Sri Lanka are among the DMCs that have accelerated rates of new connections.¹⁷ Several technical options are available, such as grid extensions, mini grids, and off-grid systems based on renewable energy sources. 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 benefits 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."¹⁸ Multilateral institutions, bilateral agencies, financial institutions (especially those dealing with microfinance), and the private sector will have to provide substantial support to government efforts in this area.

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

¹⁸ United Nations. 2002. *Plan of Implementation of the World Summit on Sustainable Development*. Johannesburg. (4 September).

F. Investment Outlook

24. The IEA estimates (footnote 4) that the global energy market will grow by 45% by 2030 (1.6% annual growth). This translates to a total investment of more than \$26.3 trillion (in 2007 US dollars) for energy supply infrastructure during 2007–2030. Of that amount, the power sector will account for \$13.6 trillion (52%), the oil sector \$6.3 trillion, the gas sector \$5.5 trillion, and the coal sector \$728 billion. With the rapid increase in energy demand, non-OECD countries will absorb more than 65% of the global investment estimates; the PRC alone will need to invest \$4.2 trillion to meet its energy demand. The IEA estimated that, while the world's energy sources are sufficient to meet projected demand, mobilizing investment resources will be a challenge.

25. Globally, financial resources are sufficient to finance this projected energy investment—energy investment needs are estimated at only 1% of the projected global GDP, while domestic savings is about 23% of global GDP.¹⁹ However, this ratio varies among regions. The PRC, with domestic savings of about 40%, will require an average annual energy investment of about 2.4% of GDP; India, with domestic savings of 20%, 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 financial resources, particularly in many developing countries where the domestic investment exceeds domestic savings as a percentage of GDP.

26. Foreign investment will need to meet the shortfall between the investment requirements and domestic savings allocated to the energy sector. Foreign debt may be available on better terms, but overdependence on foreign capital without a commensurate increase in foreign earnings can have other macroeconomic effects. Countries with a large external debt will have difficulty sourcing additional financing. Further, foreign investment is influenced by the state of the host countries' financial markets and banking sectors; better developed, transparent, and regulated financial markets generally attract more investments. Multilateral and bilateral funding agencies will need to develop innovative financing vehicles to help meet the financing gap. Carbon funds and clean energy funds are some options available that should be pursued, especially for support of clean energy development. The Global Environmental Facility and other innovative funds support environmental and clean energy initiatives; these need to be increased with more grants from developed countries. Procedures should be streamlined to improve access to such funds.

G. ADB Experience

1. ADB's Energy Sector Operations

27. 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 and then declined for a number of years (Table A1.4).²⁰ Technical assistance support has continued to increase steadily over the past 15 years. From 1998, the focus was realigned to address power sector reforms and restructuring, and to provide more support for transmission systems enhancement. One factor that contributed to this shift was 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, because of the economic slowdown, demand for new capacity had declined. Meanwhile, DMCs were increasingly able to add new generation

¹⁹ IEA. 2003. *World Energy Investment Outlook*. Paris.

²⁰ A total of \$1,658 million, the highest amount for public sector loans for the energy sector, was approved in 1993.

capacity through the private and public sectors, and this provided an opportunity for ADB to increase its assistance for (i) sector reforms, (ii) restructuring, (iii) independent regulatory mechanisms with licensing and tariff-fixing authority, (iv) commercialization, (v) creation of enabling energy markets for the private sector and systems improvement, and (vi) loss reduction. These reform-related operations needed thorough analysis of the existing situation and extensive stakeholder consultations, along with studies to provide guidance to ADB and DMCs on better options for energy sector development. Power sector reforms increased the private sector's interest, and the ADB Private Sector Operations Department successfully supported a number of generation projects.

Table A1.4: ADB Lending to the Power Sector, 1990–2006
(\$ million)

Sector	1990–1995	1996–2000	2001–2006
Public Sector	8,484	4,084	4,249
Generation	2,279	152	73
Sector development	2,450	1,496	2,134
Hydropower	896	512	48
Renewable energy	100	158	161
Transmission and distribution	2,758	1,766	1,833
Private Sector	179	123	809

Source: Asian Development Bank database.

28. ADB's oil and gas sector involvement started in the early 1990s with significant support for operations in the public sector. Thereafter, operations were sporadic with limited interventions because of the increased focus on the power sector and its move towards market-oriented operations. However, since 2002, ADB has increased operations in the private power sector, especially in gas, by financing pipelines, storage facilities, and distribution systems. Nevertheless, the share of the oil and gas sectors in ADB operations remains low (Table A1.5). Recently, interest in these sectors has increased in some DMCs because of the rise in international prices and the need to explore indigenous sources. ADB interventions are expected to increase, especially in the gas sector.

Table A1.5: ADB Lending to the Oil and Gas Sectors, 1990–2006
(\$ million)

Sector	1990–1995	1996–2000	2001–2006
Public sector	1,617	150	78
Gas pipelines	1,617	50	5
Transport	—	—	73
Private sector			862
Gas pipelines	—	—	352
Liquefied natural gas	—	—	510

— = None.

Source: Asian Development Bank database.

2. Evaluation of ADB Energy Operations

29. In its evaluation of the energy policy, the ADB Independent Evaluation Department (IED) 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 economic and political environment.²¹ To a large extent, ADB's energy projects have addressed poverty reduction indirectly through more 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 technical assistance designs were appropriate. Of the projects that were evaluated by the IED, 98% were rated partly or fully satisfactory. Project design took into consideration the project management and technical skills of the executing agencies. Consultative approaches, analysis of baseline studies, comprehensive policy dialogue, establishment of clear plans, and tranche-based assistance resulted in effective implementation and overall sector improvement.

30. Overall, the Energy Policy 2000 Review was rated "successful" based on the IED's assessment of it as relevant (bordering on highly relevant), effective, efficient, and highly likely to be sustainable. The study concluded that the Energy Policy was highly relevant and responsive to the changing needs in the energy sectors of most DMCs. However, the IED also found that analysis of alternatives in project identification and selection has been further improved.

31. ADB's Energy Policy has influenced a number of major sector reforms, including those in Bangladesh, India, Indonesia, Pakistan, the Philippines, Sri Lanka, and Viet Nam. There has been a two-way flow of knowledge. ADB's inputs into policy reform determined the programs, and the ensuing discussions with member countries and other development partners—particularly the World Bank—led to an evolving consensus on power sector restructuring. This, in turn, contributed to ADB bringing its Energy Policy into the mainstream. The energy sector reforms have been successful to varying degrees; 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—in many cases, far longer than originally expected. Progress is sometimes slow and punctuated by setbacks.

32. Although some DMCs have graduated and do not need further ADB public sector support for energy projects, most of them will require continued ADB assistance. The IED report pointed out that sustainability of lending will depend on demonstrated positive impacts, capacity to meet clients' emerging needs, and development of relevant skills of ADB staff. Competition and a smaller lending base mean ADB must (i) develop client-driven products, (ii) take a more tailored approach to covenants and safeguards, (iii) adopt a long-term approach to developing appropriate responses to client needs, and (iv) assure staffing skills are appropriate to meet these needs.

33. In its conclusion, the IED recommended that an updated energy strategy be designed to achieve the following outcomes:

- (i) Efficiencies are enhanced across the energy chain to minimize investment in new generating capacity to meet the growing demand for energy.
- (ii) Environmental externalities are reflected in decision making in the energy sector.
- (iii) Pricing and resource allocation decisions take place under market forces with effective and credible regulatory oversight.

²¹ ADB. 2007. *Energy Policy 2000 Review: Energy Efficiency for a Better Future*. Manila.

- (iv) Energy subsidies are transparent and targeted.
- (v) Policies rely on market-based incentives to promote efficiency and environmentally responsible behavior.
- (vi) Sector governance is improved to increase efficiency, create opportunities for private sector participation, and reduce opportunities for corruption.

34. The IED also suggested that an implementation plan be developed that (i) reconciles the policy and strategic aspirations with organizational, budget, and human resources implications; and (ii) includes a results framework with monitorable key indicators (for inputs, outputs, and short- and long-term outcomes and results) to ensure that implementation progress can be monitored and, if necessary, midterm corrections can be made.

H. Experience of Other Multilateral Development Banks

35. In general, operations in the energy sector are coordinated with other MDBs and bilateral development partners, as envisioned under the Paris Declaration on Aid Effectiveness. There is little difference in significant aspects such as policy reforms, restructuring, private sector development, procurement (other than eligibility), and environmental and economic sustainability. Most of the institutions have built strength in the energy sector. Considering the large demand for assistance in the DMCs, there is sufficient room for coordinated activities and similar policies.

1. World Bank

36. Starting with its first loan in 1949, the World Bank's energy operations accounted for more than 20% of the World Bank Group's annual commitments.²² Its assistance includes instruments such as loans, credits, guarantees, technical assistance, advisory work, equity participation, syndication of commercial bank financing, investment funds, and political risk coverage. In addition, programs tailored for the energy sector delivered technical assistance that supplemented traditional instruments. These include 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. Most of these programs had multilateral support and contributions. In the early 1990s, the World Bank reviewed its energy operations and developed its energy policy.²³ The policy set out guiding principles for the power sector that also apply to oil, gas, and coal operations: (i) client countries must take explicit steps to reform and restructure, (ii) regulatory process must be established, (iii) energy efficiency and private sector participation must be encouraged, (iv) highly polluting or poorly performing clients should be avoided, and (v) transfer of clean energy technologies should be encouraged. In addition, the World Bank focused on rural energy, sustainable transport, clean energy, and the environment.

37. The World Bank's analysis found that results have been mixed.²⁴ Regulatory agenda implementation, including tariff rationalization and phasing out of subsidies, has been slow. The slow pace of privatization also contributed to underachievement. However, projects focusing on curbing pollution showed better results. During the latter part of the 1990s, the World Bank's focus on renewable energy increased. Its attempts to stimulate private sector participation have

²² The World Bank Group includes the International Bank for Reconstruction and Development and the International Development Association, and the affiliates International Finance Corporation, Multilateral Investment Guarantee Agency, and International Centre for Settlement of Investment Disputes.

²³ World Bank. 1993. *The World Bank's Role in the Electric Power Sector*. Washington, D.C.

²⁴ World Bank. 2000. *Fuel for Thought. An Environmental Strategy for the Energy Sector*. Washington, D.C.

yielded expected results through reforms, and the development of clean technologies has contributed to better environmental mitigation.

38. In 2006, the World Bank adopted a clean energy and development strategy, which outlined a two-track approach: developing an investment framework that complements ongoing activities, and developing and applying technologies to address climate change.²⁵ It focuses 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.

2. European Bank for Reconstruction and Development

39. During 2000–2005, the European Bank for Reconstruction and Development (EBRD) committed more than €4 billion to the energy sector.²⁶ Electric power generation (21%), oil and gas extraction (20%), and electric power transmission (17%) were major recipients of EBRD's lending. The EBRD also increased its financing for energy efficiency projects, while continuing to engage in policy dialogue to promote its strategic objectives—economic transition, and environmentally sound and sustainable development. In general, reforms have advanced smoothly because of the establishment of the clean energy 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. EBRD's results have also been mixed, but progress is being made. Considerable gains have been seen in energy efficiency (a major focus of the EBRD), but much greater effort is needed to meet EU energy efficiency standards.

40. Countries outside of the EU have progressed slowly. EBRD's reform implementation process in the Commonwealth of Independent States countries continues to be a challenge; regulatory independence is low and tariffs are not based on costs. Privatization within the Commonwealth of Independent States has been extensive. Taking into consideration the development in the energy sector in Europe, the EU developed a revised strategy—the Energy Operations Policy 2006—to address (i) competitiveness and efficiency, (ii) increased investment, (iii) energy security, (iv) climate change, and (v) natural resource development. In line with the EU energy strategy, the EBRD has set a number of priorities: to 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.

I. Issues and Options

41. The recommended update of the 1995 Energy Policy not only responds to the rapidly changing conditions affecting the sector, but also reflects ADB's new policy directions, as laid out in Strategy 2020 (footnote 3). Strategy 2020 identifies energy as a key component of the infrastructure core area of operations, and this drives its three complementary strategic agendas of inclusive growth, environmentally sustainable growth, and regional integration. ADB needs to clearly delineate a policy to help DMCs increase their focus on promoting clean energy and sustainable development. Asia and the Pacific, like the rest of the world, is experiencing considerable environmental stress and needs to emphasize environmentally sustainable growth. Strategy 2020 identifies the environment, including climate change, as one of the five core specializations to support ADB's development agenda. The energy policy update addresses environmental sustainability and the lack of sustainability of Asia's current approach of

²⁵ World Bank. 2006. *Clean Energy and Development: Towards an Investment Framework*. Washington, D.C.

²⁶ EBRD. 2006. *Energy Operations Policy*. London.

increasing the supply of energy based on fossil fuels. Strategy 2020 emphasizes that ADB will focus on promoting energy efficiency and the development of clean energy. Energy access is an essential input for meeting the MDGs, and significant efforts are needed to address this. Strategy 2020 also focuses on addressing governance issues—a key component of energy sector development.

1. Energy Efficiency

42. The decision to prioritize and broaden efforts to support energy efficiency initiatives rests on a simple but important fact: harnessing energy efficiency is the most effective way of reducing growing energy demand, improving supply-side efficiency, and reducing carbon emissions and reliance on expensive hydrocarbon imports. Studies have shown that adoption of proper and effective energy efficiency measures can reduce energy demand by 20%.²⁷ Energy efficiency can be achieved in many ways, such as (i) energy discipline (switching off appliances when not in use); (ii) energy audits; (iii) manufacture and use of energy efficient equipment; (iv) reduction of systems losses; (v) proper energy planning and management; (vi) efficient transport planning; (vii) use of alternative and renewable fuels; (viii) market-based energy pricing, including tax policy; and (ix) cogeneration. The scope is immense and requires both public and private sector support. With CO₂ emissions increasing, and threats to the climate and energy security, energy efficiency assumes a larger role and should have a higher priority than other activities. Benefits from energy efficiency are long term, and can be exploited faster and at a lower cost. Energy efficiency contributes to lower fossil fuel consumption, improves public health, and induces commercial savings.

43. Potential obstacles and constraints were also considered. To achieve these benefits, energy efficiency interventions must be developed comprehensively. Energy efficiency can be challenging because it involves shifting consumers' attitudes and habits, requiring awareness building, policy support, and a combination of compulsory and incentive measures. Energy efficient technologies may also be more expensive, raising affordability issues for DMCs. Any project's technical soundness and the applicability of technologies to the specific countries and locations in which it is to be employed need to be carefully evaluated to ensure cost-effectiveness and maximum benefits.²⁸ Barriers to energy efficiency projects include (i) high up-front costs, (ii) high transaction and project preparation costs because of small project size, (iii) lack of appropriate financial instruments, (iv) continued regimes of low tariffs and subsidies, and (v) inadequate institutional capacities. Institutional barriers faced by MDBs such as ADB include lending products that are not conducive to small clean energy projects, long processing times for loans, and high transaction costs.

44. ADB's initial success in the efficiency and clean energy field also supported the policy proposal. ADB has made significant progress in implementing the Clean Energy and Environment Program to assist DMCs in building energy efficient and low-carbon economies. A key component of the program is the Energy Efficiency Initiative launched in 2005 to expand ADB's operations in clean energy to at least \$1 billion annually by 2008. The establishment of the Clean Energy Financing Partnership Facility was approved in April 2007 to (i) help deploy new cleaner technology in DMCs, (ii) provide a credit enhancement mechanism to finance a large number of clean energy and energy efficiency projects, and (iii) provide technical assistance to DMCs in the areas of clean energy and energy efficiency. Through effective implementation of the Clean Energy and Environment Program, ADB provided \$1.7 billion for clean energy investments in 2008, far exceeding the target of \$1 billion. To maintain ADB's

²⁷ ADB. 2006. *Report of the Energy Efficiency Initiative*. Manila.

²⁸ ADB. 2006. *Clean Energy Applications in Asia and the Pacific*. Manila.

commitment to promoting clean energy investments, a new target of more than \$2 billion annually by 2013 was proposed. The Asia Pacific Carbon Fund, launched in November 2006, is another innovative financing facility under the Carbon Market Initiative. It provides up-front cofinancing, technical assistance, and carbon credit marketing support for projects with carbon emission reduction potential.

45. To address energy efficiency issues in the transport sector, ADB launched the Sustainable Transport Initiative in 2006. The initiative provides advice and financing for public transport innovations and cleaner technologies to reduce greenhouse gas emissions and other vehicular pollution. In terms of power, heat, and gas, greater attention to energy efficiency activities is needed. In addition to support for energy efficiency projects, labeling procedures for appliances and equipment are needed, along with the development of minimum energy performance standards, facilitation of financing for energy efficiency projects through innovative and dedicated funds, and awareness raising. Support should be targeted and measurable to clearly assess the benefits achieved.

2. Renewable Energy

46. In 2004, renewable sources of energy accounted for 13% of the global total primary energy demand,²⁹ with combustible renewable sources³⁰ comprising a major share (10%). Renewable energy sources include biomass (combustible renewable and waste), hydropower, solar, wind, ocean, and geothermal energy (including geothermal heat pump systems). Biomass is currently the largest renewable energy source because of its extensive noncommercial use (mainly for cooking and heating) in developing countries. Biomass accounts for about 80% of total renewable sources, followed by large hydropower at 17%. The share of other forms of renewable sources is minimal. In this paper, renewable sources of energy will include solar, wind, geothermal, hydropower, ocean sources, waste-to-energy, and biomass (other than the current noncommercial use).

47. Most DMCs import oil to meet their energy needs. Because oil prices have risen, the foreign currency expenditure on energy imports has, in some cases, come at the expense of other essential imports. Since the bulk of oil production is concentrated in the conflict-prone Middle East, many countries need to enhance their energy security. This requires a number of measures, including efficient energy use and diversification of energy sources. Renewable energy can help diversify the sources of energy supply, while providing energy that is clean, sustainable, and generates little or no greenhouse gases. In addition, renewable energy is an appropriate option for decentralized energy systems.

48. Development of renewable energy sources in rural areas can contribute to better agricultural productivity, health, education, communications, small-business enterprise, and quality of life. The lack of access of about 1 billion people in Asia and the Pacific to modern forms of energy may be addressed largely through cost-effective renewable sources, such as modern cooking systems using biomass and small electricity grids. Operational costs of renewable energy are low and, unlike those of fossil fuels, are not subject to fluctuating prices. Furthermore, grid extension is not required, which saves transmission costs. The distributed energy system could also be a viable alternative for rural areas in some countries. Thus, suitable policies need to be framed that encourage the development of renewable energy, for which long-term support is needed. Some DMCs already have aggressive policies in place,

²⁹ IEA. 2006. *Renewables Information*. Paris.

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

requiring a minimum share of renewable energy in the electricity grid within a fixed time frame. Implementation of these policies needs support.

49. Biofuels are attracting increasing interest worldwide for their potential in addressing energy security and climate change by substituting gasoline and diesel in the transport sector. DMCs also see biofuels as a way to stimulate rural development, create jobs, and save foreign exchange. However, the development of biofuels raises some issues. Because of the rising demand for biofuels, farmers have more economic incentive to grow crops for biofuels production instead of for food production. This could lead to food security issues—less food production and higher food prices. The production of biofuels from raw materials requires energy input (for farming, transport, and conversion to the final product, as well as the production of fertilizers, pesticides, and herbicides). The net energy balance between energy used to produce biofuels and energy outcome from biofuels for different types of crops is crucial. The net impact on greenhouse gas emissions of replacing conventional fuels with biofuels depends on various factors: (i) the type of crop, (ii) the amount and type of energy embedded in the fertilizer and other inputs used to grow the crop, (iii) the energy used in gathering and transporting the crop, (iv) alternative land uses (especially the conversion of forests to biofuels production), and (v) the energy intensity of the conversion process. In addition, major changes in the use of farm land could profoundly affect local and regional ecosystems, with both positive and negative implications for flora and fauna.

50. Renewable energy development has been hindered by its relatively high initial cost. However, with larger markets and economies of scale, renewable energy equipment prices have fallen recently and are almost cost competitive with fossil fuel technologies, especially when life cycle and environmental advantages and income from carbon credits are considered. In fact, many renewable energy technologies are, or are likely to be in the near future, economical compared to some fossil fuels. If global concerns regarding CO₂ emissions trigger the imposition of carbon taxes, then renewable energy will be more competitive.

51. While sources of renewable energy—such as wind, water, and sunlight—are abundant, there are technical and economic constraints to its development, including the intermittent nature of power from renewable energy sources. Hydropower depends on water availability, and wind and solar power depend on climatic conditions. Renewable energy lacks the reliability needed for grid operations unless energy storage devices, such as fuel cells, are commercially available. Renewable sources from the 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 renewable energy use in stand-alone systems. Weather uncertainties require a backup redundancy; some believe 100% backup is necessary, but renewable energy proponents disagree. Solar power is suitable for heating purposes, but its potential for electricity generation is limited because of 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, and requires alternate backup provisions to ensure power supply at times of unfavorable weather.

52. Research is under way to develop systems that can be adopted within the grid system without any additional redundancy, which would allow the contribution of solar and wind power to be significantly increased. The involvement of the private sector is vital to the development of renewable energy, because of the need for innovation and more efficient use of resources. In some DMCs, the private sector is already engaged in promoting renewable energy. Promotion

of an enabling policy framework is needed to encourage private sector participation in renewable energy development.

3. Fossil Fuels

a. Oil

53. Oil consumption trends closely follow the growth of GDP. The IEA forecasts that primary oil demand will grow from 85 mb/d in 2007 to 106 mb/d in 2030, an annual average increase of 1.0%. Oil demand will continue to grow more quickly in non-OECD countries, with an annual average increase of 2.2%. The PRC's oil use is expected to rise by 3.5% per year from 2007 to 2030. The transport sector will account for more than half of the primary oil consumption, mainly because of higher demand for road transport fuels. Experts speculate that high oil prices since 2006 may be not sustainable in the long run and market fundamentals could drive prices down. However, oil prices tend to be volatile and certain factors (lower-than-required investments in supply infrastructure, strong demand pressures, production shortages, and geopolitical factors) could provide pressure to maintain high oil prices.

54. According to the IEA (footnote 14), sustained high oil prices will encourage consumers to reduce consumption, switch to other fuels, reduce waste, use fewer energy services, and use more energy efficient technologies. Since oil imports have a significant effect on the fiscal balance, it is essential to address this issue over a longer time frame. Some available options include the following: (i) conserve or reduce energy consumption, (ii) explore and invest in alternate and renewable fuel sources (including biofuels) and energy efficient technologies, (iii) promote effective transport planning, (iv) introduce fuel-efficient engines for transport vehicles, and (v) possibly implement taxes on larger vehicles. Though most of the world's oil is concentrated in the Middle East, some DMCs have discovered oil within their geographical boundaries, which will help stem the foreign exchange outflow to some extent. A few DMCs with high demand growth are also aggressively exploring joint ventures outside the region for oil exploration.

55. Currently, ADB does not support any oil field exploration projects because of the associated risks. As oil is an internationally traded commodity with established private sector involvement, ADB should not, in general, fund oil field development projects. If necessary, ADB may consider selective assistance to develop marginal and already proven oil fields subject to economic soundness. Recently, because of the rise in oil prices, some DMCs are exploring and developing domestic oil fields, with some success. Though the government and the private sector are actively involved in oil prospecting, support for policy assistance is needed in the management of oil resources, oil field development, refining, transportation, distribution, and the development of tariff policy and accountability. Active support is also needed for regional trade.

b. Natural Gas

56. Natural gas is the fossil fuel with the least emissions. Its consumption is expected to increase globally by 1.8% annually from 2006 to 2030—from 2.9 trillion cubic meters (tcm) to 4.4 tcm (footnote 4). Proven gas reserves in 2007 were 179 tcm, sufficient to meet the projected demand for about 60 years at current production. Investment requirements worldwide will be about \$5.5 trillion. While North America and Europe will be the largest market, the demand rate in developing Asia will be higher than the 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 gas. Regional gas trade continues,

with pipeline transportation the most favored option. Nevertheless, trade in liquefied natural gas (LNG) is expected to increase, which may spur Asian economies to lease bulk carriers, set up LNG terminals, and develop associated facilities. The gas market outlook is also favorable because compressed natural gas may replace gasoline in motor vehicles and for heating purposes to mitigate environmental impacts. Significant funding will be needed for natural gas field development, extraction, processing, storage, transportation and distribution networks, and regional trade. ADB will support safety and efficiency improvements in oil and gas transportation, and LNG terminals and carriers.

c. Coal

57. Coal will continue to be a major primary source of energy, with a share of about 29% in 2030 (footnote 4). Coal demand will increase primarily because of the higher energy needs of developing Asia, particularly the PRC and India, both of which have abundant reserves. Power generation will account for about 80% of the world coal demand. Energy security concerns have led to greater interest in coal because of its widespread availability. Unlike oil and gas, proven reserves of coal are enormous and widely dispersed. It is also easy to transport and store and is not affected by weather changes. However, coal and its use have a number of serious environmental implications, including the highest CO₂ emission rates among fuels used to generate electricity.

58. Coal is an internationally traded commodity, and the development of new coal mines is generally done with commercially available financing. The output from the new mines are either sold on an open market basis to small-scale wholesale traders or industries, or sold to dedicated installations such as power plants or metallurgical industries, through internationally enforceable contracts. An institution such as ADB would have little role to play in such development. In a few cases, however, the coal industry in a DMC may be at a nascent stage with a less explicitly defined business environment both for commercial development of new mines as well as the use of the output, making commercial finance difficult to attract without MDB support. The development of the coal sector in these DMCs may be essential for domestic electricity development and energy security. Assistance from development finance institutions such as ADB may also be necessary to set country benchmarks in mine safety, as well as in environment and social safeguards. Encouraging a DMC to adopt reporting processes in line with the Extractive Industry Transparency Initiative (EITI) would also be a worthwhile objective.

59. While it is difficult to generalize about the situations that could occur in the future regarding the development of any coal sector, ADB would require the following conditions to be prerequisites for its support for the development of any coal mine:

- (i) A substantial part of the output of the coal mine should be captive to one or more power stations, i.e., tied by commercially binding, long-term fuel supply contracts or administrative allocation to the power stations. The consultation and review processes during the preparation and approval of specific project proposals will ensure that coal mining is only supported if and when there is a general agreement in ADB that substantial use, i.e., excluding byproducts and surplus thermal coal (para 60), is for power generation. This condition will not be met if thermal coal is envisaged to be sold to the open market or exported through international trading channels; and
- (ii) The DMC should agree to implement the provisions of the EITI for all coal mines in its territory.

60. Given that the primary reason for ADB's intervention is to help start commercialization of the coal sector in the DMC, it would be counterproductive to have other preconditions. For example, the coal mine(s) and the linked power station(s) could belong to different owner groups, and not necessarily be adjacently situated. There may be byproducts produced by the coal mine(s) that have value.³¹ Such byproducts could be sold either domestically or exported to maximize the benefits of the mine's development. Further, there may be surplus thermal coal because of an unexpected mismatch in the annual power generation and coal production, which could be sold domestically, but not to open market. Given that subregional cooperation has major benefits for remote locations that lack access to international markets, power station(s) could also be sited in remote border regions.

61. ADB support is currently restricted to promoting environmentally sound mining practices and policy assistance to enable restructuring of the coal mine industry. Measures to reduce pollutants (including waste coal utilization that has a low heat content), coal mine safety, coal bed methane extraction, and environmental safeguards in coal extraction have been pursued. Since coal is abundant in Asia, coal mining will increase in DMCs because of energy security and cost. However, much larger associated environmental and social issues in coal mine development must be carefully addressed. Coal mining is associated with many negative impacts such as dust pollution, deforestation, and land degradation.³² Social impacts on the local population include involuntary resettlement, inappropriate disposal of excavated soil, and improper backfilling after mining activities are completed. ADB support could serve as a catalyst for encouraging and developing good practices, especially in terms of enforcing required environmental and social standards and adopting efficient technology.

4. Power Generation and District Heating

62. Large parts of Asia and the Pacific suffer from electricity shortages. To meet the projected increase in electricity demand, DMCs are considering options such as coal, natural gas, nuclear power, hydropower (large, small, and micro), and energy from renewable sources.

a. Coal-Based Power Plants

63. Many existing coal-based power plants have been operating for a number of years. They need retrofitting to improve efficiency, reliability, and operating life; and to comply with current higher environmental standards. Such retrofit projects will be cost-effective, and will reduce emissions of pollutants and improve efficiency.

64. Because of energy security concerns and the availability of indigenous coal, some DMCs have preferred coal-based power plants. These power plants are a major source of pollutants (e.g., oxides of nitrogen, sulfur, and carbon; heavy metals; and particulate matter). Therefore, capacity addition needs to include cleaner technologies that reduce emissions, such as fluidized bed combustion, supercritical and ultra-supercritical technologies, and flue gas desulfurization.

65. As and when new technologies—such as pressurized fluidized bed combustion, integrated gasification combined cycle, and carbon capture and storage (or sequestration)—are commercially viable, power companies will readily adopt such technologies. Meanwhile, ADB

³¹ Some examples of byproducts are higher grade anthracite coal that has metallurgical applications, waste coal that can be used for road construction or in cement kilns, and methane that is a clean domestic and industrial fuel.

³² Other negative impacts include gas emission, groundwater contamination, industrial and waste water, waste management, coal burning, noise, and other construction-related negative impacts.

needs to proactively support the dissemination and deployment of new technologies in DMCs. To achieve this, developed and developing countries need to collaborate on long-term technology transfer agreements, if necessary with the active support of bilateral and multilateral donors.

b. Oil- and Gas-Based Power Plants

66. Oil is a major source of power generation in most Pacific DMCs, some mainland DMCs such as Cambodia and Sri Lanka, and for captive use by industry. In these countries, oil imports form a large component of import expenditures, leaving the countries vulnerable to price fluctuations in the oil market. For example, Sri Lanka has the highest cost of electricity generation in South and Southeast Asia. Oil-based power generation continues to be a feasible solution for providing electricity in remote areas, island communities, and sparsely populated areas. Pacific DMCs need to reduce their dependence on imported oil by developing renewable sources of energy and other conventional base-load options, which will partly mitigate price considerations and pollution aspects. Industrial use of diesel sets for captive generation is mainly to secure energy supply, which can be addressed only when generation capacity is available to meet the demands of industry or through appropriate captive power policies.

67. The power sector will account for more than half the increase in the global primary gas demand. Gas-based power generation is expected to remain a preferred option in the long term because of 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 more environmentally friendly profile compared with coal-based power plants. Many DMCs plan to install gas-fired power plants for either their base load or peak load. However, as gas prices are also rising, gas-fired power plants are expected to face competition from coal-based power plants. Use of LNG for gas-fired power plants is an option for countries that do not have indigenous gas resources or in coastal regions, but insufficient infrastructure facilities will cause a bottleneck. ADB will continue to support financing of natural gas-based power plants because of their environmental benefit.

c. Hydropower Plants

68. Although world primary energy demand is projected to grow by more than 45% from 2006 to 2030, the share of hydropower in global electricity generation is predicted to drop from 16% to 14%. However, total hydropower output will still grow by 1.9% annually (from 3,035 terawatt-hours to 4,809 terawatt-hours). Only 31% of the economic potential of hydropower worldwide had been exploited by 2004. Since the best sites in OECD countries have been exploited, and with further increase constrained by environmental concerns, most of the increase in hydropower development will be in developing countries where the untapped hydroelectric potential is substantial. Within Asia, large hydropower development is planned in India, the Lao People's Democratic Republic (Lao PDR), Nepal, Pakistan, the PRC, Viet Nam, and some Central Asian DMCs, including the Kyrgyz Republic and Tajikistan.

69. Hydropower development has a number of benefits. It is renewable³³ (although there are opinions that large hydropower should not be included in renewable initiatives),³⁴ 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

³³ IEA. January 2007. *Renewables in Global Energy Supply*. Paris.

³⁴ International Rivers Network. 2003. *Twelve Reasons to Exclude Large Hydro from Renewable Initiatives*. Berkeley.

fossil fuels, and dams can prevent floods and provide water for irrigation purposes. It comes in a variety of sizes—large, small, mini, and micro—and each has its own niche.³⁵

70. Large hydropower projects, especially those based on reservoirs as opposed to run-of-river, are complex and environmentally and socially sensitive. They have many impacts on the surrounding ecosystem,³⁶ and, according to scientific studies,³⁷ some large reservoirs produce significant amounts of greenhouse gases—such as CO₂ and methane—because of the submerged vegetation and forest land. This largely depends on the extent of plantation that is flooded by the reservoirs and the size of the reservoirs. The projects' environmental impacts are interrelated with social impacts, and their combined effects can result in considerable attrition.³⁸ Since inappropriate management of these issues can further exacerbate their impacts, implementation of large hydropower projects require (i) robust mitigation strategies; (ii) adequate disclosure and consultation with the affected people; (iii) enforcement of environmental safeguards, including policy dialogue; and (iv) proper resettlement and economic rehabilitation of the affected people. The applicable environmental and social safeguards must be implemented and monitored in a sustainable manner. ADB has safeguard policies that govern all its projects, including hydropower projects. ADB's current policies and guidelines respect the guidelines from the World Commission on Dams³⁹ and International Hydropower Association.

71. Hydropower projects are often located in the relatively higher reaches of watersheds 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 these projects. Pumped storage plants are another variety of hydropower that have gained acceptance. These plants help to economically meet the high grid demand during peak periods.

d. Nuclear Power Plants

72. Because of the uncertainties associated with nuclear power development, future demand assessments vary. According to the IEA, the share of nuclear power in electricity will decline from 15% in 2006 to 10% by 2030 because nuclear power capacity will not increase as rapidly as demand for electricity. However, recent trends indicate that nuclear power will play an increasing role in the total energy mix in Asia. Several large countries in the region, including the PRC and India, have announced policies to accelerate nuclear power development for electricity generation. Nuclear power does not generate significant greenhouse gas emissions, and hence can contribute to reducing global warming. Nuclear power generation is suitable for base-load power plants in large scale which are the core of electricity grids. Since 1990, significant development has taken place in nuclear fission technology. Advanced designs seek improvements in three principal areas: cost reductions, safety enhancements (use of passive

³⁵ Small hydropower, for this paper, is defined as those with a generating capacity below 10 megawatts, mini hydro capacity is below 1 megawatt, and micro hydro's capacity is below 100 kilowatts.

³⁶ Ecosystem impacts include fish migration blockage, terrestrial ecosystem loss, biodiversity loss (e.g., rare and endangered species), changes in downstream aquatic and riparian ecosystems, increased downstream estuary and shoreline erosion, decreased flood-dependent fisheries, reduced sediment inflow, and public health threats.

³⁷ World Commission on Dams. 2000. *Dams and Development: A New Framework for Decision Making*. Geneva.

³⁸ Social impacts include 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.

³⁹ ADB. 2002. *ADB's Planned Responses to the World Commission on Dams*. Manila.

safety features), and proliferation resistance.⁴⁰ With the unstable oil and gas market and the global warming effects of fossil fuels, nuclear power is increasingly gathering support in the OECD countries and some DMCs.

73. Significant technological advances, international supervision, and improved safety standards and waste management have resulted in increased interest in exploring nuclear power generation. Some countries aggressively pursued nuclear power as a measure of energy security, while many others opted to phase out existing facilities. Global warming concerns have renewed interest in nuclear power, as it is a low-carbon source of electricity. Some countries that had phasing-out policies are now reviewing the options. The factors that may influence a policy change are energy security, fuel supply security, stability of fuel prices, and climate change benefits. A few DMCs—such as India, Pakistan, the PRC, Thailand, and Viet Nam—are actively pursuing nuclear power.⁴¹ Many member countries in the region—such as Japan, the Republic of Korea, and Taipei, China—have nuclear power development policies in place. Although the proportion of nuclear power worldwide is projected to decrease, nuclear power development in Asia is expected to grow.

74. 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 times, and commercial acceptability of new technologies. Overcoming these barriers is difficult, and open public debate will be required to convince the public about the benefits of nuclear power. MDBs have traditionally avoided financing nuclear power plants. In the states of the former Soviet Union, the EBRD's current energy policy (footnote 26) includes financing safety measures of nuclear plants, decommissioning and environmental rehabilitation, and promoting an efficient nuclear regulatory framework. In view of concerns related to procurement limitations, availability of bilateral financing, 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.

e. District Heating

75. DMCs in Central Asia, Mongolia, and the northern provinces of the PRC have high demand for space heating and hot water. Heating is needed by residential and institutional buildings, and this can be provided either through stand-alone systems or a centralized district heating system. District heating systems are potentially energy efficient and hence are a cost-effective way to meet the demand. Currently, large district heating systems that were installed 30–40 years ago 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.⁴² Exacerbating these inefficiencies is a lack of adequate policies and regulation. Since district heating is important for the well-being of the population in regions with long and harsh winters, an enabling legislative framework is needed to establish independent regulatory mechanisms that will encourage (i) private sector participation and financing, (ii) decentralization, and (iii) transparent tariff and subsidy mechanisms.

76. Space heating (largely based on fossil fuels) is a major source of greenhouse gases, and requires cost-effective and sustainable solutions. For centralized district heating systems, fuel sources include coal, oil, gas, industrial waste heat, and municipal wastes. Combined heat

⁴⁰ International Atomic Energy Agency. 2006. *Nuclear Power and Sustainable Development*. Vienna.

⁴¹ Armenia also has an operating nuclear power plant that supplies more than 35% of the power demand.

⁴² World Energy Council. 2003. *Towards Local Energy Systems: Revitalizing District Heating and Co-generation in Central and Eastern Europe*. London.

and power plants use the waste heat from steam turbines, significantly increasing overall thermal efficiency and reducing greenhouse gas emissions per unit of energy delivered. Renewable energy options, such as solar panels for water heating and geothermal heat pump systems that use shallow ground heat, can also reduce fossil fuel use. Consumer patterns differ between residential, commercial, industrial, and educational uses, as well as between urban and rural uses, so proper cost-effective systems are needed to ensure adequate heating is supplied in a sustainable way. For example, multifuel boilers can be designed to achieve higher efficiencies. In all cases, heating requirements may be reduced through better building designs and insulation systems. Where feasible, renewable energy sources can be used to augment the system and reduce fuel consumption.

5. Regional Cooperation

77. Regional cooperation in energy enables integration of markets for higher economic development, and is an effective way to address energy security as well as promote energy efficiency. Each country has individual energy needs and resources; integrated regional planning allows the most cost-effective and environmentally sustainable regional projects to be identified. Many DMCs have abundant natural resources that can be traded in large energy markets in neighboring countries, benefiting all parties. Each country has an interest in promoting clean air and environmental protection; by collaborating regionally, countries may maximize these regional public goods.⁴³ Barriers to regional cooperation in the energy sector include technical compatibility (e.g., compatible specifications of transmission lines) and policy framework compatibility. An enabling policy framework for regional trade of power and gas is needed, along with the regional infrastructure to encourage regional cooperation and energy trading.

78. In recent years, ADB has promoted and assisted regional cooperation efforts, including the export of natural gas from Indonesia to Singapore, and hydropower projects in the Lao PDR that produce energy sold to Thailand. ADB has been instrumental in effectively forging subregional collaboration and networks. Electricity is now sold by Nepal and Bhutan to India. Proposals are being discussed to sell power from the Kyrgyz Republic and Tajikistan to Afghanistan and Pakistan, from Kazakhstan and Mongolia to the PRC, from the Lao PDR and Cambodia to Thailand, between India and Sri Lanka, and between the Greater Mekong Subregion countries (including southern PRC). There is great potential for more regional cooperation and integration in the energy sector. For example, in South Asia, the size and scattered nature of the region's hydropower and natural gas resources—and the different sizes of its national economies and associated energy demand levels and rates of growth—suggest immense potential for mutually beneficial integration and trade in energy and energy resources. Building consensus and negotiations for bankable projects remains a challenge. ADB is well positioned to play a catalytic role in fostering regional trade in energy.

6. Power Sector Reform and Restructuring

79. In the 1980s, a trend began worldwide to restructure the power sector and establish independent regulators. Developed countries restructured to improve efficiency through competition; developing countries restructured to augment scarce public resources with more private sector financing. MDBs, including ADB, actively supported restructuring and regulatory reform efforts in DMCs seeking private sector participation in the power sector. This included unbundling the power sector, creating an independent regulatory mechanism, introducing

⁴³ ADB. 2006. *Regional Cooperation and Integration Strategy*. Manila.

competition in power generation, and in some cases privatizing through the sale of assets. These reforms encouraged private sector participation and access to commercial financing. Independent regulation separated short-term political objectives from tariff setting and enabled the power sector to operate on a more competitive basis.

80. However, progress has been slow because of delays in legislation, insufficient consultation with stakeholders, apprehensions regarding tariff increases, and a lack of clearly defined plans. Power sector reform 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 vertically integrated power companies into generation, transmission, and distribution companies. Many DMCs have pursued reform policies with varying degrees of success. The PRC has separated most of the power generation into five large national companies and established a regulatory commission. Some countries in Central Asia (Kazakhstan and the 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 independently and transparently and is helping to create a better commercial structure for private sector investments. Progress in the Philippines has been mixed. The legal, regulatory, and institutional framework was largely established; the wholesale electricity spot market became operational in mid-2006; and the transmission and distribution tariffs are being regulated. However, the objectives of making the sector financially viable and privatizing assets of the National Power Corporation are yet to be fulfilled.

81. Restructuring and competition have shown mixed results internationally. Unbundling the sector and corporatization is one approach. Transformation from a government-run organization to a completely private sector operation is a difficult transition and not always the most efficient path. Reform initiatives need careful assessment as political will, tariff rationalization, enabling legislation, improved corporate and financial management, and independent regulatory mechanisms are often difficult to ensure. Further, concerns about new investment in capacity addition have weakened the resolve for a fully competitive wholesale and retail electricity market. Very few countries have fully deregulated the electricity business, and others are moving cautiously. Privatization is not the end objective of reform activities, but it is one of the options available to improve sector efficiency and increase the availability of investment capital. Sector reforms, including privatization, should be designed and sequenced carefully on a country-by-country basis in a transparent manner.

82. In the short term, tariffs need to be set through independent and transparent regulation. In the hydrocarbon subsector, a more rapid movement towards the normative market framework and market-based pricing is imperative. In the medium term, governments should be encouraged to divest themselves of all commercial functions and retain only those classified as public or merit goods. ADB will encourage private sector participation through the development of a supportive policy and regulatory environment within DMCs.

83. Capacity building is also important for power sector reform and restructuring. Those who lead and run power sector institutions need management skills, technical knowledge about new technologies, and good governance capacity (including financial management). Human resource development is an important long-term investment in the future effectiveness of the energy sector.

7. Pacific Developing Member Countries

84. Many Pacific DMCs deploy diesel sets for power generation; oil accounts for a significant portion of import bills, and these countries are more susceptible to oil price fluctuations than most others. Some Pacific DMCs have alternate power sources that use renewable technology—such as mini- and micro-hydropower, wind, and solar—but this is not significant. To address energy security, reduce oil imports, and (on an extremely small scale) reduce greenhouse gas emissions, Pacific DMCs could adopt new and renewable sources of electricity on a large scale by (i) addressing the main barriers of community and land issues, and (ii) introducing the policy and regulatory environment to attract necessary financing and ensure sustainability. The existing oil-based power plants would ensure reliability, while renewable energy sources can provide energy when available and reduce oil consumption. Use of biomass for electricity generation is also an option, particularly for islands with a palm-tree-based industry.

85. In addition to capacity addition, energy efficiency policies (including buildings with low energy requirements) are needed to rationalize demand. As appropriate, management structures and tariff guidelines could be developed. Capacity building is needed, possibly through regional cooperation. Since some Pacific DMCs lack energy data and information, ADB will provide assistance to improve energy data collection and compilation for developing sound energy policy and sector strategies. Each Pacific DMC needs a comprehensive package for power sector support, including systems improvement. Promotion of rural electrification and appropriate institutional and implementation arrangements are vital when the rural population lives on isolated islands.

86. Pacific DMCs—similar other island economies such as the Maldives, archipelagoes, and low-lying areas of many DMCs—will be seriously affected by climate change and global warming. A rise in sea levels, as predicted by scientific studies, will submerge portions of the land mass. Therefore, in addition to mitigation measures for global warming, Pacific DMCs need to adapt to likely future changes. To ensure attention to these issues, a comprehensive energy sector package should address adaptation, particularly for Pacific DMCs.

RESULTS FRAMEWORK FOR ADB'S ENERGY POLICY IMPLEMENTATION

Impact: More people and businesses in developing member countries have access to affordable, reliable, and adequate energy
Primary Responsibility: Regional departments, Private Sector Operations Department, and Regional and Sustainable Development Department

Outcome	Outcome Indicators	Output	Output Indicators ^a	Key Activities and Initiatives Contributing to Outcome	Assumptions and Risks
Improved energy efficiency and greater use of renewable energy in DMCs	<p>Share of renewable energy in total generation capacity (increase from 2006)</p> <p>Energy consumed per unit of GDP, tons of oil equivalent (decrease from 2006)</p>	ADB investments in energy efficiency and renewable energy expanded	<p>Amount, \$ (target = more than \$2 billion per year from 2013)</p> <p>Additional installed capacity using renewable energy, MW (increase from baseline)^b</p> <p>Electricity saved, GWh (increase from baseline)</p> <p>Reduction of carbon dioxide emissions, ton of carbon dioxide avoided per year (increase from baseline)</p>	<p>Clean Energy and Environment Program (2006 onwards)</p> <p>Carbon Market Initiative (2007 onwards)</p> <p>Sustainable Transport Initiative (2007 onwards)</p> <p>Facilitation of private sector investment in energy efficiency and renewable energy projects</p> <p>Cooperation with other multilateral development banks on investment framework for clean energy</p> <p>Clean Energy Forum (2006 onwards)</p>	<p>Adequate resources will be available</p> <p>Stable economic growth in the region</p> <p>Close coordination with other development partners</p> <p>Strong commitment and willingness of DMC governments</p>
Expanded access to energy in DMCs	Electrification rate in Asia and the Pacific (80% in 2013 from 73% in 2005)	ADB investments in electrification expanded	<p>Number (increase from baseline)</p> <p>Amount, \$ (increase from baseline)</p> <p>Total additional installed capacity, MW (increase from baseline)</p> <p>Number of new households connected to</p>	<p>Energy for All project:</p> <p>(i) Support rural electrification projects</p> <p>(ii) Investments in small off-grid demonstration projects</p> <p>Promotion of cleaner technologies in power generation</p> <p>Support for regional and</p>	<p>Adequate resources will be available</p> <p>Strong commitment and willingness of DMC governments</p>

Outcome	Outcome Indicators	Output	Output Indicators ^a	Key Activities and Initiatives Contributing to Outcome	Assumptions and Risks
			electricity (increase from baseline)	subregional power and gas projects and programs	
Efficient and viable energy sector in DMCs	Sound financial health of energy enterprises (better performance of individual enterprises as assessed in RRP and compared to 2006 performance)	ADB support for reforms and capacity development expanded and effective	Level of approved investments Number of loans and grants (increase from baseline) Number of TAs (increase from baseline) Amount of loans and grants, \$ (increase from baseline) Amount of TA projects, \$ (increase from baseline) Effectiveness of investments Percentage of PCRs rated satisfactory (maintain or improve depending upon baseline) Percentage of TCRs rated satisfactory (maintain or improve depending upon baseline)	Assistance and policy dialogue to reform and restructure the power sector to improve system efficiency Support to strengthen regulators Promotion of enabling environment to encourage private sector participation Support for capacity building and institutional strengthening Support of studies and knowledge sharing and dissemination for good practice	Strong commitment and willingness of DMC governments Availability of skills to establish effective regulation Close coordination with other development partners

ADB = Asian Development Bank, DMC = developing member country, GDP = gross domestic product, GWh = gigawatt-hour, MW = megawatt, PCR = project completion report, RRP = report and recommendation of the president, TA = technical assistance, TCR = technical assistance completion report.

^a Targets for output indicators, where not included, will be developed in consultation with DMCs and reflected in country partnership strategies, as appropriate.

^b Baseline is an average of 3 years, 2005–2007.