BANK POLICY INITIATIVES

FOR THE

ENERGY SECTOR

February 1994

BANK POLICY FOR THE ENERGY SECTOR

I. INTRODUCTION

1. In the wake of the second oil crisis in 1979, the major international financing institutions decided to reassess their policies relating to energy sector assistance to the developing countries. In that context, the Bank carried out a regional energy survey and submitted a working paper to the Board in March 1981.[1] The purpose of that paper was to define the Bank's role in the energy sector of its developing member countries (DMCs)[2] and examine the implications to the Bank's operations. It envisaged a substantial stepping up of energy sector investments in DMCs in the 1980s, to about three times the level in the preceding decade, and concluded that in the 1980s the Bank should diversify its energy sector portfolio.[3] The 1980s was a decade of major expansion in the DMCs' energy sector and substantial additions were made to the indigenous sources of supply. The vigorous economic growth in DMCs has resulted in increasing demands for commercial energy. The current estimate of capital requirements for DMCs' energy sector development to meet the demand forecast for the 1990s is about $100 billion a year. Such a massive expansion has major financial, environmental, and institutional implications leading to the emergence of new issues and concerns.

2. The Bank's Medium-Term Strategic Framework (1992-1995),[4] which lays down the strategy for the Bank's operations as a whole, stresses the Bank's role in catalyzing and augmenting external capital flows into DMCs through increased cofinancing and encouraging DMCs to adopt policies creating an environment suitable for attracting external capital for development. Country strategies will define the priorities of Bank operations for each DMC within this framework to meet the development objectives of the Bank. This Paper seeks to assess the outlook for the energy sector in the DMCs in the 1990s. It identifies the major sectoral issues and concerns under three main unifying themes centered on (i) defining an appropriate role for the government in the sector; (ii) enhancing the efficiency of production, transportation, and end use of energy; and (iii) more closely integrating environmental considerations in all energy sector activities to enable sustainable development. The Paper spells out the Bank's policy towards the major issues and concerns in the energy sector and outlines the operational implications of such policy choices so that the selection and pursuit of energy sector activities for any given DMC will be in line with the Bank's overall strategy, the country strategy, and sector policies.

---

1 Working Paper No. 2-81, dated 24 March 1981: *Role of the Bank in the Energy Sector in the Region*, dated 24 March 1981.

2 The People's Republic of China was not a member country of the Bank at this stage and India was not a borrowing DMC. The term "DMCs" in this Paper hereafter refers to the Bank's borrowing DMCs at the beginning of 1994.

3 During 1975-1983 the share of electric power in the Bank's energy sector lending portfolio was 90 percent, the remainder was for hydrocarbons. During 1985-1993 the share of electric power decreased to 73 percent and the share of nonpower energy lending increased to 27 percent.

4 The "medium-term" perspective in this Paper, however, is taken as six to seven years because of the longer lead time for energy projects.

II. REGIONAL ENERGY CONTEXT

A. Region's Diversity

1. The Asian and Pacific Region has great diversity in its economic geography encompassing three industrialized, four newly industrialized, three industrializing, several developing, and many land-locked or island economies, with populations ranging from a few thousand to over a billion. The population of the Region has nearly doubled to three billion during the past 25 years. More than a half of all global population growth occurs here with about the population of Thailand being added each year.[1] The Region also carries more than half of the global poverty burden with about 800 million people below the poverty line. Also, urbanization has mushroomed; by the year 2010, the Region will have 16 of the world's 35 megapolis areas, each with more than four million people. The consequent impact on environmental degradation is evident. The amount of SO_x, NO_x and total suspended particles in the air, for example, increased by a factor of 10 in Thailand, 8 in the Philippines, and 5 in Indonesia between 1975 and 1988.

2. There is a wide range in the patterns of energy endowment and consumption, environmental degradation, energy intensity, and sectoral performance.[2] Energy security is a common policy concern of all the countries in the Region. Energy demand is highly correlated with economic growth, industrialization, and urbanization (Appendix 1 shows the relationship between per capita commercial energy consumption and per capita gross domestic product of 20 DMCs). Energy is an ubiquitous input in all production, besides comprising significant shares of private and public consumption, and different sources of energy may substitute for one another. Investments in energy supply tend to require large inputs of scarce physical, human, and financial resources for which there are often competing demands from other sectors; thus, energy issues cannot be viewed in isolation. While the proposed energy policy framework is largely influenced by considerations of efficiency and environment, it would be inappropriate to treat the DMCs as a homogeneous group facing the same problems or requiring the same policy prescriptions. Although similarities exist, there are considerable differences among DMCs' economic, geographic, political, social, and cultural perspective. These country-specific differences underscore the need to focus on the pace and sequencing of proposed policy reforms and remedial measures.

B. Commercial Energy

3. The share of commercial energy as a percentage of total energy requirements in DMCs varies from about 5 percent in Nepal to about 90 percent in Malaysia. As a group, the DMCs are net importers of energy. During 1982-1992 primary commercial energy use by DMCs increased from 641 million tons of oil equivalent (toe) to 1,419 million toe at 8.3 percent per year and electricity consumption increased from 439 terawatt-hour (TWh) to 1,147 TWh at 10.1 percent per year. However, with 51 percent of global population, the DMCs used only 17 percent of the world's primary commercial energy. The DMCs' average per capita primary commercial energy use of about 510 kilograms of oil equivalent (kgoe) is therefore quite modest.

---

1 The population of Thailand in 1993 was 58.6 million.

2 For example, only Afghanistan, Indonesia, Malaysia, and Papua New Guinea are net exporters of energy among the DMCs; the rest are net importers.

4. Energy intensity indicates the consumption of primary energy in an economy per unit value of economic output. Reckoned in terms of toe/million 1980 United States dollars of GDP, the average energy intensity of the DMCs declined by about seven percent from 857 toe/million US$ in 1980 to 793 toe/million US$ in 1990; the PRC's 1990 energy intensity was 1,236 toe/million US$ in 1990. These energy intensity figures appear high in comparison to 590 toe/million US$ in Canada and US, and 370 toe/million US$ in Western Europe. However, the difference would not be so marked if the economic output is assessed in terms of GDP in purchasing power parity US dollars. It is historically true that OECD countries which showed high energy intensities in the early phases of their industrialization gradually reduced these intensities through changes in industrial structure, energy conservation policies, and adoption of energy efficient technologies. The DMCs need not traverse the same path and could conceivably leapfrog to energy efficient technologies through policies which facilitate their adoption. A further decline of about 10 percent in their energy intensity is feasible by the year 2000 with added emphasis on end-use efficiency.

5. The DMCs are relatively well endowed with primary energy resources, but the mix and geographical spread of these resources are uneven. The proven oil reserves of about 46 billion barrels (equivalent to 6.3 billion toe) account for 4.6 percent of global reserves with a reserve to production ratio of 22 years. The PRC and Indonesia account for almost 70 percent of these oil reserves. Natural gas reserves of about 331 trillion cubic feet (tcf) in DMCs (equivalent to 8.6 billion toe) account for 7 percent of proven world reserves with a reserve to production ratio of 65 years. Because of the current low level of natural gas utilization, the reserve to production ratio for natural gas looks relatively better than that for oil. Coal reserves are large, DMCs being endowed with about 401 billion tons of coal (equivalent to 267 billion toe) accounting for about 33 per cent of the world's proven reserves. At current levels of production, the reserve to production ratio is about 300 years. The DMCs' hydropower potential of about 650 gigawatt (gw) is also substantial, while geothermal energy resources estimated at 16 GW and mostly limited to Indonesia and the Philippines are modest.

6. In terms of energy utilization mix, the primary commercial energy requirements of DMCs (about 1.6 billion toe in 1992) were met by 2.9 billion barrels oil products (25 percent of the total energy requirement), 3.5 tcf of natural gas (5 percent of the total), 1.6 billion tons of coal (67 percent of the total), and 367 TWh of primary electricity (3 percent of the total). The amounts of energy reserves and annual consumption show that DMCs' energy resources, if adequately developed, can make them self-sufficient in energy. Coal plays a dominant role in PRC and India, accounting for 76 and 51 percent, respectively, of total primary energy supply, and for 74 percent and 71 percent of electricity generation. Other DMCs depend on coal for only about 10 percent of their primary energy needs. In electricity consumption terms, the share of the DMCs was only about 9.6 percent of the global figure of 12,000 TWh in 1992. This reflects the disparities of annual per capita electricity consumption and per capita installed capacity between the DMCs and the OECD countries (500 kWh vs 6,600 kWh and 0.1 kW vs 1.9 kW).

C. Past Bank Assistance

7. In line with the growing DMC needs, the Bank's average annual lending in the energy sector increased from $0.5 billion in the early 1980s to $1.7 billion in the early 1990s. As of 31 December 1993, the Bank's cumulative energy sector lending had reached $12.2 billion or 26 per cent of the Bank's overall lending, and supported over 200 energy projects. Power generation, transmission, and distribution projects have accounted for $9.4 billion, or 77 percent of this; a major part of the power subsector lending was for the increase in generation facilities. The hydrocarbon subsector (oil, natural gas, and coal) has accounted for $2.8 billion, or 23 percent, with the major share directed to natural gas development. In the 1970s, the Bank focused through project loans on designing and implementing well-formulated projects. In the 1980s, the Bank used both the project lending and sector lending modalities to focus on institutional issues relating to organizational efficiency and subsector issues such as planning and pricing. In the 1990s, a modest beginning has been made in policy-based program lending in the hydrocarbon subsector, focusing on divestments and subsector efficiency. Judging from postevaluation of 82 completed energy projects, a measure of success has been achieved: 65 projects (79 percent) were found generally successful, 16 projects (20 percent) partially successful, and only one project (1percent) unsuccessful. The Bank has also provided $85 million of technical assistance (TA) to the DMCs' energy sector, with nearly two

thirds ($56 million) of it being for the power subsector.

D. Capital Requirements for Expansion

8. During the 1960s and 1970s, the strategy in most DMCs in the power subsector was to integrate the small and inefficient power utilities into larger units to achieve reasonable economies of scale and accelerate power development. As a result, the installed power generation capacity in DMCs practically doubled in each successive decade, and many DMCs increased supply of electricity both geographically and in per capita terms. From 1980 to 1990 the DMCs' installed capacity increased from 114,130 megawatt (MW) to 251,277 MW, at a rate of 8.2 percent a year, and is expected to reach about 450,000 MW by the year 2000 at a growth rate of 6 per cent a year. The capital requirements of the DMCs for power generation plants and the associated transmission and distribution facilities during the 1990s are estimated to be about $45 billion a year.[1]

9. Developments by 1990 in the DMCs' hydrocarbon subsector resulted in oil and natural gas production equivalent to about 8.8 million barrels of oil per day, construction of about 14,000 kilometers (km) of natural gas transmission and provision of oil refining capacity to cater for about 6.6 million barrels per day. Based on Bank commissioned studies carried out in October 1993, the DMCs' oil demands are projected to increase at 6 percent a year and natural gas demands by 10 percent a year during the 1990s, and the hydrocarbon subsector is estimated to require about $55 billion a year on the average, consisting of $43 billion for exploration and development, $7 billion for transmission and storage, and $5 billion for oil refining and natural gas processing.

10. An energy sector expansion of this magnitude involving an investment of $100 billion a year through the 1990s calls for fresh approaches towards (i) redefining government's role in the sector and providing greater scope for private sector participation, (ii) sharply enhancing efficiency considerations, and (iii) integrating more closely the environmental considerations in energy development (including environmental costs). Redefining the government's role requires the restructuring of the sector with a greater role for private participation in a competitive environment. Efficiency considerations relate not only to the energy supply side but also to the demand side including pricing. Environmental considerations relate to the sustainability of development and have local, regional, and global dimensions. These sets of issues and possible policy approaches are discussed in Chapter III.

III. ENERGY POLICY ISSUES

A. Structural Reform

1. Background

11. The Bank's energy policy during the 1970s and 1980s had focused on (i) accelerated development of indigenous energy resources and supply augmentation, (ii) adoption of least-cost considerations in energy planning, (iii) efficiency in construction and operation of energy supply facilities, (iv) adoption of energy prices based on full cost recovery, and (v) institution building. Because the priorities of the international capital markets, multinational oil, and gas companies and the DMCs had not always been congruent, DMC governments found it necessary in the early 1970s to establish state-owned coal, oil, and natural gas companies to survey, explore, and develop their hydrocarbon resources. Successive oil price shocks with a major impact on the balance of payment of DMCs lent urgency to such state intervention. During the past two decades, these companies had achieved a measure of success in terms of hydrocarbon discoveries and development. In addition, a large pool of technically qualified personnel with hands-on experience has been developed in DMCs. Nonetheless, direct state involvement as owner in the hydrocarbon subsector may be regarded as a transitory phase mainly intended to initiate the subsector activities since many governments have subsequently encouraged

---

[1] Based on Bank staff estimates.

private sector involvement in exploration and development. Power subsector developments have been mostly within the public sector.

12. Towards the second half of the 1980s, limitations of the existing energy sector structure (dominated in most DMCs by large public sector entities fully owned by the governments[1] and functioning as monopolies) became increasingly evident. In most DMCs, the systems had become large enough so that further increases in size were not likely to result in greater economies of scale. In a number of DMCs, revenue flows were found inadequate to cover a reasonable share of investment costs after meeting debt service and operation and maintenance (O&M) expenses because energy prices were often too low, revenue collection unsatisfactory, and system losses high. Management and staff performance remained poor partly because of unattractive pay and personnel policies not conducive to motivate and retain experienced personnel. As a result, O&M tasks were often inefficiently performed, leading to frequent plant breakdowns, unreliable quality and availability of services, and eventually to further investments in new capacity additions. Revenue flows in the energy sector were inadequate despite a monopoly structure largely due to public ownership. In fact, whenever a commodity is publicly supplied at less than its true value, various consumer groups tend to organize and spend resources to capture and extend the entitlements to that commodity. Such organization by "beneficiaries" tends to make reversal of inefficient pricing policies politically difficult.

[1] Notable exceptions were some parts of India, and the power distribution entities in the Philippines and Vanuatu.

3. Multilateral Coordination

15. The World Bank has also identified the above mentioned weaknesses in the developing countries and redefined its role in respect of handling power subsector issues and energy efficiency issues.[1] Neither the Bank nor the World Bank holds a comparative advantage as far as expertise in energy sector operations in the DMCs is concerned, although physical proximity in the case of the Bank does provide a logistical advantage. On the other hand, given its larger number of developing member countries, the World Bank provides centralized support to its operating divisions to study sector restructuring and regulation issues and energy efficiency issues, and the Bank has benefited from some of these studies. There is no division of responsibility between the Bank and the World Bank for specific energy sector activities in the DMCs. The financing of projects in the various subsectors is pursued on the basis of either a geographical division of work or past association in respect of physical development of energy systems, or a functional division of work in respect of institutional development. Careful attention is given by both parties to maintain close coordination, particularly on least-cost energy development planning, institutional restructuring, development of institutional and legal frameworks to promote private sector investment, tariff analysis, environmental considerations, and financing conditionalities.

16. Joint financing by the Bank and the World Bank is considered only in the case of large and complex projects or under very weak institutional circumstances, coupled with high country risk resulting in genuine difficulty of mobilizing commercial sources of financing. Given the Bank's mandate to finance both public and private sector projects, the Bank has maintained close coordination with the International Finance Corporation also in respect of private sector operations. Joint financing is, again, resorted to in special circumstances as in the case of joint financing with the World Bank for the public sector. A relationship similar to that with the World Bank is being built up by the Bank with the European Bank for Reconstruction and Development in the process of carrying out operations in certain common developing member countries. In view of the importance attached to global environment problems in the region, the Bank has, in principle, endorsed its participation as an executing agency in the Global Environment Facility (GEF).[2]

3. Power Subsector Reforms

17. The Bank's power sector lending experience since 1968 has borne out certain broad characteristics common to the poor power sector performance in some DMCs. These are (i) institutional weaknesses; (ii) uneconomic pricing; (iii) inefficient generation, delivery, and use of power;[2] (iv) high demand growth; (v) adverse environmental impacts; and (vi) indigenous fuel supply limitations. Power subsector expansion during the 1980s, in particular, was largely based on foreign borrowing, and government loans and equities because internal cash generation was insufficient to support the expansion due mainly to tariffs lagging significantly behind cost of supply in many utilities. The debt-service burden carried by many utilities is now so large that they would not be able to put through the forecast expansion based on past practices.

18. Utilities should not continue to depend on the government for incremental equity and debt, especially when governments have to cut budget deficits, control inflation, and meet requirements in the social sectors. Thus, utilities need to raise equities and loans from sources other than the government and to rely more on equity. Also, the envisaged power subsector expansion program for the next 10 years is so large that it is beyond the implementation capacity (especially in terms of trained and experienced personnel) of many utilities. It is, therefore, necessary and urgent that new participants and institutions come into the field. Restructuring of the DMCs' power subsector has therefore become necessary to (i) introduce competition, (ii) allocate a greater role for the private sector, (iii) separate the roles of owning and regulating, (iv) provide for fair, objective, stable, and transparent regulation, and (v) broaden the financing base. Such a restructured power subsector will also be conducive to technologies and methods facilitating higher operational efficiency and environmental improvement.

---

1 See World Bank policy papers titled, *The World Bank's Role in the Electric Power Sector (1993)* and *Energy Efficiency and Conservation in the Developing World (1993).*

2 A Board Information Paper titled, *Participation of the Bank in the Global Environment Facility*, was circulated on 4 October 1993.

2 In India, for example, the cost to the economy of "unserved electricity" is estimated to be 2.5 percent of GDP.

19. Major changes are taking place in many parts of the world to restructure the power sector to introduce competition. In the United States, legislation has brought into existence a large number of independent power producers (IPPs) who have introduced an element of competition. The United Kingdom and New Zealand are the two countries which have introduced far-reaching reforms to enable competition and transparent regulation (see Box 1). France, on the other hand, has not followed the restructuring approach, but has a highly autonomous national power utility which is heavily decentralized with every profit center having a performance contract with the utility management to maximize efficiency in planning, construction, and operation, and thereby ensure achievement of quantified performance levels. Experience in the OECD countries, as well as the modest beginnings made in the PRC, India, Indonesia, Malaysia, Pakistan, Philippines, and Thailand, shows that there is a wide range of options for power subsector restructuring. Thus, the Bank will encourage DMCs to undertake restructuring efforts appropriate to the maturity of their stock exchange and capital market, the extent of autonomy of their public utilities as well as the existing structure of the subsector. The overall medium-term goal will be to reach market structures which allow freedom of entry, remove restrictions on ownership and management, enable competition, and allow to the extent possible costs and prices to be determined by market forces.

Box 1: Power Sector Restructuring in the United Kingdom

Among the OECD countries, the United Kingdom has carried out a remarkable restructuring and privatization program to promote efficiency and competition. In England and Wales, the erstwhile government-owned Central Electricity Generating Board has been reorganized into four new companies, viz. (i) National Power, (ii) Power Gen, (iii) Nuclear Electric, and (iv) National Power Grid. The area boards engaged in power distribution in their franchise areas have been converted into regional distribution companies and privatized. The first two generating companies have been privatized and National Power Grid is owned jointly by all regional distributing companies, while Nuclear Electric continues to be government owned. The restructuring has also enabled the emergence of a number of privately owned independent generating stations. All power generating units notify their prices for each half hour for each unit for the following day, thus creating a lively spot market for power. The larger consumers have a choice to buy power from any of the two large generating companies or from any other independent new power generating company based on price competition. The purchased power is wheeled through the monopolistic National Power Grid for a wheeling charge and distributed through the regional distributing company for a similar fee. Similarly, the regional distributing companies also enter into long-term contracts with power generators on the basis of price competition. The Director General of Electric Supply acts as the regulator adjudicating among these entities, enforcing standards, quality, reliability, and safety, as well as ensuring consumer protection.

20. Whatever model is regulatory, most feasible in terms of the pace and sequencing for restructuring, the key objectives should be to (i) separate the management, and ownership functions of the government; (ii) restructure utilities as corporate, commercial entities so they can function with managerial autonomy; (iii) enable the utilities to issue equity and bonds and raise long-term borrowings from the capital markets based on their financial performance; (iv) enable utilities to raise the needed equity to finance expansion through retained earnings; (v) retain nationwide least-cost planning and optimal loading of generating units in operation; (vi) improve operational performance in terms of heat rates, plant factors, system losses, and collections; and (vii) aggressively pursue demand side management (DSM) programs.

21 Some DMCs have started moving in the right direction. The Metropolitan Electricity Authority in Bangkok and the Electricity Generating Authority of Thailand (EGAT), for example, are government-owned utilities that are efficiently managed and that enjoy considerable autonomy and a good credit rating in the market. EGAT is implementing new large power plants jointly owned with the private sector and envisaged for full privatization some time after their commissioning. The Philippines has most of the distribution function in the private sector and has recently promulgated legislation to allow private sector participation in power generation through build-own-operate-transfer (BOOT) and build-own-operate (BOO) options. The Philippines already has an independent Energy Regulatory Board with jurisdiction over all energy supply entities. The National Electricity Board of Malaysia has been restructured as a corporation and renamed Tenaga Nasional Berhad, and 25 percent of its shares have been successfully issued to the public. Malaysia is also encouraging the entry of private sector in power generation by BOOT and BOO options and has allocated the overall electricity regulation function to the newly created office

of the Director General of Electricity. Pakistan has formulated a set of rules and procedures to enable the entry of large private generating units. India has opened its power subsector to local and foreign investors for setting up new power generation units and is offering a range of incentives and guarantees. The PRC has permitted the construction of privately owned large power generating units.

22. It is envisaged that during the next 10 years, restructuring of the power subsector in the DMCs would take place on the following lines. The power transmission function and some hydro generating units would remain with the existing utilities, which may be privatized. Most of the existing thermal units would be privatized and most of the new thermal units would be in the private sector or jointly owned by the private sector and the utility. In the smaller DMCs, the distribution functions may be handled within the transmission function mentioned above. In the larger DMCs, the distribution functions would be separated from generation and transmission and entrusted to one or more distribution companies that are owned privately, by the government, or by local authorities, each with a specified franchise area. An independent regulatory board would regulate the transactions among the various entities, ensuring quality and reliability of supply and adjudicating on tariff adjustments. The extent to which these structural changes will take place and the timing might vary among the DMCs depending on their present structure and the momentum for change.

23. The focus of power subsector work in the Bank will be to assist DMC governments to (i) identify the optimal structure for the subsector, (ii) prepare the legislative framework needed to establish independent energy regulatory boards, (iii) formulate an appropriate compensation and benefit package to stem the exodus of skilled staff as well as to soften the impact on staff identified for severance, and (iv) carry out the restructuring work in an agreed time frame. Wherever necessary, this work will be undertaken in close coordination with the World Bank and other funding agencies. The thrust of institutional work will be to identify government-owned utilities that cannot be privatized straight away and to prepare them for eventual privatization through a program of public enterprise reforms to restructure the utilities as corporate, commercial entities. Bank assistance to the power subsector from the public sector window will be in the context of demonstrated willingness by DMC governments to undertake meaningful subsector restructuring and institutional reforms. Simultaneously, the governments will be encouraged to create the legal framework and the necessary incentive and guarantee packages to allow and attract private sector entrepreneurs to build, own and operate the new power generating units supplying power to the grid at contracted prices.

24. Nuclear power generation is a proven technology that provides about 20 percent of the world's electricity production. About 4,000 MW of nuclear power generating plants are in operation at present in the DMCs. They are located in the PRC (2,100 MW), India (1,800 MW), and Pakistan (100 MW). The PRC and India, in particular, are carrying out large-scale expansion of their nuclear power generating facilities. There is however widespread public concern about the safety of nuclear power operations and waste disposal methods. Past accidents such as that at Three Mile Island in the United States in 1979 and that Chernobyl in the former Soviet Union in 1986 have contributed to public fears while also providing numerous lessons to the nuclear industry and its regulators. In addition, nuclear power generation requires high initial capital expenditure and skilled manpower.

25. Continued use of nuclear power in developed and developing countries and its further expansion require not only firm assurances that technical and institutional measures will be effective in protecting public health and safety, but also sustained public confidence and broad political support. The technical complexity of nuclear power technology is a barrier to public understanding, which makes it difficult for members of the public to evaluate safety questions for themselves. The Bank is very much aware of this background and has not been involved in the financing of nuclear power generation projects in the DMCs due to a number of concerns. These concerns include issues related to transfer of nuclear technology, procurement limitations, proliferation risks, fuel availability and procurement constraints, and environmental and safety aspects. The Bank will maintain its policy of non-involvement in the financing of nuclear power generation.

4. Hydrocarbon Subsector Reforms

26. Compared to the Bank's involvement in the power subsector, its involvement in the hydrocarbon subsector has been relatively modest (see para. 9). Most of the projects financed were related to transmission and distribution of natural gas and, to a lesser extent, to development of oil and gas fields. Oil to a large extent and coal to a lesser extent are internationally tradeable commodities and, therefore, their production is generally considered more attractive to commercial developers. Natural gas, on the other hand, is not a readily tradeable international commodity and, therefore, its development has greater difficulty in attracting investors. Moreover, natural gas

transmission and distribution have the character of natural monopolies.

27. Hydrocarbons are critical to DMCs' economic development. Without a reliable supply of primary energy, it is not possible to build the key power, transportation, and manufacturing capabilities that are required for an outward-looking industry and service economy which is the key for rapid development. Expanding indigenous hydrocarbon resources, either through new finds or exploitation of undeveloped reserves, has a particular priority in meeting the primary energy requirements since many DMCs spend a substantial part of their scarce foreign exchange earnings on importing petroleum. Natural gas reserves in DMCs, in particular, are underexploited. Natural gas is the most efficient energy form for many applications and is environment friendly compared to alternative fuels. A more productive hydrocarbon sector will also create additional benefits through downstream integration as natural gas and associated liquids are the most appropriate feedstocks for the fertilizer and the petrochemical industries.

28. The Region's hydrocarbon subsector development needs are concentrated in the poorer DMCs. It is estimated that of the DMCs' total capital requirements of $55 billion a year in the 1990s, about 83 percent for oil and gas development and about 98 percent for coal development will be in DMCs with per capita GDP lower than $1,000 and with limited access to capital markets. As such large investment needs cannot be financed through government budgets, the majority of the investment has to come from the private sector, both domestic and foreign. To further augment resources, public sector hydrocarbon entities have to be corporatized and commercialized to achieve pricing and operational efficiencies that will support capital market access. Accounting and external audit practices also have to be improved to international standards to enable these entities to raise borrowings from the domestic and foreign markets based on their financial performance. In the medium term, it is clearly understood that governments should be able to divest to the private sector most of the commercial activities and retain for themselves only those which could be classified as providing merit or public good. Governments will therefore be encouraged to divest their oil and gas companies to the private sector. Such divestments will need to be done gradually, as the value of their equity may be several times higher than the present absorptive capacity of the domestic capital market.

29. There appears to be, however, some justification for the currently government-owned entities to construct and operate natural gas transmission pipelines as they involve long gestation and pay back periods not attractive to the private sector. Gas development will be critically dependent on transmission infrastructure in the DMCs. At present, the DMCs have just over two kilometers (km) of gas pipeline for every billion cubic meters of reserves (compared to 90 km per billion cubic meters in the United States). Many DMCs, despite having huge natural gas reserves, are unable to utilize them adequately because of the inadequate gas pipeline infrastructure. Plans are being made to construct a total of about 32,000 km of pipeline over the next decade so as to triple present transmission capacity, at a cost of $45 billion. Even after such expansion, the DMCs will lag far behind the more developed countries in respect of gas pipeline infrastructure.

30. Similarly, pipeline infrastructure for oil and oil products in many DMCs is grossly inadequate, resulting in supply shortages and inhibiting fresh private investment in exploration and development. Transportation by alternative means has resulted in unacceptable levels of congestion of roads, ports, and railways, environmental degradation, and safety risks. The Bank would encourage private sector investments in pipeline infrastructure, and to the extent it remains unattractive to the private sector, public sector investments in this regard would be considered acceptable provided they operate as a common carrier and encourage upstream investments in exploration and development.

31. There is an urgent need and significant scope for the improvement of efficiency and environmental standards. Operational efficiencies of many public sector entities in the hydrocarbon subsector are well below international standards. In some cases, institutional weaknesses include poor financial condition, low tariffs, high accounts receivables, and high system losses. Strategies and investments are poorly formulated resulting in the sub-optimal capturing of the true value of reserves and capital. Onstream availability and utilization of many refineries is below the acceptable norm of 90 percent despite a shortage of products. Safety and environmental aspects of coal mining are in urgent need for upgrading. Environmental regulations relating to nitrogen, sulphur,

and lead need major improvement, as well as strict enforcement in all the DMCs. There is an urgent need to facilitate technology transfer for meeting more stringent environmental norms. The Bank can play a developmental role in these areas.

32. To enhance the indigenous self-sufficiency level of hydrocarbon supplies, the level of exploration and development will have to increase. For this, the governments will have to adopt well head pricing policies, procedures and mechanisms which make it attractive to the local and international oil and gas firms to invest in these activities. Steps that could be taken include identification of offshore and onshore blocks for exploration based on detailed resource surveys, carrying out credible rounds of biddings, adoption of a concessions approach or a production sharing agreement, accelerated development of already proven oil and gas fields on terms fair to both the bidder and the host country, and adherence in good faith to the signed contract. The existence of a transparent and fair regulatory system is an essential precondition for gaining the confidence of international investors.

33. In this context, the Bank's strategy for the 1990s in DMCs with significant hydrocarbon resources would be to stimulate their economic development and increase their market orientation by catalytic funding of reform-oriented public sector hydrocarbon entities, as well as resource constrained private ventures. The economic development will be stimulated by (i) accelerated indigenous hydrocarbon resource development; (ii) elimination of transportation and delivery bottlenecks; (iii) enhancing efficiency and effectiveness of energy production and utilization, with special focus on DSM in the industrial, transportation, and domestic sectors; and (iv) adoption and enforcement of stronger environmental regulations. Market orientation will be facilitated by financing projects and programs designed to (i) achieve progress in enterprise restructuring and regulatory reforms, skill building, and price reforms; (ii) promote private sector participation and investment; (iii) promote efficiency enhancing trade through regional projects in the subsector; and (iv) enhance the provision of "public goods" through appropriate regulation and adoption of industry standards.

5. Private Sector Role

34. Private sector initiatives and market-oriented behavior are expected to improve the energy sector's performance and efficiency. Increased private sector participation in DMCs can be promoted in several ways depending on country-specific circumstances and government objectives. Three broad categories, somewhat sequential and overlapping in scope, can be distinguished. In DMCs with very weak institutional bases, technical functions such as O&M of power plants, and commercial functions such as billing and collection, could be contracted to private firms through competitive bidding. In DMCs with stronger institutional, operational, and financial capabilities, the private sector could be attracted to independent power generation (through BOOT/BOO schemes), turnkey hydrocarbon production, and refining and transmission activities, provided a credible legal framework exists. In DMCs with a mature energy sector, the private sector could be interested in investing on its own or jointly with the public sector, or in making equity investments in energy sector entities that have been successfully restructured into corporations and listed on the stock exchange. The private sector can also play an important role in improving energy efficiency by investing in the production of energy efficient goods, and should specifically be encouraged to do so.

35. In the power subsectors of DMCs with very weak institutional bases, technical functions such as O&M of generating plants or even the power system as a whole, commercial functions such as metering, billing, and collection, or housekeeping functions such as fleet maintenance, could be contracted to private firms on the basis of international competitive bidding (ICB) as far as possible. Through its technical assistance activities, the Bank could assist the utilities to prepare bid documents, evaluate bids and enter into performance contracts with the selected bidder. The contracts will, of necessity, be for specific periods such as three years, at the end of which rebidding will have to take place. The foreign currency requirements of such contracts for specific periods could be financed by the Bank under project loans financing a time slice of the power development plan of the given DMC. Bank could also arrange bilateral cofinancing of such contracts.

36. If a utility's financial condition or implementation capacity does not allow it to undertake new projects, independent power producers could be invited to set up new generating plants and the utility can purchase power from them. Even when a utility has the necessary ability to finance and construct new generating plants, it is sensible to check through competitive bidding among IPPs whether IPPs could quote power prices lower than

what it would cost to the utility if it were to set up the plant, and take the “make” or “buy” decision on that basis. Governments could also encourage such entry of privately owned power plants to provide a measure of efficiency competition[1] to the public utility. These power plants could be built, owned, and operated for a number of years by a private firm and then transferred to the utility (BOOT) or built, owned, and operated throughout its plant life by the private firm (BOO) on the basis of a power purchase agreement between the utility and the private firm. When there is a competition for the limited resources available with the Bank for investment, the Bank would give preference to BOO projects over BOOT projects since the former is less likely to distort power pricing through rapid amortization of debts.

37. For financing a BOO/BOT project from its private sector window, the Bank would promote selection on the basis of international or local competitive bidding. Where necessary, the Bank, in coordination with bilateral and multilateral agencies active in the area, would assist DMCs to identify projects for BOOT/BOO, prepare request for proposals (RFPs), prequalify bidders, evaluate bids, and select the BOO/BOT entrepreneur. Unsolicited proposals might, however, be considered under certain circumstances such as severe time constraints, a first time BOO/BOT effort on the part of the concerned Government in the absence of an established competitive process or when the sponsor has access to a unique site or fuel resources that would not be accessible to other potential bidders. Under such circumstances, the Bank will reasonably satisfy itself that host DMCs facing serious energy shortages are not led to pay uneconomic prices and excessive returns to BOO/BOT entrepreneurs. Such unsolicited proposals should not be seen as cases of favoritism and the resulting cost should be comparable to utility's "avoided costs"[1] and costs obtained in other similar cases based on competitive bidding. Unsolicited proposals may also merit consideration if there are special economic and environmental benefits, such as cogeneration, or unique institutional features particularly in the initial stage of private sector participation in the power subsector of a DMC. The purpose of resorting to the BOO/BOT option is to secure for the utility and the economy additionality of financial resources, project implementation capability, and superior management structures, construction technology and O&M services. In this context, the Bank's role should be seen as catalytic and its financial support by way of equity and long-term loan without government guarantee should be seen as modest, demonstrational and a source of comfort to the entrepreneurs, rather than as the main source of funds.[2]

38. In the early stages of attracting private sector entrepreneurs, some DMC governments might be prepared to allow some government guaranteed Official Development Assistance (ODA) to go directly to such entrepreneurs or through an appropriate development finance institution (DFI)/Apex lending institution or a special window.[3] Power projects are capital intensive and because of their long useful lives, need loans of longer maturities than are normally available to private entrepreneurs. For large BOOT/BOO projects, the Bank could be willing to act as the lead agency and syndicate equity and commercial loans from the International Finance Corporation (IFC), Asian Finance and Investment Corporation, Ltd. (AFIC), insurance companies, social security funds and commercial banks. Complementary cofinancing could be considered to enable the entrepreneur access to credit with longer maturities and to provide relief from the debt service burden in the early years. Thus, by combining guaranteed and unguaranteed assistance and complementary co-financing, the Bank could provide the entrepreneur comfort, risk sharing, longer maturities and a share of total funds. While syndication should be the norm, such multiple assistance by the Bank would be an exception and should be resorted to with prudence and under certain conditions. First, the entrepreneur should contribute substantial equity and loans. Second, government-guaranteed assistance must not divert scarce ODA funds from more pressing needs of the economy. Third, such multiple assistance may be justified only in DMCs that, for the time being, have limited or no access to

---

1 Based on such indicators as plant availability, heat-rate, power output, staff to output ratio, etc.

1 The term “avoided cost” refers to the cost to be incurred by the utility, should it choose to finance, construct and operate the plant by Itself. This comparison is not always easy to make as identical conditions are not always available for comparison. Subsidies and concessions given to the utility must be taken into account as well as the incentives given to the entrepreneur.

2 The total amount allocated for assistance to the private sector without government guarantees will continue to be limited and therefore it will not be prudent for the Bank to consider substantial assistance in each case. The total number of such energy projects is expected to be 4-6 a year, with a total exposure limit of $200 to $250 million.

3 If a DMC government agrees to guarantee ODA for a private sector power project, the terms of the loan to the private party including the guarantee fees should not distort the capital markets. The interest rate and maturities should not tend to subsidize the transaction. The World Bank has given several loans in India for private sector utilities with government guarantees.

world capital markets.

39. Because of the wide range of commercial and country risks faced by the foreign investor, BOOT/BOO projects, even obtained on the basis of international competitive bidding, tend to be somewhat costlier than others (the premium over the normal utility costs varying as a function of the country's access to world capital markets and the performance and efficiency of the power purchasing utility). As DMCs gain experience in this process, and as more entrepreneurs enter the competition, the premiums are expected to fall. Since BOOT projects generally involve greater returns on equity (to cover country and projects risks) than are usual in the case of public utilities, and since the commercial credits available to BOOT projects have maturities ranging from 5-10 years, (far shorter than the economic lives of 20-25 years for most power facilities) extensive resort to BOOT options will tend to distort the pricing of electricity and may have balance of payment implications, especially in the case of smaller DMCs.

40. Some priority could be given to BOOT/BOO cases in which a significant part of the resources is raised by the issuing equities and bonds in the local capital market, as experience in many OECD countries indicates that utility and capital markets can help each other to grow. Also, the local private sector may not view the country risk aspects with the same degree of skepticism as foreign investors. New generating plants being set up on the basis of joint ownership among the government/utility and private entrepreneurs (as is being done in the Lao People's Democratic Republic and Thailand) with governments borrowing from the Bank to invest in the equity of such new companies (as is being contemplated in Lao PDR) is also a practical option. In less developed countries such as Lao PDR and Nepal having hydropower potential as perhaps the only significant item for export, mechanisms will have to be devised so that foreign private investment in hydroprojects will maximize the country's potential export earnings.

41. The overall purpose of encouraging BOOT/BOO operations is to provide support to the power subsector and improve its health. The analysis of BOOT/BOO projects must, therefore, be carried out all the time with that purpose in view; thus, impact of the BOOT/BOO projects on the utilities' finances should be carefully evaluated, and the sustainability of the options clearly demonstrated. The BOOT/BOO project should be a part of the least-cost power development plan prepared for the country or the utility. The analysis should attempt to capture all social costs by foregone taxes and duties and other incentives (to the extent they are not applicable to the utility or to similar transactions in other subsectors) as well as the temporal and efficiency gains such options bring in. The Bank should finance BOOT/BOO projects only if the DMC government is committed to improve the efficiency and performance of its power subsector and only after substantial policy dialogue has been held with the government and appropriate covenants agreed to under the public sector lending mode.

42. Privatization of the government-owned utility in whole or part (such as specific generating stations) would be an attractive option in DMCs that have well-developed capital markets and stock exchanges. Since the investments in the power subsector in many DMCs are much larger than the total value of market capitalization, one has to proceed with this option in stages, and time each issue carefully so as not to strain the market. First, the utilities have to be brought under the company law, which governs all companies and commercialized. The utilities' accounts have to be compiled following generally accepted accounting practices under the company law, and subjected to a transparent external audit. The utilities' properties and debts have to be inventoried and correctly valued and the correct net worth of the company in terms of stock exchange regulations established. Thereafter, well-planned equity issues as advised by competent financial advisors have to be carried out.

43. In the normal course, bureaucratic resistance and labor resistance are the two key impediments to privatization of a government-owned utility and the government should be helped to tackle these problems. The concept of privatization has to be promoted among all staff as a major efficiency objective of the government and safety nets created to soften the social impact on staff identified for separation. Preferential stock issues to retained as well as separated staff have generally been found effective in securing staff support. The essential precondition to privatization is to free the power tariffs from direct government control and to enable them to be set by a transparent regulatory body based on clearly enunciated financial objectives, so that investors will be attracted to invest in the utility. Introducing and stabilizing an autonomous corporate culture enhancing the utility's overall accountability to the shareholders and debtors is also an essential prerequisite. The main focus of the Bank's work in relation to government-owned energy utilities would thus be on restructuring them into corporations, commercializing them and partially or fully privatizing them. Loans from the public sector window, TA and related sector work activities will be directed to DMCs that are amenable to proceed in this direction.

B. Energy Efficiency

1. Supply Side Measures

44. Considering the enormous amounts of capital invested in energy supply facilities, getting the maximum benefits from these facilities assumes great significance. The Bank believes that creation of additional capacities could normally be considered only for utilities that are optimizing the output from their existing facilities. In the 1980s, the Bank consistently advocated improvements in power subsector load forecasting and least-cost planning techniques to avoid building excessive capacities and reserve margins and has argued for realistic levels of availability of supply. The Bank also accorded high priority to reducing auxiliary consumption of generating units as well as transmission and distribution losses (total system losses among DMCs' power utilities range from 25 per cent to 35 per cent compared to acceptable levels of 15 per cent to 18 per cent). These aspects will therefore continue to receive high priority in the 1990s. In addition, the utilities will be encouraged to rehabilitate and retrofit in a cost-effective manner their older generating units and substations to optimize the efficiency of their operation and to prolong their useful lives (heat rates of many conventional thermal power plants in DMCs can be reduced from about 13000 Btu per kWh to about 10000 Btu per kWh). Efficient and economic O&M practices as well as load management efforts of power utilities to shift peak demands to off-peak periods will receive special encouragement. Promotion of technologies such as cogeneration, which simultaneously improve fuel consumption efficiency, environmental conditions (through fuel avoidance) and private sector involvement, would be specially encouraged. Box 2 gives some recent examples of Bank assistance to improve energy efficiency.

2. Demand Side Management

13. Since industry accounts for over 55 per cent of the final energy consumption in DMCs, the Bank had accorded importance to energy audits of energy-intensive industries and to persuading such industries to adopt energy efficient technologies and equipment. While this approach had been practical for public enterprises (especially in the PRC), the response of the private sector to energy audit has not been as enthusiastic as expected

in many DMCs (such as India, Republic of Korea, Malaysia, Pakistan, the Philippines, and Thailand). The private sector is most likely to respond to energy price signals and legislative requirements. The key to the success of programs to promote energy efficiency lies in a combination of: (i) energy prices fully reflecting the long-run marginal cost of supply, border prices and opportunity costs; (ii) legislation and enforcement of sound environmental standards (covering all types of pollution) as well as building codes and appliance standards focusing on energy efficiency; (iii) trade regimes and investment regimes that allow the easy flow of energy efficient technology and goods; (iv) fiscal policies that penalize the production and import of energy-inefficient goods and technologies and that reward the energy efficient ones; (v) evolution of energy efficient national and regional standards for appliances and equipment, establishment of testing facilities and introduction of labeling and truth-in-labeling requirements; and (vi) tax and other forms of incentives for industries, households and commercial establishments to adopt energy efficient technology and equipment. The Bank's program lending modality could be used to achieve policy changes in DMCs along these lines (see also para. 46).

Box 2: Bank Assistance for Energy Efficiency Related Projects

Projects aiming to improve energy efficiency and protect the environment are accounting for a growing share in the Bank's lending in the energy sector. In terms of loan amount, the share reached about 30 per cent in 1992. A $107 million loan was made for the Industrial Energy Conservation and Environmental Improvement Project in the People's Republic of China (PRC), which covered seven industrial enterprises. This was followed by a loan of $147 million for the Energy Conservation and Environment Improvement Project aimed at promoting energy efficiency and reducing pollution in oil refineries throughout India. A $250 million loan was made in India in 1992 for the Power Efficiency Project, which covered a number of public power corporations. The project is aimed at energy efficiency and environmental improvements through supply side investments. During the past 21 years, the Bank has provided 76 technical assistance grants for studies, institutional strengthening, conferences and seminars on energy efficiency and environmental protection at an aggregate cost of almost $32 million. Typical examples were a regional study-cum-conference on Environmental Considerations in Energy Development, a regional study on Global Environmental Issues (with focus on global warming), a regional seminar on Energy Conservation in the Electricity Sector, an Energy Conservation Study for Malaysia (with focus on the industrial sector), studies on Environmental Management of Coal-Based Power Generation in India, Indonesia and Philippines, an Energy Audit, Efficiency and Conservation Study for Mongolia, a Power Demand Analysis for Java in Indonesia (with focus on demand side management) and expert services for Institution Building for Energy Conservation in Thailand. Specially worthy of mention are the Bank's publications, *Energy End-Use* (June 1993) and *Environmental Considerations in Energy Development* (May 1991).

46. About 19 per cent of the commercial energy and about 30 per cent of all electricity in DMCs are consumed by residential and commercial consumers. As experience in OECD countries illustrates, getting the energy prices right is a necessary but not a sufficient condition for inducing consumers to use energy efficiently. Unlike the industrial consumers, residential and commercial consumers of natural gas and electricity are numerous, each with a relatively small amount of consumption. From their perspective, front-end costs of changing over to energy efficient demand side management (DSM) options (such as compact fluorescent lamps, electronic ballasts, improved switchgear, energy efficient motors, compressors and consumer durables, heating and cooling systems) are far too high compared to the relief they get in monthly energy bills.

47. However, extensive studies in North America and Europe have conclusively shown that from the perspective of the nation and the utility the cost of reducing demand by a kW of electricity is substantially lower than the cost of adding a kW of generation, even without taking into account the unquantified environmental gains by avoiding such generation. Thus, North American utilities and European utilities have instituted comprehensive DSM measures, such as free or subsidized distribution of energy efficient systems and applications, and provision of up-front financing on reasonable terms for energy efficiency investments made by the consumers. The costs incurred are added to the rate base of the utility so that the expenditure incurred is accorded the same status as expenditure incurred in capacity addition. In preparing least-cost power development plans, these utilities have adopted integrated resource planning, in which: (i) demand reduction options such as DSM are accorded the same status as supply addition options, so that utilities are required to treat all cost-effective DSM options on the same footing as supply additions; and (ii) environmental costs and benefits of all options considered are more fully incorporated than in conventional least-cost analyses.

48. In view of the scarcity of resources and the serious environmental implications of supply increases required to meet the accelerated demands, it is urgent that the DSM concept finds widespread acceptance in DMCs. While the average annual per capita electricity consumption in DMCs is only a fraction of that in OECD countries, there is still a great deal of inefficient electricity consumption that DMCs can ill afford. Also, unlike the OECD countries, DMCs with a very low coverage of electricity supply and a very low stock of installed appliances have an excellent opportunity to ensure that demand grows on the basis of efficient electricity use.[1] Therefore, DSM options in DMCs should receive as much attention as supply side options. Available studies imply that the forecast demand growth could be moderated by about 10 per cent during this decade. However, DSM options deal with thousands of consumers and make a major demand on the institutional capacity of the utilities. Subsidized pricing of electricity is also a major constraint to DSM initiatives.

49. The Bank's approach will be to (i) encourage utilities to incorporate into their energy planning models the key elements of integrated resource planning (IRP), (ii) organize in the utilities an adequately staffed DSM group to plan and undertake DSM activities, (iii) support such groups with appropriate training programs, and (iv) to use the Bank's TA resources to prepare DSM master plans and components to be included in projects to be financed by the Bank. The Bank will also promote the establishment of energy service companies to undertake energy efficiency improvements in the premises of consumers. The Bank will also have to encourage simultaneous shifts in government policy and related legislative changes. Such beginnings have already been made in PRC, Indonesia, Malaysia, the Philippines and Thailand. In general, before agreeing to finance new capacity addition, the Bank will have to be satisfied that the utility is paying adequate attention to both supply side efficiency options such as economically sound rehabilitation and retrofitting of existing plants, system loss reduction and optimizing system operations, as well as demand side management options.

---

1 A recent study by the International Institute of Energy Conservation estimated that India will add 103 million refrigerators in the next 16 years and that by the year 2010 annual refrigerator sales in India will exceed those in the United States by 33 per cent.

50. The DSM concept has been recognized as an integral part of the energy planning for all energy resources, sectors and forms. The energy efficiency potentials within reach of the agriculture, industry, buildings, transportation and electricity sectors could provide a major boost to DMCs' economies. However, for the possible efficiency gains to happen, a number of institutional barriers should be removed. These have been identified as (i) scarcity and high cost of energy efficient products and services, (ii) low energy prices; (iii) limited indigenous human resource skills to implement DSM, (iv) lack of commitment to DSM programs, and (vii) governments' reluctance to entrust the utilities with DSM implementation programs. The Bank's sector studies will have to focus on methods that minimize or eliminate these barriers.

C. Energy Pricing

1. Background

51. Price is a major determinant of energy demand, supply and end-use efficiency. The energy pricing policies adopted by the DMCs vary widely. On the whole, there is an inadequate appreciation of the fact that prices below the true opportunity costs invariably lead to wasteful use of energy. Many DMC governments tend to use energy price as a public policy instrument to carry out welfare transfers across groups. The Bank's approach to energy pricing is that wherever possible, prices should be market-driven or market-related. In the case of a readily tradeable energy source such as oil, this is clearly possible and necessary. Where the form of energy is nontradeable (such as electricity) and is being provided by monopolistic producers (whether private or government-owned), the prices should be regulated transparently to ensure fairness to both the producers and the consumers. In the case of natural gas, which under the circumstances of many countries is non-tradeable, such a market-oriented approach is still possible by relating natural gas prices to the market prices of tradeable substitutes such as fuel oil. The specific approaches in respect of each major subsector are discussed below.

2. Power Subsector

52. In most DMCs the power subsector has a monopolistic structure and electricity prices are set or approved by governments. The monopolies are government-owned, the roles of the government as owner and as a regulator of prices are blurred, and the price fixing process is motivated by considerations other than financial and economic. The Bank's approach had been to encourage DMCs to recover the full costs of supply (including the cost of capital) while simultaneously focusing on optimal efficiency of supply by stipulating both tariff covenants (such as rates of return on asset base, debt service ratios and self-financing ratios) and efficiency covenants (such as those relating to least-cost planning, efficient O&M, system loss reduction, and billing and collection improvement). To improve allocative efficiency, utilities were also encouraged to periodically calculate long-run marginal costs (LRMC) of supply and relate tariff structures and levels to LRMC. Success in this regard had been somewhat mixed. In many DMCs tariffs still lag behind LRMC of supply, and in some DMCs tariffs are inadequate to meet financial targets. Cross subsidies within the subsector (such as industrial and commercial consumers subsidizing domestic and agricultural consumers) are also prevalent. The subsector as a whole is subsidized in a number of DMCs by excessive government equity contributions, low interest loans, and exemptions from corporate taxes and taxes on imports and fuel.

Box 3 : Electric Power Tariffs

Electric power is not a merit good or a public good. It is a service provided to clearly identifiable consumers for a charge that must cover the full cost of supply. In the absence of competition as in the United Kingdom (see Box 1), tariffs will have to be set to cover all operating costs, depreciation and interest, and to produce an adequate return on equity. For public utilities, which have the responsibility to undertake system expansions, the tariffs should enable the utility to generate internal cash adequate to service the debt and meet at least 40 per cent of the capital cost of system expansion. Such returns on earnings should be predicated on the utility achieving certain minimum efficiency norms relating to capital investment, O&M, plant availability, heat rates, system losses and the like. Tariffs should also provide for automatic and timely adjustments for variations in fuel prices and exchange rates. The structure of the tariff should not be on the basis of the use to which the power is put, but on the basis of (i) voltage and quantum of supply, (ii) long-run marginal capacity costs, and (iii) marginal energy costs. Tariff structures should also 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. Life-line rates to consumers with very low monthly consumption (such as 50 kWh) could be an acceptable compromise in low-income countries. Subsidies to the power sector as a whole through arrangements such as subsidized interest rates; excessive equity from government budgetary resources; exemption from interest rates and foreign exchange risks; exemption from corporate taxes, property taxes, import duties and sales taxes; as well as direct subsidy payments should be avoided. Such subsidies, if any, should be made transparent, quantifiable and capable of being phased out within the medium-term.

53. The Bank will continue to encourage DMCs to phase out gradually the subsidies to the subsector, minimize the internal cross subsidies and adjust tariffs at regular intervals to cover the costs of supply and generate internal cash to meet a reasonable proportion of the system expansion costs (see Box 3). Another major focus will be to encourage DMCs to carry out the tariff adjustments by independent regulatory bodies on the basis of a set of transparently promulgated tariff principles (such as rates of return, etc.). Such tariff decisions will be based on a review of the applications by utilities and on public hearing. The Bank will also encourage periodic automatic adjustments of tariffs for changes in exchange rates and fuel prices. The existence of such a transparent and predictable regulatory mechanism is essential for inducing private capital to enter the electric power subsector. As subsector restructuring proceeds to enable competition in generation and to reduce monopolistic elements (see para. 20), prices will be increasingly determined through competitive markets. Regulation in this context will focus on maintaining and reinforcing a fair and competitive environment.

3. Hydrocarbon Subsector

54. The Bank will continue to actively encourage the DMCs to adopt market-related prices for hydrocarbons. In respect of petroleum, most DMCs maintain domestic prices higher than border prices due to added taxes that promote energy efficiency as well as environmental benefits, while in some DMCs consumers of kerosene and diesel are subsidized by consumers of other oil products, notably gasoline. The oil subsector on the whole provides net revenues to the state in most DMCs; however the mechanisms in some DMCs to insulate the economy from too frequent price changes through oil price stabilization funds periodically lead to state subsidization. The Bank will continue to emphasize that it would be in the best interests of DMCs to quickly phase out such funds. It is, however, recognized that full price liberalization in the short-term may not be easy to achieve, especially considering the continuing gap in energy demand and supply and the public desire for equity in energy pricing.

55. In most DMCs, administered price regimes are in place for natural gas. The Bank's approach to natural gas pricing is that it should approximate the realistic market prices of alternative fuels. In the DMCs where natural gas reserves are abundant in relation to present and forecast rates of consumption, the price of natural gas could be somewhat lower than the market price of alternative fuels, but in no case should it be lower than the sum of the (i) LRMC of extraction, transmission and distribution; and (ii) the depletion premium.[1] To attract private

[1] A depletion premium reflects the exhaustible nature of natural gas by factoring in the period over which the resource would last and the cost

sector oil and gas companies to invest in the exploration activities in DMCs, the well-head prices should be high enough to cover costs of risk capital and provide reasonable profits. Natural gas transmission and distribution companies should also be able to earn a reasonable return on their investments after servicing their debts. The difference between market price of alternate fuels and LRMC of extraction, transmission and distribution of natural gas represents the economic rent which is significant in DMCs with low LRMC (such as Bangladesh and Malaysia) and there is a good case for the government to capture the rent by way of taxes. In appropriate cases, governments could share the rent with gas producers by allowing a higher well-head price to attract the private sector to invest more in this activity. The rent may also be shared with consumers in countries with surplus natural gas to promote interfuel substitution and environmental benefits. Transparent regulation equitable to both the suppliers and consumers and based on promulgated tariff criteria (such as return on equity) by an independent regulatory body is a necessary key element to encourage private sector development of the natural gas industry.

56. Pricing of coal would in most cases follow the same principles indicated for oil, as the domestic pricing of coal can be structured on the prices of internationally traded coals. In respect of all forms of energy and especially in respect of fossil fuels, there is a good case to tax energy consumption to compensate for the adverse environmental costs their use imposes on society. The resulting higher price would also encourage more efficient energy use.

4. Rural Energy

57. Energy utilities should not be used as vehicles for welfare transfer across consumer groups. Forms of subsidies aimed at promoting commercial energy in rural areas should be transparent, should clearly reach the target groups, should preferably be financed out of tax revenue and not through cross subsidization, and should be capable of being phased out. Rural energy pricing is discussed further in the section on Rural Energy Development in this paper.

D. Energy and Environment

58. Most energy production, conversion, transportation and utilization activities have significant adverse environmental impact. However, driven by the imperatives of population growth and economic growth and the present low levels of per capita energy consumption, most DMCs cannot avoid continuing growth in energy consumption. Further, because adequate quantities of alternative sources are not readily available, many DMCs (notably PRC and India) cannot substantially reduce their large dependence on coal to meet their commercial energy needs. It has therefore become urgent to mitigate the environmental consequences of such growth (see Box 4).[1]

59. The emphasis, so far, has been to adopt suitable measures to mitigate the adverse environmental impact of each project on a case-by-case basis, mainly through carrying out comprehensive environmental impact assessments and designing mitigating measures, which are appropriately covenanted. The Bank has produced a manual for the selection of cost-effective emission control systems for coal-fired power plants.[2] The Bank has also developed comprehensive environmental guidelines related to hydropower, thermal power, power transmission, oil and gas transmission and distribution as well as mining. Increasingly, the Bank will emphasize the need for DMCs to incorporate systematically environmental considerations as well as social considerations (such as resettlement and rehabilitation) and the associated costs and constraints in their energy planning models so that project costs adequately reflect the environmental and social costs.[3] While an ideal method of internalizing the external environment cost has not been found, several practical methods are in use.

---

of the alternative fuel to which the users of natural gas would switch to.

1 In 1990 coal-fired power plant in PRC, India, Korea, Hong Kong, Taipei (China), Indonesia, Thailand, the Philippines and Pakistan had a total installed capacity of 149,000 MW and emitted 641 million tons of carbon dioxide, 32 million tons of sulphur oxides and 4 million tons of nitrogen oxides representing about 3 per cent, 25 per cent and 7 per cent, respectively, of worldwide emissions of these pollutants from fossil fuel burning.

2 RETA 5453: Development of an Environmental Manual for Coal-Fired Power Plants ($100,000) approved on July 1991.

3 See Bank study entitled *Environmental Considerations in Energy Development*, (May 1991) and the various country studies.

Among these, use of pollution control costs as a proxy for actual damage costs or actually carrying out surveys to estimate damage costs are relatively well known. The Bank plans to use its TA resources to assist DMCs by undertaking studies to develop typical damage cost estimates. In this context, the Bank brought out a publication in August 1986 titled *Economic Analysis of the Environment Impacts of Development Projects*. Further, work is being carried out under a recent TA[1].

Box 4: Energy and Environment in PRC

The Peoples Republic of China (PRC) has the fastest growing economy in the world and is the third largest producer and consumer of energy. The PRC's final commercial energy consumption at 537 million toe in 1990 (622 kgoe per capita), accounted for 68 per cent of total use by DMCs. However, the PRC's 1990 energy intensity was the highest among DMCs, about 1.4 times their average. About 76 per cent of the PRC's energy came from coal, 17 per cent from oil, 5 per cent from hydro and 2 per cent from natural gas. The PRC's carbon dioxide emission was 554 million tons in 1986 and rose to about 610 million tons by 1990; the PRC now ranks third in emissions of greenhouse gases, behind the United States and the former Soviet Union. Thus, coal bed methane gas recovery has particular relevance to the PRC. Methane supplies associated with coal beds are estimated at about 560 TCF and about half of this is recoverable. The PRC's probable natural gas reserves could therefore be increased from about 1200 TCF to 1500 TCF. However, the PRC's proven natural gas reserves are only about 40 TCF. This emphasizes the urgency of investigations to establish the PRC's reserve levels of natural gas, including coal bed methane.

60. Increasing attention will be paid to ensure the participation of beneficiaries in the development of energy sector projects and avoid or minimize involuntary resettlement, wherever feasible. If population displacement is unavoidable, the Bank's strategy would be to ensure that the project-affected persons are at least as well-off after resetttlement with the project as without it. Favourable resettlement will be beneficial from social and environmental considerations and will promote more equitable development. The Bank will encourage the efforts of governments to promote consultation with beneficiaries on proposed energy sector development plans and projects and their implications to the beneficiaries.

61. Adverse environmental impacts can be local, regional/national, transborder and global. Global concerns have to do with the accumulation in the atmosphere of carbon dioxide (CO_2) and other greenhouse gases, and the climate change that these gases are believed to cause. They also relate to the depletion of the high altitude ozone layer because of excessive release of chlorofluorocarbons (CFCs) from refrigeration devices. Most DMCs are signatories to the Climate Change Convention of 1992 at Rio de Janeiro, and the Bank will generally assist DMCs in abiding by the Convention. However, some DMCs (such as PRC and India) will have to continue using large quantities of coal. To avoid transborder problems such as emissions from a DMC causing acid rain in adjoining countries, the Bank could undertake regional studies within the framework of its regional cooperation mandate to encourage governments to cooperate in abatement measures and facilitate inspection of power utilities to ensure that they meet regionally agreed standards. In collaboration with the World Bank, the Bank is already developing a computer model *Rains Asia*[2] to analyze the acid rain problem and to arrive at optimal policy responses. Promoting the export of power from a DMC to another country could be considered if it clearly leads to a reduction in the relative levels of local and transborder environmental impacts. Export of hydropower from Myanmar and Lao PDR to Thailand and from Nepal to India could fall under this category.

62. In dealing with local and regional impacts, the Bank will continue to play an active role. The requirement to carry out comprehensive environment impact assessment (EIA) studies will be used to evaluate national environmental standards and to stipulate project specific norms, taking into account the current and projected background and incremental pollution levels. Emphasis will be given to incorporating mitigating measures such as flue gas desulphurization, denitrification,[3] etc. or making suitable provisions for adding them when background pollution levels increase, as well as to encouraging a strong monitoring and enforcement program for this purpose. The Bank will also encourage DMCs to stipulate emission level standards rather than

1 TA No. 5515: Economic Assessment of Environmental Impacts ($600,000) approved on 10 December 1992.

2 RETA 5528: Acid Rain and Emissions in Asia ($450,000), approved on April 1993.

3 The process of minimizing the NO_x emissions.

solely rely on ambient air quality standards. The Bank will insist on provision for automatic shutdown of plant when O&M of the environment protection measures (e.g., electrostatic precipitators) fail, or when the monitoring program indicates an unacceptable level of pollution. Appropriate control and monitoring equipment will be procured as part of the capital equipment and, wherever possible and necessary, third-party monitoring of O&M of the environment protection arrangements will be encouraged.

63. The Bank will encourage washing and benefication of coal and blending of coal to minimize problems relating to the emission of particulates and SO_x. Through its TA and loan instruments, the Bank will promote the use of clean coal technologies, such as fluidized bed boilers, integrated gasification and combined cycle plant and coal gasification, as and when they become economically viable options for use in medium to large-size units. Finally, whenever the Bank funds a large coal-fired power project in a DMC, it will also encourage the DMC to invest simultaneously in a large reforestation program, or support major forest or biodiversity conservation programs since forests act as CO_2 sinks.[1] These considerations will be taken into account when country operational programs are prepared.

64. The Bank will actively promote and support cost-effective options that result in the lowest production of CO_2 per unit of electricity generated. Options of this kind include (i) retrofitting and rehabilitating existing thermal power stations to improve their heat rates; (ii) using combined cycle technology with natural gas or oil as fuel leading to high efficiencies, of the order of 50 per cent; (iii) using cogeneration units, which utilize the spent low pressure steam from the power plant for production processes and hot water for district heating; and (iv) implementing load management, better plant utilization and higher levels of efficiency of generation. Reduction of system losses, and more efficient O&M of power systems are other major options the Bank has emphasized. The emphasis needs to be continued in many DMCs (such as Bangladesh, India, Indonesia, Pakistan and the Philippines) as there is considerable scope for reducing transmission and distribution losses.

65. The Bank will continue to extend its support for technically and economically feasible hydropower projects, which form part of a country's least cost energy development plan, provided their environmental effects (including those on fisheries) and social effects, if any, can be satisfactorily managed in accordance with established Bank policies. Potential hydropower projects will be evaluated in the context of integrated water resource management of the entire watershed and take into consideration, to the extent possible, the cumulative impacts of possible future reservoir developments. Projects exploiting steep rivers, which offer relatively high water heads (drops), are generally more economically feasible than those with low heads, since the lengths and sizes of waterways required to generate a given amount of power generation are reduced. High priority has been given by the DMCs and by the Bank to this type of project particularly when coupled with limited water storage and proximity to a power transmission grid. However, projects with such attractive topological features are limited, and many of the available sites have already been developed. As a result, it has become necessary for the DMCs to consider utilization of water heads available over longer lengths of river flow with storage facilities in most cases to provide additional head as well as regulation of water flow. Since rainfall, and consequent river flow, varies from season to season and from year to year in most DMCs, a certain extent of reservoir storage is necessary in typical hydropower projects to ensure the reliability of energy supplied and maintain economic feasibility. Measures to mitigate environmental impact of such reservoirs and compensation for social disruption that might arise as a result of their construction (after exploring alternative approaches to avoid or minimize involuntary population displacement), need to be fully reflected in the project design and costs, and balanced decisions taken between implementing run-of-river type projects involving limited storage and large-scale storage based hydropower developments.

E. Rural Energy Development

---

1 The World Resources Institute has estimated that global CO_2 production is about 31 billion tons a year while the global forests and oceans acting as carbon sinks absorbing only 17.5 billion tons a year, adding 13.5 billion tons a year as greenhouse gas.

1. Introduction

66. The economic and social development of rural areas is a Bankwide concern. Adequate energy supplies and appropriate energy utilization technologies in conjunction with other technical, financial and physical resource inputs are essential for such development. Nearly 70 per cent of DMC populations live in rural areas where their energy needs are largely met by traditional, noncommercial energy sources such as agricultural waste, animal dung and fuelwood. The current utilization practices of traditional rural energy sources tend to have low efficiencies of the order of 10 per cent and adverse environmental impacts are prevalent in most rural situations. Centralized sources of energy supply, such as electricity and hydrocarbon products (liquefied petroleum gas) are generally not easily extendable to rural areas because of technical complexities and high costs associated with developing rural distribution networks. As a result, the consumption of energy supplied from such sources accounts for a low share of the total energy consumption in the rural areas. Decentralized renewable energy systems may offer more viable options to meet rural energy shortages.

2. Rural Energy Systems

67. Rural energy systems in the DMCs have the following common features: (I) energy consumption is dominated by the domestic sector; (ii) energy demand is determined by basic human needs rather than by factors such as choice, taste or income; (iii) traditional noncommercial energy sources are generally overexploited but rural incomes are so low that alternative energy forms are not affordable unless at subsidized prices; and (iv) social and institutional policies (which often work to the disadvantage of the poor) determine the distribution of and access to energy resources. Therefore, rural areas have a pressing need for more equitable access to energy resources and more efficient end-use technologies. The Bank is emphasizing this aspect in its rural planning activities. Such emphasis is in line with the social action program of the United Nations Conference on Environment and Development (UNCED) Agenda 21, which calls for integrating environment and development in decision making, changing consumption patterns and promoting human health.

68. The consumption of commercial fuels in rural areas, whether for domestic, transport or agro-industrial purposes, will produce the same kinds of pollution experienced in urban areas but the relative significance and intensity of the environmental effects produced is much lower. Attempts to factor the environmental impacts of the production and use of traditional fuels into the rural energy planning process need to address three problem areas. These are: (I) the impact of fuelwood consumption on deforestation; (ii) the health effects of traditional fuel utilization, especially those associated with the manner of combustion of such fuels for domestic purposes; and (iii) the interface between energy and agriculture, particularly the diversion of crop residues and animal wastes from agricultural uses to energy uses. Detailed assessments of the initial state of the rural environment and the manner in which it is likely to be affected by future patterns of energy demand and consumption therefore form an important part of rural energy planning.

3. Traditional Energy Sources

69. Energy for cooking in rural areas, which accounts for about 70-80 per cent of total energy use, is largely met from traditional energy sources ---mainly in the form of biofuels which have direct impact on forests. A critical problem facing the Bank's DMCs is that of maintaining fuelwood supplies without causing serious environmental damage since rural people, as well as the urban poor in the DMCs, will continue to use fuelwood as their main source of energy in the absence of affordable supplies of commercial energy forms. In accordance with its policy on Forestry, the Bank will support sustainable fuelwood production by local communities and farmers by promoting incentives such as landuse policy reforms, security of property rights, restricted access to previously "free" resources, promotion of alternate energy sources, and improved benefit sharing arrangements. The Bank will also support direct fuelwood plantaion projects including, whenever possible, native tree species in already degraded lands preferably in locations accessible by the poor, and efficient harvesting and delivery systems. However, indoor air pollution resulting from inefficient cooking methods and biofuels is a major health hazard, especially for women and children. The use of improved biofuel stoves or other alternative cooking systems would reduce deforestation and improve the quality of life by reducing the time spent in gathering fuels and cooking.

70. Developing an optimum mix of energy sources for each location (based on available natural resource endowment pattern and their efficient utilization) is the key to augmenting rural energy supply from traditional sources coupled with the use of renewable energy technologies. Therefore, rural energy policy should be aimed at providing the basic human energy needs by choosing an optimum mix of the energy resources at a minimum cost to economy. Conserving and managing forest and nonforest, woodfuel resources, adopting equitable pricing policies and ensuring sustainable development will be the key objectives. Bank assistance to rural energy planning would focus on the (i) role of the fuelwood in energy planning for rural areas; (ii) augmentation of fuelwood supplies from commercial fuelwood plantations, natural forests (excluding primary and protection forests) and social forestry projects; and (iii) fuelwood use efficiency aspects such as efficient cooking stoves. It will also pay special attention to the use of biomass for heat and motive power, small-scale hydropower, and solar and wind based energy forms (see paras. 74 through 81).

4. Commercial Energy Options

71. There are many complexities and biases in evaluating rural electrification (RE). Although power subsector lending has accounted for about 75 per cent of the Bank's overall energy lending, only a modest portion is devoted directly to the electrification of DMC rural areas, where 70 per cent of the people live. The electrification ratio in many DMCs is still low.[1] The main difficulties with RE are that its (i) nonmonetary benefits are not widespread or strong enough to warrant waiving of conventional evaluation criteria; and (ii) unit costs are comparatively high because of long distances, low load factors and wide dispersion of load. The RE contribution is maximized when it is applied to end uses that use electricity or where use of electricity has an advantage over alternative energy forms or both. Such end uses are usually associated with mechanized productive activities such as pumped irrigation and agro-industries. Experience in RE through grid supply suggests that this option succeeds when in conjunction with other rural development activities that provide economic loads to the RE system. Therefore, the Bank will, encourage an integrated development approach.

72. Electricity constitutes only a small proportion (less than 10 per cent) of the total energy used in electrified rural areas, even though electricity tariffs charged are usually below the LRMC. Even the subsidized tariff seems to impose on low-income households costs that are higher than those of fuel substitutes as these in most rural situations, have subsidies as well. This factor, together with high initial connection costs, renders RE unaffordable to a large segment of the rural population. Governments may decide, as a matter of social policy, to provide subsidies to targeted groups which cannot afford to pay the economic price of electricity, on the clear understanding that such subsidies will be gradually phased out in a time bound manner. Cross-subsidization of rural consumers by urban consumers needs to be discouraged and, instead, the utility needs to be provided with direct cash injections from tax revenues to meet the costs of financially non-viable electricity supply extensions. Such cash injection is a must in the case of economically non-viable supply extensions pursued purely for social reasons. The Bank would give priority to assisting RE schemes that are economically and financially viable and not considered for investment by the private sector. When RE schemes that are economically sound but financing will be to determine the quantum of rural electrification that the utility can cover without adversely affecting its own overall financial viability, and to stage or schedule RE works accordingly.

73. In nonelectrified areas, kerosene is used extensively for lighting, and diesel for pumping and agricultural machinery. While the use of such fuels may have to continue, the focus of Bank interventions will be to ensure that these are supplied in an environmentally sound and sustainable manner and used with optimum efficiency. The power grid will be extended only if it is a lower cost option than decentralized generation based on diesel, minihydro, solar, biogas and wind energy, with all costs accounted for in economic terms in an unbiased manner. On the other hand, the supply of electricity to the power grid from renewable energy sources, where feasible, will be encouraged. The Bank will therefore carefully review the feasibility of selecting suitable technologies and sites using its TA resources in respect of all these rural energy supply options. Decentralized electricity systems for rural areas may lend themselves to supply and distribution by small-scale private sector IPPs.

---

[1] The ratio ranges from about 10 per cent in Nepal to about 80 per cent in Malaysia.

The Bank may encourage them, in addition to the development and management of renewable energy sources by rural communities on a cooperative basis.

Box 5: Renewable Energy Options and Rural Electrification

Technologies relating to environmentally friendly renewable energy options such as solar photovoltaics, wind-based systems, mini-hydro systems and biomass-based systems are making rapid advances and are becoming viable options for privately owned decentralized applications where extension of the grid power is uneconomic. The Bank's analytical framework for comparing these options with conventional grid supply will be reviewed to remove possible bias against these options by attempting to fully internalize the environmental benefits. The comparisons will be in economic terms to avoid distortions caused by implicit and explicit financial subsidies to grid power and isolated diesel generation. In view of the high front-end cost to the consumer compared to the option of receiving grid supply, some innovative financial engineering has to be done to design repayment terms and amortization schedules to match the cash flow of the consumer. Experience in many DMCs suggest that these options work well when handled by private owners or local communities, and generally fail when handled by large utilities with their high cost structure. For decentralized privately owned systems, the Bank could provide local banks lines of credit for lending to entrepreneurs. Technical assistance to the banks to evolve standard sizes, technical parameters, financing terms, etc. will be appropriate.

5. Renewable Energy Systems

74. A variety of decentralized renewable energy systems exist in the rural areas of the DMCs. The most widely used systems are (I) small-scale hydropower systems for mechanical and electrical energy; (ii) biogas systems for heat and motive power; (iii) solar photovoltaic power systems for domestic lighting, water pumping, medicine refrigeration and voice and data communication; (iv) solar thermal systems for heating purposes; and (v) windmill-based power generation, water pumping and battery charging systems. The extent to which the various systems have been established varies from country to country.

75. Small-scale hydropower systems, when simply designed to suit local circumstances have advantages such as long service life, high operational reliability (given water availability) and minimal environmental impact. The main disadvantages are high capital cost per kW of installed capacity and lack of water during dry seasons particularly in the absence of water storage facilities. The capital cost can be reduced to some extent by accepting lower efficiencies in favour of using standard designs permitting substantial local inputs and simple construction methods. Biomass energy can be produced from almost any organic material, including terrestial and aquatic plants, and agricultural residues. Motive power, and thereby electricity, can be generated from biomass by direct combustion or by converting biomass first into an intermediate fuel for combustion. Despite the many advantages of using biomass, there are some related problems arising from land area constraints, and transportation and storage requirements.

76. Photovoltaic (PV) power generation is based on the conversion of direct and diffuse sunlight into electricity using PV cells which can be combined to form PV modules that currently have energy conversion efficiencies of around 15 per cent. These modules are used in conjunction with power control and storage equipment in typical solar PV power supply systems. Since PV technologies are based on semiconductors, they lend themselves to mass production and their economic potential is substantial. PV modules which now cost about $3.5 per kilowatt of electricity output are expected to come down in price to about $2.0 per kilowatt by the year 2000. Solar thermal systems are used for water heating, cooking, drying of timber and grains, and power generation. Solar thermal electric generating systems, which produce electric power by concentrating sunlight to heat a working fluid and use that fluid to drive a thermal power generating unit, operate most efficiently around the equatorial belt and have no airborne emissions. The resource base for wind energy is very large; however, actual use needs to be limited to preferred areas with special wind characteristics and a form of backup energy storage is needed to get reasonable reliability from stand-alone wind energy systems. The key physical constraint on the development of wind energy projects is land requirement. Acoustic noise emission and visual impact are environmental concerns.

77. Only modest achievements have been made in the development of small-scale hydropower systems in most DMCs with the exception of the PRC. The total installed capacity for small-scale hydropower in the PRC is about 13,000 MW, forming about 7 per cent of the aggregate installed capacity of the centralized power system. This high level of development is largely due to the use of simple technology with equipment, construction materials and labor obtained locally. In respect of biogas technology, it is well established that PRC and India have extensive experience among the DMCs. The costs of both family and community size plants have come down over the years in most DMCs and their reliability has improved. The most significant advantage of biogas is its ability to displace fuelwood use for cooking. In addition, waste discharge from biogas systems is rich in mineral nutrients which are used as fertilizers.

78. Some experience has been gained in the installation and use of solar photovoltaic domestic lighting systems in Sri Lanka, Indonesia, the Philippines and some of the Pacific island economies where private sector firms have been involved in intensive marketing efforts. Solar energy based domestic water heaters are also being marketed in most of the DMCs by the private sector. However, it is relevant to note that such systems are not commonly used in rural households because of high initial capital costs. Solar drying processes are well-established and proven in most DMCs. A measure of success has also been achieved in the DMCs in using windmills for water pumping and battery-based lighting systems due mainly to the simplicity of the technology, the capacity for its local manufacture and the relatively low import dependency.

79. Significant technological advances are being made in solar and wind energy systems. Because capital costs of these options are coming down as a result of such advances, they are becoming reasonable decentralized solutions for remote locations in isolation or in combination with other energy supply options. Such systems should be marketed and serviced by the private sector and the Bank should at best provide lines of credit to local development finance institutions or commercial banks, as well as TA for a better understanding of the scope, costs and risks involved. Governments may have to adjust their trade and fiscal policies to remove barriers that deter the private sector from importing, manufacturing, marketing and servicing such systems. The institutional issues are important and the Bank will focus on them through TA activities.

80. Some of the major constraints to the development of decentralized and sustainable renewable energy systems in rural areas include (I) overemphasis of national energy policy on the expansion of bulk commercial energy supply capacity through centralized systems largely to meet urban and industrial needs; (ii) low priority of energy in rural development in national planning, leading to the lack of fiscal and financial incentives for decentralized renewable energy systems; (iii) weak technology research, transfer and development policies; (iv) lack of emphasis on establishing close links between research and development outputs and local manufacturing and fabrication capabilities; (v) weak institutional structures for implementation of rural energy projects; and (vi) unavailability of reliable information on rural energy needs, supplies and environmental status.

81. Limited access to investment capital and distorted pricing of alternative energy forms also prevent renewable energy applications from achieving their potential market shares. Fuel subsidies and electricity rate structures that do not make consumers pay more for power during peak demands or at remote locations bias end-user decisions against renewable energy supply sources. Removal of such energy price distortions needs to be supplemented by fiscal policy reforms that encourage imports of renewable energy generating equipment. The environmental benefits of renewable energy sources, their modularity and fuel independence, and applicability in remote locations have also to be captured in energy planning models in an economically unbiased manner.

F. Regional Cooperation and Energy Development

82. Regional cooperation is a key component of the Bank's strategic agenda. Many of the energy resources yield optimal benefits when exploited by two or more countries rather than a national framework, especially when the countries are relatively small and the resource base is spread over many countries. Thus, the planning for exploitation of the hydroelectric potential of a river valley system covering several countries is more

cost-effective when it covers the whole valley rather than individual countries. Interconnection of electricity grids reduces reserve margin requirements and leads to an overall lowering of the system costs. Similarly, gas grids connecting several markets provide greater capacity utilization and lower costs. Under the funds available for regional TAs, the Bank will attempt to identify the promising regional projects, formulate them and determine the most suitable implementation and lending arrangements. The focus will be to involve the international and local private sector to the extent possible.

83. The Bank has provided a number of regional TAs covering a wide range of subjects, aimed at improving the efficiency of energy sector institutions in carrying out their planning, operations, tariff regimes, and accounting and managerial roles. A good example of the Bank's regional role in lending operations was the assistance to the Lao PDR in building power generating capacity for export to Thailand.[1] More recently, the Bank has been successful in assisting the Lao PDR to negotiate a joint venture arrangement with private sector partners from Thailand and Scandinavian countries to finance and build further power generating capacity for electricity export to Thailand.[2] These hydropower export arrangements, which will be carried out with careful attention to minimize environmental impact, will result in considerable regional environmental protection by avoiding equivalent (or larger) amounts of coal-fired generation in the importing country.

84. About 75 per cent of natural gas transfer in the Region takes place through pipelines and regional gas trade could be promoted through pipelines such as the Trans-ASEAN gas pipeline system (about 8000 km long to link the East Asian markets).[3] Australia, Brunei, Indonesia and Malaysia dominate regional LNG trade by exporting about 40 million tons a year to Japan, South Korea and Taipei,China.[4] Transportation of LNG over long distances requires large dedicated reserves and cryogenic infrastructure that require very high investment costs, but growth in energy demand and rising concerns over environment have made LNG the fuel of choice for power generation in the importing countries. Natural gas has provided security of supply for consumers and security of demand for producers. Because future prospects for increased natural gas utilization in the Region appear distinctly promising, the Bank has recently commissioned a Regional TA for "Increased Utilization of Natural Gas" covering 11 countries.[5] The study covers natural gas utilization plans, taking into account demand and supply scenarios including regional trade, existing programs, institutional frameworks, policy constraints and strategies for natural gas development. The prospects of importing gas from the Middle East as well as from the Central Asian Republics to South Asia are also being assessed separately.

85. A major initiative is also being taken for regional cooperation in energy development under the Bank's ongoing regional TA for subregional cooperation among Cambodia, PRC, Lao PDR, Myanmar, Thailand and Viet Nam. The focus in this connection will be on the hydropower and gas/oil resources of these countries and the scope for increased regional energy transfer through the formulation of appropriate energy projects.

---

1 The 150-MW Nam Ngum Hydropower Project in the Lao PDR exports about 75 per cent of its annual generation of 900 GWh to Thailand, while the 45-MW Xeset Hydropower Project exports practically all of its 180 GWh of generation.

2 The 210-MW Theun-Hinboun Hydropower Project to be implemented under this arrangement will export over 1000 GWh per year.

3 Another ambitious regional gas pipeline plan, called the "Energy Silk Route", has recently been endorsed by the Japanese Government. The plan will permit export from Turkmenistan and PRC to Japan through a 9000-km-long pipeline to cost $12 billion and commissioned by 2003.

4 Indonesia accounted for about 55 per cent of the supply and Japan accounted for nearly 90 per cent of the demand.

5 Bangladesh, India, Indonesia, Malaysia, Myanmar, Pakistan, PNG, PRC, Philippines, Thailand and Viet Nam.

IV. CONCLUSIONS AND RECOMMENDATIONS

86. The Paper has attempted to identify the major energy sector issues likely to be faced by the DMCs in the 1990s and the policy initiatives that may be appropriate for the Bank to adopt in dealing with these issues. The recommended policy initiatives focus on enhancing (i) private sector participation to fund the large scale energy investments of the 1990s; (ii) energy efficiency both on supply and demand sides; and (iii) closer integration of environmental considerations in energy development. The overall thrust of the suggested policy initiatives is to encourage the DMCs to develop appropriate market structures and to encourage greater competition in the energy sector. Such an approach encompasses a broader field than concerns with cost recovery and public sector reforms. It calls for special attention to the essential issues of freeing entry, removing restrictions on ownership and management, enabling technological choice and permitting market forces to determine costs and prices. It is recognized, however, that the extent and speed of success in achieving this ideal framework will vary from country to country and from subsector to subsector. It may be relatively less difficult to achieve this in respect of traded energy forms such as oil and coal, and in countries with a greater degree of market orientation such as the Philippines, Malaysia, and Thailand than in respect of nontraded forms of energy like electricity and in countries with a tradition of administered prices. The Paper takes the approach that the suggested framework should be the one which the Bank should encourage DMCs to seek, and that all other sectoral concerns discussed should be regarded as steps leading to its realization.

87. Thus, in respect of the power subsector, the Paper advocates sector restructuring in the medium-term involving unbundling of the mix of generation, transmission and distribution to enable greater private sector participation, introduce elements of competition and to minimize monopolistic segments of the subsector. In the short term, it advocates corporatization and commercialization of government-owned utilities as a prelude to their privatization and the entry of private sector through BOO/BOOT options. It also advocates in the short-term tariff setting through independent and transparent regulation and focusing sharply on demand side management. The major recommendations made for Board approval are the following:

(i) A major portion of the Bank's lending and technical assistance should be directed to those DMCs which are willing to restructure their power sector to increase efficiency and to mobilize the incremental investment funds from the private sector, both domestic and foreign.

(ii) The Bank should finance new capacity additions only if the utility pays adequate attention to both supply side efficiency options such as economically sound rehabilitation and retrofitting of existing plants, system loss reduction and optimization of system operations, as well as demand-side management options.

(iii) The Bank should encourage power utilities to prepare and implement master plans for DSM measures.

(iv) The Bank should encourage power utilities to incorporate into their planning models IRP with its key elements of DSM and environmental cost internalization, and provide assistance for related training.

(v) The Bank should support BOO/BOT projects if (a) they are part of the least-cost power development plan; (b) they provide additionality in terms of financial resources, implementation capability and experienced O&M manpower; and (c) their sponsors have been selected through competitive bidding. Unsolicited proposals may be considered under special circumstances such as severe time constraints, exploitation of unique natural or institutional features, or in the initial stage of private participation in the power subsector of a DMC.

(vi) The Bank should support joint-venture projects between governments/utilities and private entrepreneurs by providing loans to the former, which could be used as equity in the project.

(vii) The Bank should actively pursue environmental protection by giving high priority to power projects with minimum environmental impacts and insisting on adequate mitigation measures and monitoring for projects with significant environmental impacts. The use of clean coal technologies (when economically viable) and energy conversion processes yielding high overall efficiency (such as cogeneration) will be encouraged. Full compliance will be required in project planning, design and implementation with the Bank's policies on beneficiary participation and involuntary resettlement.

(viii) The Bank should support regional trade in electricity between neighboring countries from projects where this meets environmental standards and is cost-effective for all parties.

(ix) The Bank should encourage DMCs to phase out gradually subsidies to the power subsector, minimize cross-subsidies, adjust tariffs at regular intervals to fully cover the costs of supply and meet an adequate proportion of system expansion costs; such tariff setting and adjustment should be carried out by independent regulatory bodies on the basis of transparent principles.

88. In respect of the hydrocarbon subsector, the Paper advocates a more rapid movement towards the normative market framework and market-based pricing and recommends that in the medium-term governments should divest themselves of all commercial functions and retain only those coming under the classification of merit or public good. Meanwhile, this will require the establishment of a supportive regulatory regime which is transparent and equitable to both producers and consumers so as to accelerate private sector participation. The Paper recognizes that because of the environmental friendliness of natural gas and the high efficiency with which it can be used, the development and utilization of natural gas should receive a high priority for investment and Bank assistance. It advocates the use of sector lending and program lending modalities to focus on policy reforms involving divestment, substantially greater role for private investment, and market-based pricing. The main recommendations made for Board approval are the following:

(i) The Bank should encourage private sector participation through the development of a supportive policy and regulatory environment within DMCs and through the Bank's joint participation in projects where the additional comfort of a multilateral institution catalyzes private sector participation.

(ii) As oil is an internationally traded commodity with established private sector interest for its development, the Bank should not, in general, fund oil development projects but would provide policy assistance to create a policy environment which attracts private investors, provides greater competition and independent and transparent regulation. If necessary, the Bank should consider assistance to develop marginal and already proven oil fields, if such a development is economically sound.

(iii) The Bank should assist in promoting good practices in hydrocarbon field operations to enhance their efficiency and environmental management.

(iv) The Bank should play a major role in funding natural gas field development, processing, transportation and distribution networks. Cofinancing and private sector participation should be encouraged to the maximum extent possible in all Bank-financed natural gas projects. The Bank should not finance exploration activity as it has a high risk profile and should be equity financed by entrepreneurs.

(v) The DMCs need a significant expansion in refining capacity to meet growth in petroleum product consumption. The Bank should consider providing catalytic financing to the private sector for greenfield or expansion projects. The Bank should also finance projects for desulphurization and elimination of lead content to help comply with stricter environmental standards.

(vi) The Bank should encourage DSM in hydrocarbon use particularly in industrial and domestic applications.

(vii) The Bank should support regional trade in natural gas through financing the necessary infrastructure to enable DMCs to have greater access to this resource.

(viii) Coal is the primary energy source in the Bank's largest DMCs and its use is a major cause of environmental degradation. The Bank should actively promote environmentally sound mining practices and clean coal technologies. As coal is an increasingly internationally traded commodity, the Bank should not directly finance coal mine developments except where it is for captive use by a thermal power plant, and economically superior to other coal supply options. The Bank should offer policy assistance where necessary to enable restructuring and privatization of the subsector. The Bank should become more active in promoting environmental and safety programs in coal production and in projects to minimize the environmental costs of coal burning through approaches such as coal benefication and centralized coal gasification systems.

89. In respect of the rural energy systems, the main recommendations made for Board approval are the following:

(i) The Bank should assist in the provision of commercial energy sources to rural areas whenever it is economically and financially viable and private sector investment for the purpose is not forthcoming. Where only the economic viability is confirmed after factoring in all costs in an unbiased manner, such provision should be assisted to the extent that the utility responsible can accommodate it without adversely affecting its own financial viability.

(ii) The Bank should ensure that subsidies, if any, on commercial energy are provided to targetted groups which cannot afford to pay its economic price on the clear understanding that such subsidies will be gradually phased out in a time bound manner. Cross-subsidization of rural electricity consumers by urban consumers needs to be discouraged and, instead, the utility needs to be provided with direct cash injections from tax revenues to meet the costs of financially non-viable electricity supply extensions. Such cash injection is a must in the case of economically non-viable supply extensions pursued purely for social reasons.

(iii) To stem deforestation and promote equity and health in rural areas, the Bank should help DMCs to develop efficient fuelwood stoves and give high priority to fuelwood plantations in formulating rural energy development plans; such fuelwood plantations should, whenever possible, include native tree species and should be established in already degraded lands preferably in locations accessible by the poor.

(iv) The Bank should provide technical assistance to DMCs to assess, in an unbiasedd manner, the economic viability of solar, minihydropower and wind energy options, or hybrids in conjunction with diesel plants, to meet demand for electrical and mechanical energy, particularly in isolated locations. Decentralized energy systems that may be recommended by such assistance are, however, best owned and operated by the private sector.

(v) The Bank should allocate adequate resources for regional studies and seminars that promote renewable energy use and address renewable energy supply issues.