**Extracts from the secretariat's technical paper on**

**Barriers and opportunities related to the transfer of technology**

**(Document FCCC/TP/1998/1)**

[ Please note, these are direct extracts and the information has not been rewritten or updated to reflect changes in country circumstances since 1999]

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# I. GENERAL DISCUSSION

## A. Introduction

1. Environmentally sound technologies (ESTs) and know-how,[1] in the climate change context can be divided into two categories: mitigation technologies to reduce emissions by sources or to enhance removals by sinks of greenhouse gases and adaptation technologies to reduce the adverse impacts of climate change.[2]

2. The international transfer of ESTs and know-how can be considered as a process originating from the countries and the companies that developed and produced them to the countries and subjects that will receive and facilitate their effective implementation and dissemination. This process follows different pathways and in each case there are different entities that can intervene and influence the process.

3. A typical technology transfer process can be divided into the steps summarized in table 1 below, according to the different participants in the process. This is not a strict division of roles, and action may be taken by both sides.[3]

**Table 1.Steps in the technology transfer process**

| ***Supplier side*** | ***Recipient side*** |
|---|---|
| a) research and development | a) create awareness of the need for ESTs |
| b) project preparation | b) develop capacity for the adoption of ESTs |
| c) demonstrations | c) assess technological options |
| d) project implementation or technology commercialization | d) implement and operate technology |
| e) feedback analysis | e) feedback analysis |

4. The implementation of the above processes calls for the involvement and commitment of different actors. There are six main actors who may enter the process at different stages: Governments, private sector businesses, multilateral financial institutions, international organizations, non-governmental organizations (NGOs) and consumers/households. These actors often perform multiple functions; for example, the private sector develops, manufactures, markets, finances, and operates technologies. However, the

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[1] Environmentally sound and economically viable technologies and know-how conducive to mitigating and adapting to climate change. The term encompasses “soft technologies” and “hard technologies”. Examples of soft technologies include capacity building, information networks, training and research, while examples of hard technologies include equipment and products to control, reduce or prevent anthropogenic emissions of GHG in the energy, transportation, forestry, agriculture, industry and waste management sectors, to enhance removals by sinks, and to facilitate adaptation (FCCC/SBSTA/1996/4).

[2] In the context of this paper, to the extent possible, we will refer to all categories giving specific mention when only one group is concerned.

[3] Steps in table 1 are not directly linked between the supplier and recipient sides.

boundaries between actors are not rigid and may differ for different types of technologies.[4]

5. All the above actors participate in the process. Nevertheless, the process itself depends upon the varying conditions, in both developed and developing countries. To be able to facilitate the adoption and implementation of ESTs it is essential to consider specific regional, national and sectoral barriers and incentives. Encouraging key actors to value the medium- and long-term economic and competitive benefits of sustainable development over the short-term costs of shifting production and consumption patterns remains one of the most important objectives to be achieved.

## B. Barriers

6. Barriers may generally be defined as factors that inhibit the technology transfer process. Examples of barriers are abundant in the literature.[5] However, the following is a short list of barriers relevant to the transfer of ESTs:

(a) Institutional: lack of legal and regulatory frameworks, limited institutional capacity, and excessive bureaucratic procedures;

(b) Political: instability, interventions in domestic markets (for example, subsidies), corruption and lack of civil society;

(c) Technological: lack of infrastructure, lack of technical standards and institutions for supporting the standards, low technical capabilities of firms and lack of a technology knowledge base;

(d) Economic: instability, inflation, poor macroeconomic conditions and disturbed and/or non-transparent markets;

(e) Information: lack of technical and financial information and of a demonstrated track record for many ESTs;

(f) Financial: lack of investment capital and financing instruments;

(g) Cultural: consumer preferences and social biases;

(h) General: intellectual property protection, and unclear arbitration procedures.

7. A first step in the process of overcoming barriers is to identify and assess them according to the technologies chosen and the targeted categories of users. An example of such a process is the technology and technology information needs survey conducted by the

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[4] In some of the groups it is possible to find suppliers and users. The actors will behave differently depending on whether they represent the supplier's or receiver's side.

[5] See for example: World Investment Report 1996, UNCTAD, and Technology and Finance: new opportunities and innovative strategies for sustainable development, UNDP (1994.)

secretariat with the cooperation of the University of Amsterdam (FCCC/SBSTA/1998/INF.5).[6]

8. In that survey Parties were requested to provide information on past experiences and projects, and to list the perceived barriers encountered in formulating and implementing them. The results are presented in table 2.

**Table 2.Barriers to the transfer of technology as identified by Parties**

| *Reporting Countries* | *Key barriers* | *Category* |
|---|---|---|
| Belize, Guinea, Latvia, Mali Poland, Republic of Korea | Lack of finance, terms of funding | Financial |
| Mali | Inability to obtain international finances for dissemination of indigenous technologies | Financial |
| Mali, Kiribati | High investment cost | Economic |
| Mali, Poland | High cost of service and maintenance | Economic |
| Zimbabwe | Affordability for technology end-users | Economic |
| Albania, Panama | Lack of/access to technical information | Technological |
| Mali | Lack of supply of spare parts | Technological |
| Egypt | Lack of technical capacity | Technological |
| Egypt, Guinea, Indonesia | Lack of local management skills, training of personnel | Institutional |
| Barbados, Costa Rica | Lack of public acceptance: low level of public awareness | Institutional |
| Mali | Cultural, including perceived comfort. | Cultural |

Source: see footnote 9.

9. The conclusions from the data provided in the survey are limited by the number of projects reported. Therefore it is not possible to give a general assessment of the comparative importance of various types of barriers. However, the key barriers, in order of decreasing importance, appear to be: financial, economic, technological, institutional and cultural. In particular, access to national and international sources of financing is seen as a major obstacle.

[6] See also R. van Berkel, E. Arkesteijn, Transfer of Environmentally Sound Technologies and Practices under the Climate Convention: survey of experiences, needs and opportunities among non-Annex II countries. IVAM Environmental Research, 1998.

## C. Opportunities

10. Agenda 21 provides a list of activities that can create opportunities to promote the transfer of technology, these include: a) government policies creating favourable conditions for both public-sector and private-sector transfers; b) institutional support and training for assessing, developing, and managing new technologies; c) information networks and clearinghouses that disseminate information and provide advice and training; d) collaborative networks of technology research and demonstration centers; e) international programmes for cooperation and assistance in research and development and capacity building; f) technology-assessment capabilities among international organizations; and g) long-term collaborative arrangements between private businesses for foreign direct investment and joint ventures.[7]

12. Many governments are undertaking such actions by developing legal instruments, tax regimes that reward technology upgrading, targeted lending programmes from public and private banks, public/private partnerships to support the import/export of ESTs, tax refunds or subsidies for the import and implementation of ESTs, subsidized infrastructure, tariff protection, and providing clear information about government programmes and actions. Some governments are also using economic instruments together with traditional command and control regulations (for example, emission standards) to achieve environmental goals and to encourage the transfer of technologies. Case studies suggest that no single policy instrument is likely to be sufficient to address environmental problems, and that, therefore, a combination of instruments is likely to be needed. To be effective, economic instruments also need strong institutions, the active support of economic, financial and industrial authorities, and few bureaucratic restrictions.

13. Further examples of recent activities undertaken by non-Annex II Parties can be drawn from the results of the technology and technology information needs survey, where Parties were requested to provide details on enabling measures adopted by their governments to facilitate the transfer and implementation of ESTs in different sectors relevant to climate change in their countries. The responses of Parties are summarized in table 3.

[7] There is general recognition that the private sector plays an important role in introducing and implementing environmentally sound technologies and know-how, and that the relationship between the public and private sectors is particularly important and needs to be further explored. In this context, the secretariat is preparing a technical paper that will be available in 1999, on the role of the private sector in developing and promoting clean technologies, including problems and prospects.

**Table 3. Enabling measures initiated by non-Annex II Parties**

| Creating awareness | Disseminating information | Providing technical assistance | Creating a fiscal environment | Removing trade barriers |
|---|---|---|---|---|
| Albania | Albania | Bangladesh | Barbados | Bulgaria |
| Barbados | Bolivia | Barbados | Bulgaria | Mali |
| Belize | Costa Rica | Bolivia | Lithuania | Poland |
| Benin | Ecuador | Botswana | Mali | Senegal |
| Bhutan | Egypt | Bulgaria | Poland | Uruguay |
| Bolivia | Georgia | Guinea | Republic of Korea | |
| Botswana | Guinea | Indonesia | Uruguay | |
| Bulgaria | Indonesia | Mali | | |
| Costa Rica | Lithuania | Poland | | |
| Ecuador | Mali | Uruguay | | |
| Egypt | Philippines | | | |
| Georgia | Poland | | | |
| Guinea | Republic of Korea | | | |
| Guyana | Senegal | | | |
| Jamaica | Singapore | | | |
| Latvia | Trinidad & Tobago | | | |
| Lesotho | Uruguay | | | |
| Lithuania | Venezuela | | | |
| Mali | Zimbabwe | | | |
| Nigeria | | | | |
| Philippines | | | | |
| Poland | | | | |
| Republic of Korea | | | | |
| Senegal | | | | |
| Singapore | | | | |
| South Africa | | | | |
| Syria | | | | |
| Trinidad & Tobago | | | | |
| Uruguay | | | | |
| Venezuela | | | | |
| Zimbabwe | | | | |

Source: see footnote 9 (Responses from national focal points or other national climate change coordinators have been considered for this table).

## II. CASE STUDIES: South-East Asia

### A. Introduction

17. Many economies in Asia, including the Republic of Korea, Indonesia, and Thailand, have experienced substantial growth rates over the past decades, one of the major factors influencing GHG emissions. Before the current financial crisis, many analysts suggested that these trends would continue. The most recent statistics seem to indicate that the trend will be reversed to a significant degree at least for the short term.

18. The Asian region accounted for nearly 17 per cent of the total world GDP in 1971 and approximately 25 per cent in 1994. During this period the region was industrializing more rapidly than any other region. At the same time, the Asian share of the total world population increased from 53.9 per cent in 1994 to 55 per cent in 1997. This rapid economic development and increased population resulted in a rapid growth in energy consumption. The region's share in the world's total primary energy consumption was about 24.8 per cent in 1994, compared with only 13.8 per cent in 1971.

19. GHG emissions in the energy sector grew by approximately 2.4 per cent per annum in the Republic of Korea during the period 1971-1994 while those for Indonesia and Thailand grew by 3.4 per cent and 3.6 per cent respectively. These rates were high relative to other developed countries.[8]

20. An analysis of GHG emissions by sector shows that the industrial and residential sectors contribute the major share of GHG emissions in the Republic of Korea while in both Indonesia and Thailand it is the transport and power generation sectors that contribute the major share of such emissions. These sectors seem to have relatively larger potential for technology transfer than other sectors. The electricity generation sector appears to be important for all three countries since electricity consumption has grown and will probably continue to grow as incomes rise, since electricity is easy to use and of high quality.

21. Fossil fuels are likely to remain a major source of energy in these countries, even in the long run, and some strategies, such as adoption of clean fuel technology and conversion efficiency improvements, will be essential. Examples of such technologies include clean coal technologies (CCT) and integrated gasification combined cycles (IGCC).

22. As all three countries are now experiencing major economic problems, it is not certain how and when they will be able to resume economic progress. The current financial crisis will, therefore, be a major barrier to the transfer of ESTs for some time, especially owing to their lack of foreign exchange for the purchase of ESTs from abroad.

### B. Examples of government enabling activities

[8] ESCAP/UNDP, 1995.

23. Asian governments have played a very active role in all aspects of social and economic life. One of their most important enabling activities was to incorporate technology transfer and development as a key element in their national development plans at an early stage. In Korea, the first "Five Year Economic Development Plan" was initiated in 1963 while the first "Five Year Development Plan" (Replita) in Indonesia and the "National Economic and Social Development Plan in Thailand" (NESDP) were introduced in 1969 and 1961 respectively. These plans provided adequate government budget allocations for institutional development needed for the transfer of technology.

24. All these countries undertook policy reforms to change institutions and legal frameworks in order to facilitate the transfer of technology. In Thailand and the Republic of Korea, environmental and energy conservation laws and regulations have been established and periodically revised to reflect the environmental needs of each country. An example is the Thai National Environment Protection Law of 1995 that stipulates energy conservation measures. There are also a number of laws and regulations facilitating transfer of technology in Thailand including the Alien Business Law (for foreign investment) and the Investment Promotion Act (providing investment incentives).

25. The Indonesian Government also issued the Environmental Law in 1992 making environment impact assessments (EIA) mandatory for all projects prior to their approval or implementation. Under the law measures for environmental protection have been undertaken including the transfer of ESTs.[9]

26. In order to encourage the private sector to develop indigenous technologies and to participate in technology transfer, the Korean Government established and strengthened in 1990 a number of separate laws and regulations for the protection of intellectual property rights (IPRs) including patents, trademarks, industrial designs, trade secrets, copy rights, and computer programmes.[10] For the same reason, the Thai Government also established an Intellectual Property Court for protecting IPRs.[11]

27. Concerning intellectual property rights and patent laws, the Indonesian Government issued Act 6 in 1982 to replace an existing patent law dating back to its colonial era. However, it has been suggested that more work needs to be done to make it operational.[12]

28. In the case of the Republic of Korea the Government provides tax exemptions for advanced technologies, which are regarded essential for the national economy but are too advanced to be developed domestically. Also the licensing fees received by the technology licensor are exempted (100 per cent) from income and corporation tax for five years. In the future, the Korean Government has plans to set up a technology promotion fund to help

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[9] Sasmojo, Soejachmoen, and Siagian, 1994

[10] Lee and Kim, 1994.

[11] Thebtaranonth, 1997.

[12] Sasmojo, Soejachmoen, and Siagian, 1994.

develop some core technologies as well as to expand the Korea Technology Financial Corporation. Also, tax deductions for private investments in R & D will be increased and an 80 per cent tariff reduction is planned for the import of equipment and material for R & D.[13]

29. Thailand also provides financial incentives for technology transfer, such as import duty exemptions and tax incentives. The former have been reduced on all proven energy conservation machinery and equipment from about 40 per cent to 10 per cent and the latter have promoted energy conservation projects through energy conservation funds in accordance with the Energy Conservation Act of 1992. In addition, the government-owned Industrial Financial Corporation of Thailand provides capital financing to eligible projects.[14] Also, the Energy Conservation Promotion Fund make subsidies available to projects which yield a rate of return below 9 per cent.[15]

30. Technology research and development plays a key role in all phases of technology transfer from acquisition to indigenization. The establishment of an R & D infrastructure can benefit the transfer of technology in various ways. It can increase efficiency and promote assimilation and adaptation of transferred technologies. It can also contribute information that could be helpful for the selection of technologies prior to technology transfer, and can enable countries to negotiate better technology transfer contracts. Even after transfer of technology, it remains a useful source of learning.[16]

31. The most important factor affecting R & D in the Republic of Korea was the phased establishment of R & D institutions and implementation of government policies with clear objectives. In the early stage of industrialization in the 1960s, the Ministry of Science and Technology and the Korea Institute of Science and Technology (KIST) were established in accordance with the Science and Technology Promotion Law of the 1960s. Throughout the 1980s and in the early 1990s, Korean firms began to enhance their own R & D capacity as the protective government regulations favouring domestic industries were gradually lifted. The government's science and technology policy during this period was directed towards localization of key core technologies, and the promotion of private sector R & D capabilities.[17]

32. The Indonesian Government is considering incentive measures, such as output price incentives, and input price incentives,[18] to accelerate the adoption of new technology. Most R & D initiatives are undertaken by the university system and comparable R& D activities by government research organizations such as the Indonesian Institute of Sciences, BATAN, and

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13 Lee and Kim, 1994.

14 Boonyubol and Chamchoy, 1994.

15 Geronne, 1997.

16 Bad, 1997.

17 Hong, 1994.

18 CES/IPB, 1998.

the National Aeronautic and Space Agency.

33. In Thailand, universities, along with R & D units of large industries, are the main organizations conducting R & D. It is also notable that R & D for technology transfer has been carried out at the university level. For example, the Department of Energy Development and Promotion has sponsored an electronic ballast development project at Chularlongkorn University.

34. All these countries have had institutions for R & D in place for a number of years, but their scope and performance varies with government support and other factors. One way to enhance R & D capacity is through partnerships between public- and private-sector institutions based on a long-term development perspective.

35. These countries also have formal education and informal education and training institutions. For example in the Republic of Korea, a number of universities are producing qualified engineers for technology development, such as Pohang Institute of Technology. Also a number of vocational schools were established in the 1980s, and large corporations have in-house training centres. The industries' internal training programmes are supported by the Government.

### C. Barriers related to the transfer of environmentally sound technologies

36. Although the Republic of Korea has a number of successful cases of technology transfer, it still faces barriers in some areas. Since technology transfer is an ongoing process in all countries in the world, regardless of their level of industrialization, new barriers constantly emerge even as old barriers are overcome.

37. Until recently, the transfer of ESTs through FDI was limited resulting in lost opportunities for the transfer of ESTs. The role of FDI has been negligible in the Republic of Korea due to the strong orientation of the Government and private entrepreneurs towards independent business operations.[19]

38. The Korean economy depends heavily on energy-intensive heavy industries, such as steel and cement. Efforts by the private sector to improve energy efficiency have been largely neglected due mainly to the low share of energy costs in total production costs. Government policy has aimed to keep energy prices down to support industries. In manufacturing industries, for example, the share of energy costs is so low (on average 4 to 5 per cent) that entrepreneurs do not bother to adopt energy efficient technologies as savings from the adoption of such technologies are negligible.[20]

39. In the Republic of Korea, despite the presence of a number of information centres for new and efficient technologies, small and medium enterprises(SMEs) still have difficulty

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[19] Hong, 1994.

[20] Jung, 1996.

accessing technology information because[21] database systems are inadequate and there are inefficiencies in transferring information. As a result, some SMEs often cannot find optimal ESTs to meet their needs.

40. Improper planning can also be a factor affecting the performance of technology once it is imported. For example, the Korean Government initiated a wind power development project in the 1990s, acquired technology from abroad and further developed it domestically. However, there was insufficient wind to make the project economically viable. A wind survey should have been conducted prior to the transfer of the technology.

**Table 6.Examples of barriers per technology in the Republic of Korea**

| **Technology** | **Barriers and Constraints** |
|---|---|
| Efficient lighting | High price, unreliable product quality |
| Condensing gas boiler in building | Domestic technology is not yet developed; high price |
| CNG vehicle | Lack of infrastructure; high price |
| Electric vehicle | Lack of technology, lack of infrastructure, high price. |
| Efficient motor | Lack of technology development; unreliable product quality. |
| LNG combined cycle power plant | High fuel cost; lack of infrastructure |

Source: ALGAS final report of Republic of Korea

41. Examples of barriers to the transfer of technology in Indonesia are listed below:

(a) Cultural: business practices in Indonesia differ greatly from those in other countries. Business contracts may not be drafted in a legally enforceable manner, and often rely on relationships and bonds of trust between stakeholders;[22]

(b) Legal system: some of the Indonesia's commercial codes are old and complicated, which creates problems in business investment;[23]

(c) Subsidies: prices of energy are currently set by the Government and subsidized. As energy prices do not reflect the full cost of energy supply, end users have little incentive to invest in energy efficient technologies,[24]

(d) Lack of information: domestic investors and consumers tend to have insufficient information regarding efficient technologies, which entails increasing transactions

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[21] To access the passive database one needs a certain level of expertise which is often difficult to come by.

[22] Sasmojo Soejachmoen, Siagan, 1994.

[23] Sasmojo Soejachmoen, Siagan, 1994.

[24] ESCAP/UNDP, 1995.

costs associated with identification of options;

(e) Low world energy prices in the late 1980s and 1990s: Indonesia relies heavily on revenues from the sale of oil and gas. The currently low world prices for oil and gas reduces earnings on these exports and therefore the ability to pay for technology transfer. These investments are therefore less attractive as the rates of return drop.[25]

42. In Thailand, barriers to the transfer of technology can be summarized as follows:

(a) Low energy costs: since energy prices are regulated and kept low the benefits from the adoption of energy efficient technology are negligible;

(b) Lack of funding: the economic crisis in Thailand has resulted in a scarcity of financial resources for funding the transfer of ESTs. Also the recent fall in the country's credit rating will raise the financial cost of projects involving the transfer of ESTs. Lack of financial resources inhibits large-scale deployment of ESTs;

(c) Lack of awareness:[26] owing to a lack of environmental awareness the prices of products often do not reflect the environmental benefits from ESTs, so there is no compelling reason for the transfer to be viewed attractive; and

(d) Lack of human capital: there is an insufficient supply of trained manpower for the assimilation and adoption of technologies.[27]

## D. Cogeneration programmes

43. Cogeneration is one of the most attractive modes of electricity generation because it is 70 per cent efficient compared with conventional thermal power plants that are 40 per cent efficient. It is also appealing because of its high energy efficiency, low capital investment requirements and relatively short construction periods, due to modular unit construction.

The Republic of Korea[28]

44. The Ildo combined cycle cogeneration project was built in 1992 to provide both electricity and heat to the Ildo area. A private company, Korea Heavy Industry Corporation, and General Electric of the U.S. were the contractors. The total cost for two units of 940 MW cogeneration was 1.1 billion US dollars. Korea Electricity Power Company (KEPCO), the government monopoly company in the electricity generation industry, made an attempt to indigenize the cogeneration technology by identifying three different areas of activity:

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25 Sasmojo Soejachmoen, Siagan, 1994.

26 ESCAP/UNDP, 1995.

27 Boonyubul and Chamchoy, 1994.

28 Ildo Combined Cycle Cogeneration Project, Lee and Kim, 1994.

management techniques, technician training, and design techniques for boilers. As a result the level of indigenization reached 60 per cent, but the core technology came predominantly from foreign sources.

45.The following enabling activities were developed for the implementation of this project:

(a) Many of the participants in the project benefited from government R & D initiatives during the 1970s and 1980s. This helped to build the necessary human capacity for the project;

(b) Reinforcing environmental regulation: the Government restricts the use of coal or oil in large cities so that many commercial and residential building have no option but to use the small-scale gas engine cogeneration system developed from this project. The Government helped diffuse the technology which was indigenized from this project; and

(c) Facilitating financial support and legal reforms: the Government provided financial support as well as legal reforms to facilitate the utilization of the cogeneration power plants in the industrial sector.

46. The barriers identified in this project are:

(a) Relatively high input fuel cost: many cogeneration systems use natural gas, usually more expensive than coal or oil. Also, these systems are often used for peak loads. Therefore, their utilization rates are relatively low and the potential benefits are not fully realized;

(b) Slow indigenization of core technologies: when transferred, the desired level of efficiency of the system was so high that imported support was the only available option. There was little indigenization at the outset of the project and afterwards the indigenization process became too slow; and

(c) Monopolistic environment: as KEPCO, is a government company, and a monopoly, commercialization of gas engine cogeneration technology was not been promoted aggressively.

Indonesia[29]

47. An Indonesian plywood manufacturing company, PT Siak Raya Timber located in Pekanbaru, Sumatra, produces a yearly average of 160,000 $m^3$ of plywood and secondary plywood products. In addition, an affiliated woodworking factory produces about 50, 000 $m^3$ per annum of downstream products. The raw materials used for these products comes mainly from company-owned forests in central Sumatra. In the process, a lot of residues are produced. So far, the company generates electricity using diesel gensets, but it has decided to install an energy plant, using its own wood residue as fuel, to meet its heat and

[29] A woodwaste power plant in Pekanbaru, Sumatra. Pennington, Lacrosse, and Gonzales, 1997.

power requirements.

48. The project will reduce costs and environmental impacts by replacing the existing diesel engines with a new energy plant fueled by wood residues generating 5.55 MW of electricity for captive use. In this way, expenditures on fossil fuels are also avoided. Contracts have been signed with European equipment suppliers. This is slightly more expensive than locally- manufactured equipment, but it is anticipated that reliability and efficiency will be higher, thus reducing the operating and maintenance costs.

49. For this project, the EC-ASEAN COGEN programme has carried out a pre-investment study. Operating staff are to receive special training and the plant will be monitored following implementation.

50. The total investment cost for the equipment on a turnkey basis is US$5.6 million. Based on the present diesel consumption and price, the annual savings in diesel purchase will be more than US$1.7 million. The expected pay-back period is around three years.

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52. Environmental benefits will also occur as residues from plywood manufacturing are recycled and emissions of carbon monoxide, poly cycle-aromatic-hydrocarbons (PACs), nitrous oxides (NOx) and particulates are reduced. The use of wood fuel, including the residue, is beneficial to global climate since it is carbon-neutral.

Thailand[30]

53. In October 1992, Nordic Power Invest AB (NPI),[31] and BANPU,[32] a local coal company formed a joint venture called Cogeneration Co. Ltd. (Coco). The joint venture initiated a contract with Marubeni Corp. (Japan) and Balck & Veatch (U.S.A.) to supply and install a power plant in the MapTa Phut Industrial Estate in Rayoung Province, Thailand. This plant has an electricity generating capacity of 400 MW and 350 tons of steam per hour. The plant consumes 800,000 tons of bituminous coal per day and 50-60 million cubic feet of natural gas per day. Contracts for the supply and installation of power transmission lines and cable and distribution systems were awarded to Thai Electric Development Associated and Sino Thai Engineering & Construction Plc.

54. The enabling activities of the Thai Board of Investment (BOI) that led to the implementation of this projects included: a) exemption or reduction of import duties on machinery; b) exemption from corporate income tax for 8 years, and further reductions of

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30 Map Ta Phut Cogeneration Project, Geronne 1997.

31 NPI was established by four major utilities from Sweden, Denmark, and Finland.

32 The leading coal company in Thailand.

50 per cent for additional years; c) income tax deduction for water, electricity and transport costs for 10 years from the date of first sales; d) deduction of the costs of installation or construction of the project's infrastructure facilities from net profits; and e) exemption of dividends to shareholders from personal income tax.

55. The joint venture also sought to attract financing for the project by demonstrating the strong commitment of the project sponsors and securing long-term electricity contracts from metal processing industries situated in the industrial estate. The Electricity Generating Authority of Thailand (EGAT) played an important role by not only purchasing surplus electricity from the project, but also providing backup electricity. In this way EGAT enhanced the reliability of the project.

56. In addition to these enabling activities on the recipient side, GEC ALSTHOM, the technology supplier, provided assistance to the developers including: a) proposing viable technological options; b) advising on fuel choice and supply, taking into account environmental aspects; c) tailoring the design of the power plant to meet the developer's need and specification; d) making a firm commitment on the specified project milestone; e) providing subsidized buyer credits to help ease the financial burden; f) entering into an operation support and maintenance contact; and g) becoming a partner in the ownership.

57. The barriers this project had to overcome include:

(a) Technical and financial constraints and poor institutional frameworks;

(b) Limited human technical capacity in the design, construction, and operation of the cogeneration power plant;

(c) Scarcity of capital: in an effort to reduce the burden on developers the Government is promoting financial incentives such as subsidies and tax relief; and

(d) Lack of public awareness and concern for environmental protection. As cogeneration is a relatively new concept the benefits are still not widely known.[33] In order to cope with the lack of public awareness, the Royal Thai Government established the Energy

Conservation Act to show its strong commitment to energy conservation and environmental protection.

58. Other barriers include: a) scarcity of experienced power engineers; b) uncertainties associated with the sale of excess electricity to the utilities and direct to associated customers, which will lower the expected rate of return from the technology transfer; and c) the low share of energy cost in the total production cost. In some industries where the energy cost is only a small fraction of the total production cost, the energy efficiency (saving) does not get high priority in the capital investment programme.

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[33] Chullabodhi and Tia, 1993.