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Business Focus Series

ASEAN Electric Power Generation Markets: Opportunities for U.S. Companies



Prepared by:

U.S. Agency for International Development

Office of Energy & Infrastructure

in Cooperation with:

U.S. ASEAN Council

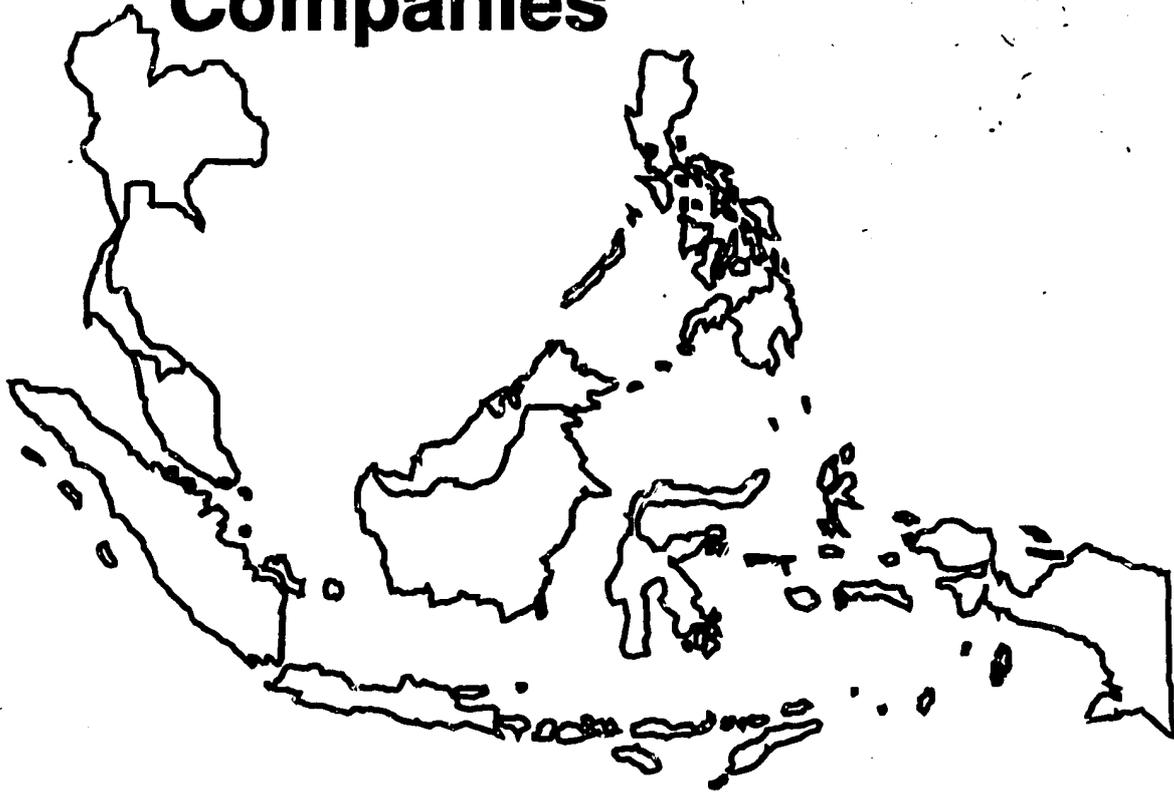
for Business and Technology, Inc.

under the USAID/ASEAN PITO Project

September 1992

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Acronyms

ADB	Asian Development Bank
BOO	Build-own-operate
BOT	Build-own-transfer
DOC	U.S. Department of Commerce
ECA	Export credit agency
GDP	Gross domestic product
GNP	Gross national product
NIC	Newly industrializing country
MW	Megawatt
ODA	Overseas Development Agency
OECD	Organization for Economic Cooperation and Development
PURPA	U.S. Public Utility Regulatory Policies Act
tcf	trillion cubic feet
UNOCAL	Union Oil Company of California

Indonesia

BAPPENAS	National Development Planning Board
DGENE	Directorate General of Electricity and New Energy
EPC	Engineering, procurement and contracting company
IUKS	Electricity production for self-use
IUKU	Electricity production for public use
MME	Ministry of Mines and Energy
PGN	Perusahaan Umum Gas Negara
PLN	Perusahaan Umum Listrik Negara

Malaysia

METP	Ministry of Energy, Telecommunications, and Posts
NCCIM	National Chamber of Commerce and Industry of Malaysia
SEB	Sabah Electricity Board
SESCO	Sarawak Electricity Supply Company
TNB	Tenaga Nasional Berhad

Acronyms

Philippines

DENR	Department of Environment and Natural Resources
EMB	Environmental Monitoring Board
IFC	International Finance Corporation
MERALCO	Manila Electric Company
NEA	National Electrification Administration
NPC	National Power Corporation
OEA	Philippine Office of Energy Affairs
PAP	Philippine Assistance Program
PDP	Power Development Plan
PNOC	Philippine National Oil Corporation
ROT	Rehabilitate-operate-transfer

Singapore

MTI	Ministry of Trade and Industry
PUB	Public Utilities Board

Thailand

EGAT	Electricity Generating Authority of Thailand
MEA	Metropolitan Electricity Authority
NIC	Newly industrializing country
PDP	Power Development Plan
PEA	Provincial Electricity Authority



Introduction and Regional Overview

Over the next ten years, Southeast Asia will represent an important market for U.S. power generation equipment and associated services. The ASEAN countries of Indonesia, Malaysia, the Philippines, Singapore, and Thailand¹ anticipate electric power additions of more than 19,000 MW by 1996 and 44,000 MW by the year 2000. These five nations' markets for power sector equipment and services will reach nearly \$20 billion by 1996 alone. U.S. companies will be in a good position to capture roughly 20 percent of this market, or \$3.7 billion.

Economic Development Trends

The ASEAN region has a population of more than 320 million. Its total gross domestic product (GDP) is about \$250 billion per year -- 5 to 6 percent of the GDPs of the U.S. or European Community. With the exception of the Philippines, the region experienced rapid economic growth throughout the 1980s, averaging well above 5 percent annually. Inflation has remained fairly constant, overall public health and education have improved substantially, and the manufacturing capability and export earnings of most of these countries have increased dramatically. Exhibit 1 provides key indicators for selected ASEAN countries.

¹ The Association of South East Asian Nations (ASEAN) fosters economic, political, social and cultural cooperation among its six member countries. ASEAN was established in 1967, with the signing of the Bangkok Declaration by Indonesia, Malaysia, the Philippines, Singapore, and Thailand. Brunei Darussalem joined ASEAN in 1984. Brunei, which has less than 400,000 people and an installed generating capacity of less than 350 MW, is not included in this study.

Introduction and Regional Overview

Exhibit 1

Comparative Economic Indicators for Five ASEAN Countries

Country	1991 GNP per capita (US\$)	Annual GDP Growth Rate 1980-89 (%)	1991 GDP Growth Rate (%)	Mid-1991 Population (millions)	1987 Per Capita Electricity Demand (kWh)
Indonesia	587	5.7	6.4	186	250
Malaysia	2,637	5.7	8.6	18	1,012
Philippines	739	2.0	-1.0	63	400
Singapore	14,141	7.3	7.0	3	4,000
Thailand	1,596	7.3	7.5	58	510

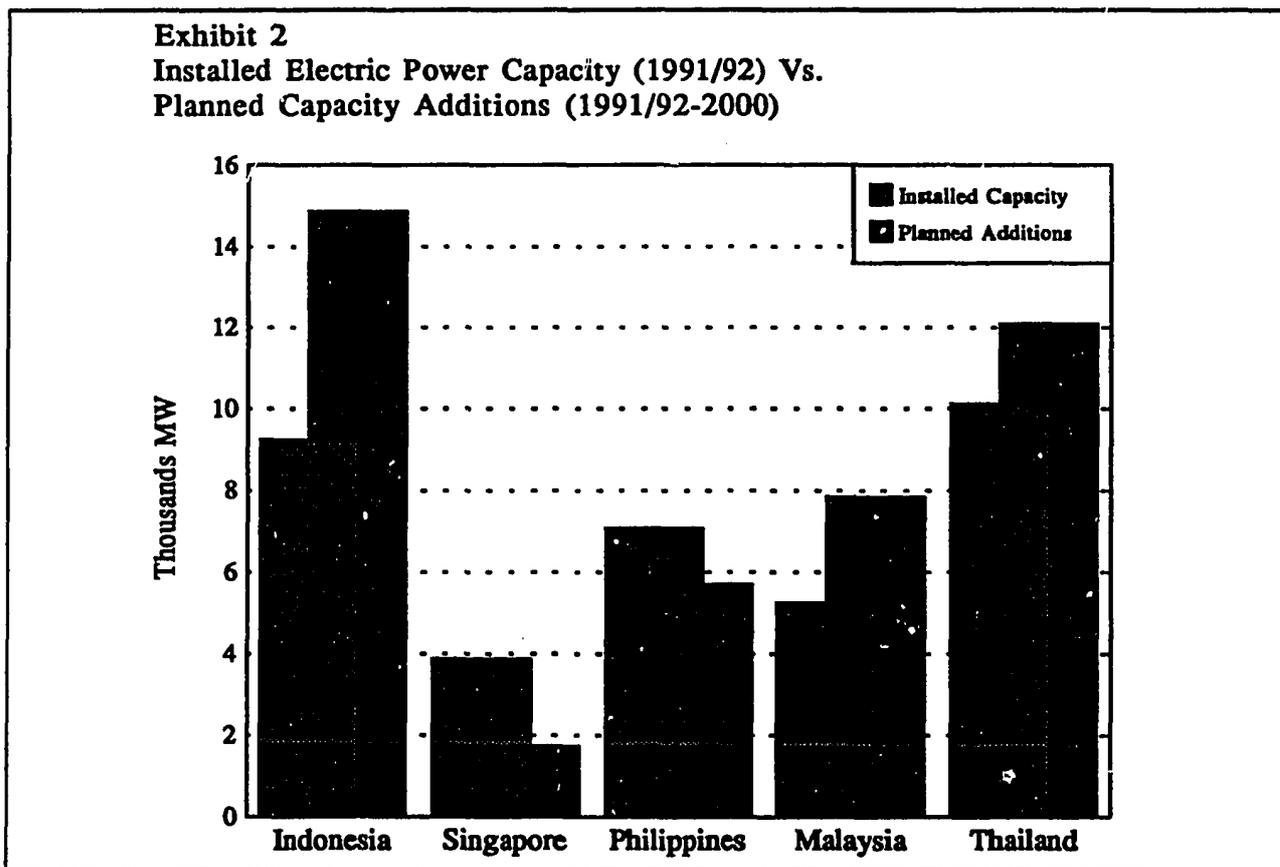
Sources: Asian Development Bank and U.S. Department of State.

If the ASEAN countries continue their rapid economic expansion, their electricity demand will double during the 1990s. Indonesia and Malaysia, in particular, have experienced average electricity consumption growth rates in excess of 10 percent a year. Increased consumption, in turn, will require a corresponding increase in generating capacity and unprecedented, large capital investments in the supply infrastructure. In Indonesia, the Philippines and Thailand, access to an adequate and reliable supply of electricity has been a constraint to growth and is a specific concern for industries deciding whether to locate in the region.

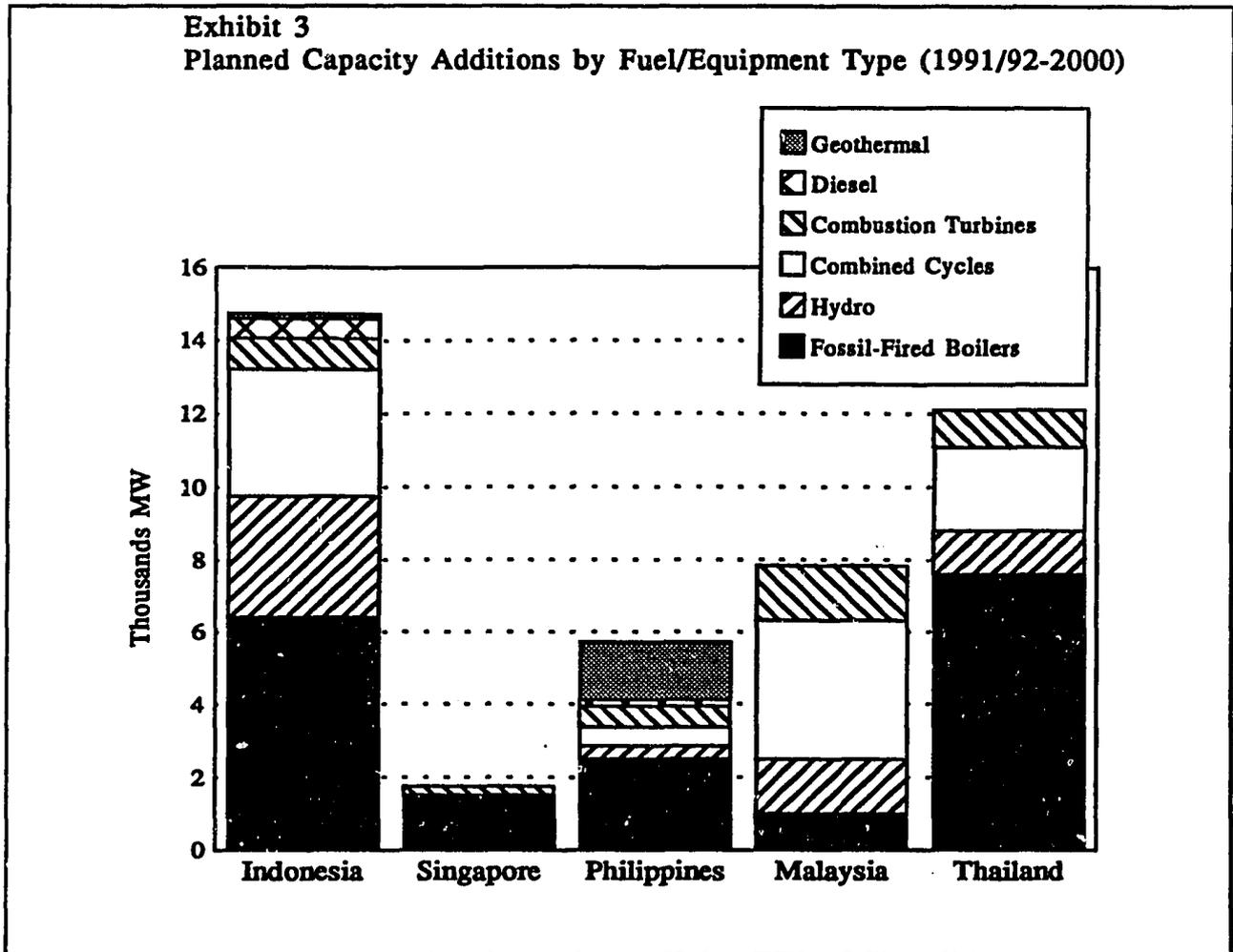
There is considerable disparity among the ASEAN countries in terms of per capita electricity consumption. Singapore, with its largely urban population, consumed nearly four times as much electricity as Malaysia in 1987, and about ten times as much as Indonesia, the Philippines and Thailand, which have much larger rural populations and economies. Industrialization and urbanization trends in Indonesia, Malaysia, the Philippines and Thailand will undoubtedly result in substantial increases in per capita electricity demand, which closely tracks per capita gross national product (GNP).

Electric Power Generation Capacity Additions

The electricity subsector is an important priority for all ASEAN governments. Their national utilities are planning ambitious electric power capacity expansion programs during the 1990s and are generally revising their expansion estimates upward in each subsequent forecast. All told, the ASEAN power utilities plan to more than double their 1991/92 installed capacity of 32,583 MW to about 74,400 MW by the end of the century, through the addition of nearly 19,000 MW of fossil-fired boiler capacity, 10,000 MW of combined-cycle units, 6,400 MW of hydro-electric units, 3,500 MW of combustion turbine-based plants, 1,850 MW of geothermal steam plants, and 600 MW of diesel capacity (Exhibits 2 and 3). Captive industrial generating capacity, especially in Indonesia, should also increase during this period.



Introduction and Regional Overview



Indonesia and Thailand anticipate the largest increases in terms of new electric power capacity additions; their current utility expansion plans show projected additions of about 14,860 MW and 12,100 MW, respectively. For Indonesia, this means a 160 percent increase its generating capacity during this decade. Malaysia and the Philippines have plans to add over 7,800 and 5,300 MW, respectively. Singapore, a much smaller utility system, will add about 1,750 MW of new power generation capacity.

Introduction and Regional Overview

These capacity additions will be realized primarily through imported equipment and associated services. The ASEAN region, while capable of manufacturing semiconductors, consumer electronics, light machinery, and textiles, has not developed a utility-grade electric power equipment manufacturing capability. Historically, the expansion of the region's electric power sector has been financed by government borrowings and multi-lateral development banks. There remains a potential for the development of joint-venture agreements and technology transfer projects with ASEAN companies to assemble and manufacture key components, especially in conventional steam plant and hydroelectric equipment market segments.

Environmental Considerations

Electricity planners in the ASEAN region are increasingly faced with the problem of meeting electricity demand in both an economically viable and environmentally acceptable manner. The power sector is a significant source of harmful emissions, and the land use consequences of siting power plants in environmentally or culturally important areas have already raised concerns in the ASEAN countries.

Power sector emissions are directly related to a facility's generation mix and fuel characteristics, particularly the use and quality of coal and oil. Electric utilities account for over half of the total coal consumption in three ASEAN countries: Indonesia (53 percent), the Philippines (65 percent), and Thailand (68 percent). These nations use high-sulfur coal and oil for power generation. Growing awareness of the detrimental effects of power plant emissions is leading to increased environmental regulation and enforcement in ASEAN. In addition, the World Bank, a major source of financing for ASEAN utilities, now requires flue gas desulfurization or the equivalent on all of the coal-fired projects it sponsors.

U.S Exports to the Region

The ASEAN region is an important destination for U.S. exports of manufactured goods and services. The ASEAN countries constitute the third-largest overseas export market for the U.S. after the European Community and Japan. Further, U.S. manufactured goods and services exports have increased faster in ASEAN than in any other major market, with the exception of Mexico. Last, U.S. companies enjoy a good reputation in the region as being among the world's leaders in power generation equipment and services.

Introduction and Regional Overview

Estimated Market Size and U.S. Share

Over the 1992-1996 period, the total market for electric power generation equipment and services for ASEAN utilities is estimated to be nearly \$20 billion. About 90 percent, or more than \$17 billion, in equipment and supporting services for this market will be imported from abroad. Exhibit 4 compares U.S. power generation exports to total U.S. merchandise exports to the ASEAN region. Projections of the 1991 average annualized U.S. share of power generation exports to the region over the 1992-1996 period are also provided. The market size estimates are based on the number, size and fuel type of generating units included in the utility expansion plans of each country, plus the potential for additional capacity through private power projects. The unit costs reflect typical project costs on a \$ per installed megawatt basis.

Exhibit 4
U.S. Exports to ASEAN (\$ millions)

Country	1991 U.S. Merchandise Exports ¹	1991 U.S. Power Generation Exports ²	1992-96 Total Power Generation Market ³	1992-96 Avg. Annual U.S. Power Generation Exports ⁴	1992-1996 Avg. Annual U.S. Mkt. Share (%) ⁵
Indonesia	1,900	167.6	5,893	251	25%
Malaysia	3,900	7.5	4,428	40	5%
Philippines	2,300	20.7	3,657	259	40%
Singapore	8,800	30.0	1,604	72	25%
Thailand	3,800	73.9	4,195	113	15%
Total --->	20,700	301.0	19,777	735	average 20%

¹ 1992 National Trade Estimate Report on Foreign Trade Barriers, U.S. Trade Representative.

² Compiled from U.S. Department of Commerce subsector studies and estimates from country-submitted trade statistics.

³ Estimates based on ASEAN power generation expansion plans.

⁴ Averaged over the five-year period.

⁵ RCG/Hagler, Bailly estimate, June 1992.

Introduction and Regional Overview

Overall, the U.S. is projected to maintain its historical market share position in the ASEAN power generation equipment and services sector through 1996. The market share analysis is primarily based on the following characteristics: historical experience of the U.S. equipment and services industry, capital availability, and qualitative perspectives on the receptiveness and competitiveness of each ASEAN market. Based on these yardsticks, the U.S. power equipment and services industry should capture about 20 percent of this market, or approximately \$3.7 billion. The U.S. share will range from a high of 40 percent in the Philippines to a low of about 5 percent in Malaysia. The market share will depend principally on the competitiveness of U.S. suppliers, both technically and financially, and on the relationship the supplier enjoys with each utility client. Although ASEAN nations often view U.S. companies as supplying superior equipment, sales have been lost because U.S. firms have not been able to match the export credit and mixed credit financing available from foreign competitors. Another notable trend is that lower-cost power equipment is finding its way into the ASEAN market from suppliers in other newly industrializing and developing countries.

Industry Practices

The power generation equipment industry comprises equipment manufacturers, engineering/design/construction companies, planning and other service providers, and a host of related equipment vendors supplying switches, pumps, emissions controls, and other equipment.² There are manufacturers of heavy electrical equipment in virtually all of the developed countries (Australia, Canada, France, Germany, Italy, Japan, the Netherlands, Sweden, Switzerland, and the United Kingdom) that export to the ASEAN region.

Traditionally, ASEAN countries have been interested in turnkey suppliers who are responsive to their specific electric supply requirements. In these instances, the national utilities would work with a small number of prospective power plant suppliers and then select among them. Because power plant orders tend to be competitive and represent large and relatively infrequent business opportunities, the cost of competing in ASEAN markets is very high.

² Although not covered in this study, the U.S. has a prominent role in the manufacture and export of transmission and distribution equipment worldwide.

Introduction and Regional Overview

U.S. participation in the power generation equipment market has shifted to being more of a licensor, with orders often going to foreign licensees with better access to concessional financing from their respective official export credit agencies. European competition is stronger than ever, with groups such as Alsthom (France), Deutsche Babcock, Siemens/Kraftwerke Union (Germany), Asea Brown Boveri (Sweden/Switzerland), John Brown (U.K.), and Fiat (Italy) active in ASEAN markets. Japanese corporations, such as Mitsubishi, Toshiba, Hitachi and Fuji, have also been very successful in the ASEAN region. In addition, more and more new manufacturers will come from developing and newly industrializing countries (such as Taiwan, South Korea, India and Brazil), particularly as these suppliers are able to underprice their competition from developed countries. For example, Bharat Heavy Electric Ltd. (India) is now considered to be a strong competitor throughout the ASEAN region and in the rest of Asia.

Foreign competition has hurt the key U.S. manufacturers, causing several of them to consolidate their activities. For example, GE and Westinghouse have been streamlining their turbine divisions. Other suppliers have been very actively diversifying, with the consequence that several U.S. companies have "reshaped" their activities through licensing and marketing alliances to participate in foreign markets. These new arrangements often imply less business control over technology, limited U.S. manufacturing content, and lower resulting export earnings.

The power plant project cycle involves more than the mere solicitation and procurement of power generation equipment. It begins with sophisticated computer models for forecasting demand and generation planning. The U.S. electric utility industry and its consultants have been instrumental in the development of models for demand forecasting, production costing, and integrated (supply- and demand-side) resource planning. Indonesia, Malaysia and Thailand have shown an interest in demand-side management, an area where U.S. consulting firms dominate.

From the generation plan, the utility develops an expansion plan or power development plan, usually with a ten-year or longer projection of the units needed to meet demand. These plans are typically updated on an annual basis, allowing for adjustments in demand forecasts, power plant scheduling, scheduled retirements, donor disbursements, and other factors. Subject to the availability of domestic financial resources, each power utility examines the eventual cost of generating electricity using various types of fuel before committing itself to an expansion plan. The cost analyses take place in two stages. First, an average discounted cost is calculated to indicate the relative economic attractiveness of each option. Second, a least-cost computation is carried out to choose, among alternative types and sizes of power plants, a mix that would meet future demand at a minimum cost.

Introduction and Regional Overview

The utility then approaches its Ministry of Finance or other appropriate government entity, and such multi-lateral development banks as the Asian Development Bank and the World Bank for financing. The power sector in ASEAN countries has accounted for as much as one-third of all available development bank funding in any given year. Given the ever increasing budgets requested by the national utilities, it is the area of financing where some innovation in the sector is beginning to take place. The U.S. Government, through the Agency for International Development as well as its foreign counterparts, often provides technical assistance grants to the ASEAN governments and utilities for policy reform, pricing, planning, and other activities.³

Other OECD (Organization for Economic Cooperation and Development) countries have successfully combined grant funding with export credit financing to lower the cost of capital to ASEAN countries. The use of mixed credits is often cited as a principal factor in the U.S. loss of market share. Consequently, the U.S. Export-Import bank now administers a "war chest" to add discipline to the new tied aid agreement reached among the OECD nations' export credit agencies (ECAs). The Eximbank "war chest" is a year-to-year authority from the U.S. Congress for providing grant monies mixed with its regular loans or guarantees in selected transactions. In 1991, the war chest was utilized for power projects in three ASEAN countries: Indonesia, the Philippines and Thailand. In fiscal year 1992, it has yet to be used in ASEAN power projects.

In recent years, there has been growing interest in involving private capital and expertise in the ASEAN power sector.

- The Philippines has a fairly well-developed private power program, modelled after the U.S. Public Utility Regulatory Policies Act (PURPA).
- Indonesia is designating certain units in its expansion plan for private development. Both the Philippines and Indonesia allow 100 percent foreign ownership of their private power facilities.
- Thailand, after exploring a variety of alternatives, appears willing to entertain proposals from the private sector, particularly in the form of joint ventures with the utility. The Thai government recently passed laws allowing its national utility to establish private subsidiaries and to joint venture on a

³ U.S. bilateral assistance in ASEAN is limited to Indonesia, the Philippines and Thailand, but other programs are available in Malaysia and Singapore.

Introduction and Regional Overview

project-by-project basis with private firms. The Thai utility has submitted a plan to the government to privatize its operations by 1997.

- Malaysia and Singapore are pursuing privatization as a means of accessing additional sources of capital.

The introduction of private utility-scale power projects, small power generating plants (less than 10 MW), and industrial cogeneration, especially in Indonesia and the Philippines, may create opportunities for new firms to enter these markets. U.S. project developers have significant experience with third-party financing and the operation of power projects.



Indonesia

Indonesia's improving economy and its recent moves to manufacture more goods for export have spurred the demand for electric power. The country's 14 percent electricity demand growth is the fastest in the ASEAN region. Recently, however, foreign investors have displayed concern about the lack of a guaranteed electric power supply, especially for industrial sector expansion.

Indonesia's electricity supply is primarily met by the national electric utility, Perusahaan Umum Listrik Negara (PLN), and by captive industrial generation. The Indonesian government's energy sector objectives focus on reducing Indonesia's dependence on oil-fired generation, promoting private power involvement in the sector, and expanding rural electrification.

The Indonesian utility sector offers equipment suppliers and project engineers a large market, conservatively estimated at nearly \$5.9 billion until the end of 1996, of which \$5 billion will be imported. The U.S. could realize an estimated 25 percent share of this market (\$1.25 billion) over the same period. (These estimates are based on PLN planned capacity additions and do not include captive or cogeneration power schemes.) The U.S. Department of Commerce (DOC) indicates that the total market for equipment and services could be as high as \$7.6 billion through 1995 due to unprecedented increases in PLN spending and the emergence of many new private power projects.¹ The DOC estimated the actual 1991

¹ In its May 1992 subsector analysis and forecast for the Indonesian power generation equipment market, the DOC estimates that by 1994, PLN's generating capacity will increase to 12,225 MW over the 9,273 MW of capacity in place at the end of 1991. Also, the Minister of Mines and Energy has stated that an additional 11,000 MW of power needs to be added between 1994 and 1999 at a cost of \$22 billion.

import market size at \$614 million and projected that this market would post an annual growth rate of 50 percent for 1992, declining to a 45 percent growth rate for the 1993 to 1995 period.

Power Sector Overview

The power sector is regulated by the Ministry of Mines and Energy (MME) through the Directorate General of Electricity and New Energy (DGENE). The MME was established in 1978 to coordinate and control the state enterprises responsible for the various energy sources including Pertamina (oil, natural gas, and geothermal energy), Perum Batubara (coal), Perusahaan Umum Gas Negara (PGN) for utility gas, and PLN for electricity. The MME dominates energy sector policy-making and is responsible for approving all energy sector investments.



Indonesia

Indonesia has significant proven energy reserves. Its current production of petroleum is about 1.4 million barrels per day, half of which is exported. Proven oil reserves are estimated at 9.5 billion barrels. Natural gas production amounts to 2.16 trillion cubic feet (tcf) a year, with reserves of 217 tcf in associated and non-associated gas deposits. Indonesia exports about 80 percent of its gas in the form of liquified natural gas (LNG) to Japan and South Korea, and has a new contract to supply Taiwan as well. Coal reserves are estimated at about 4.4 billion tonnes. The Indonesian government decided in the early 1980s to dramatically increase the use of coal for electric power generation, and coal production has increased seven-fold since 1985. Hydropower potential is estimated at 75,000 MW, of which 34,000 MW may eventually be developed. Indonesia's geothermal potential is estimated to be 10,000-15,000 MW.²

PLN was formed in the 1950s as a result of the nationalization of a number of smaller regional electric utilities. It is state-owned, but operates autonomously as a statutory authority. PLN is considered one of the fastest growing power utilities among the developing countries of Asia; its installed capacity of 536 MW in 1969 expanded to 9,237 MW in 1991. PLN's energy sales grew at an average annual rate of 16 percent during the 1980s, posting an incredible 18 percent sales growth in 1989 alone.

PLN is the major electricity supplier in Indonesia, accounting for nearly 97 percent of the country's total utility production (small private utilities account for the remaining 3 percent). Indonesia relies on indigenous coal, geothermal energy, hydropower, natural gas and oil to meet its power generation fuel requirements. The 1991 electricity generation supply mix for PLN was 62 percent fossil-fired steam boilers, 6 percent gas turbines, 10 percent diesel generators, 19 percent hydroelectric, and 3 percent geothermal.³

Utility production accounted for approximately 58 percent of Indonesia's total capacity in 1991; the remaining 42 percent (7,000 MW) was provided by captive plant capacity.⁴ Indonesian industry has historically invested in captive generation on a large scale

² The island of Java alone has about 8,000 MW of geothermal potential. Private firms are being encouraged to develop geothermal energy; Union Oil Company of California (UNOCAL) has developed a project at Mount Selak and AMOSEAS (Italy) is developing the Darajat geothermal fields.

³ *Pricing Frameworks and Methodology for Electricity Purchases and Sales Related to Non-Utility Power Transactions*. Prepared for the Private Power Team by the Directorate General of Electricity and New Energy (DGENE), Ministry of Mines and Energy, Indonesia, November 1991.

⁴ Estimates provided by PLN and the Beca Worley International report, *Update Report on Captive Power in Indonesia*, April 1991.

because of inadequate electric supply and the poor reliability of the PLN system. Diesel represents close to 62 percent of this captive capacity, hydro and gas turbines contribute another 12 percent each, and the remainder is oil-, gas- or wood-fired steam boilers.

Current Situation

Indonesia's electricity demand is projected to grow at an annual rate of about 14 percent over the next five years. So critical is the problem of electricity shortfall that many foreign firms are reassessing their future investment plans for building and expanding industrial plants in Indonesia. At the same time, PLN is facing formidable financial constraints and will be hard pressed to meet these urgent demands.

To cope with the forecast annual growth rate in energy sales, PLN is implementing a long-term power development plan involving significant capital expenditures over the next ten years.⁵ The Indonesian government is focusing on three major objectives for the power generating sector:

- reducing the share of oil in the energy mix
- increasing the share of private power development
- expanding rural electrification programs.

Indonesia is Asia's largest oil exporter and oil represents its largest source of foreign exchange. As a result, the MME's chief concern is to reduce oil consumption in the power generation industry and effectively utilize other available fuels. PLN's expansion plan reflects the objective of diversifying its resource base away from oil and towards cost-effective indigenous energy resources -- natural gas, coal, geothermal energy, and hydro -- and where appropriate, to realize economies of scale by building large power stations and larger-sized power generating units. Further, system improvements, including loss reduction programs, are slated by PLN to improve system efficiency.

The rapid growth of Indonesia's manufacturing sector and the government's policy to encourage foreign investment have strained PLN's ability to meet the country's increasing power requirements. Despite a record increase in PLN's sales during 1990, the government

⁵ PLN estimates that it needs to spend about \$2 billion per year (including both power plant and transmission and distribution investments) in order to properly implement this plan and to ensure adequate supplies and reliability for its electric system and network. Uncertainties regarding financing contribute to this report's conservative estimate of a \$5.9 billion total market between 1992 and 1996.

Indonesia

is actively inviting private companies to invest in electricity generation projects in cooperation with PLN. Laws governing private power production have been in place since the 1960s, but the policy was further empowered by Law No. 15 of 1985 and subsequent regulations and decrees. Currently, two types of licenses may be obtained: 1) IUKU -- electricity production for public use and 2) IUKS -- electricity production for self-use. A presidential decree in July 1992 authorized 100 percent foreign ownership of private power projects. Ministerial guidelines on this matter are expected in September 1992. The government has already announced that it is seeking private power producers to meet almost half of its proposed expansion plan by the year 2000. Public-use private power projects will be primarily coal- and natural gas-fired units.

Industrial captive generation and cogeneration are currently unrestricted and represent an important resource for supplementing PLN's installed electric generation capacity. Captive power generation grew at almost 7.5 percent annually in the 1980s. It is expected to maintain a similar growth rate through the early 1990s, particularly if PLN is unable to meet the growing demand from industry. The strong preference for diesel generators is most likely due to technical equipment considerations and the availability of relatively cheap diesel fuel. Cogeneration, while having significant potential in Indonesia, is still relatively rare.

At present, rural electrification activities are a concern to the government: about 70 percent of Indonesia's villages are without electric power supply.⁶ However, PLN is beginning to devote considerable resources to electrifying islands outside Java and Bali.

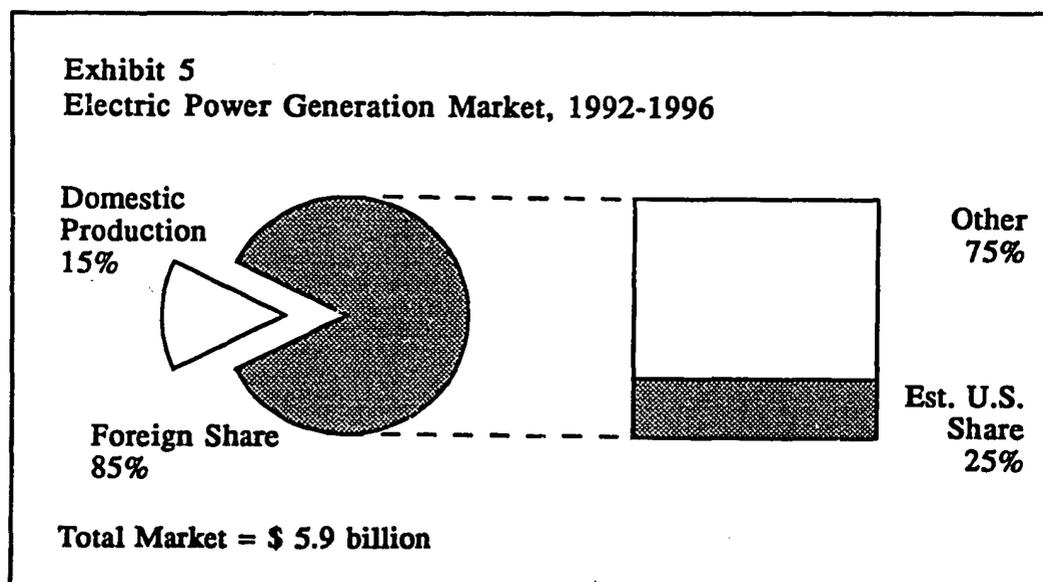
Power Sector Market Assessment

Historically, PLN received as much as 70 percent of its operation and construction budget from the government, which relies heavily on oil and gas export revenues and foreign borrowings. During the mid-1980s, the procurement of electric plant and equipment dropped off when world oil and gas prices fell. But since the last oil price drop in the late 1980s, the economy has improved and investment in power generating equipment has grown. In 1991 the total market for power generation equipment doubled, from \$331 million to \$667 million. The U.S. Embassy in Jakarta reports that 75 projects (including transmission and distribution

⁶ During the last two expansion plan programs undertaken by PLN, about 30 percent of the country's rural areas were electrified. The current expansion plan hopes to achieve a rural electrification rate of 50 percent. Indonesia's electrification rate is still below 28 percent, even in Java, the most heavily electrified island. Further, per capita electricity generation, which is estimated to be around 250 kWh/year, is low when compared with other developing countries in similar or lower-income categories.

network projects), valued at approximately \$10 billion, are planned for the electric power sector through the year 2000.⁷ In addition, the "Blue Book" of the National Development Planning Board (BAPPENAS) reports 29 proposed electric generation projects worth \$4.6 billion; over 75 percent of these are expected to be sourced from foreign investors.

Two factors favor PLN's continued growth over the next five years: the country's million new customers each year, indicating vast unmet demand, and the improved finances of PLN. These factors have spurred an unprecedented level of business activity in the electric power sector. The Government of Indonesia, multi-lateral development banks, bi-lateral aid agencies, private industry and commercial banks are all expected to contribute financing for the sector's expansion.



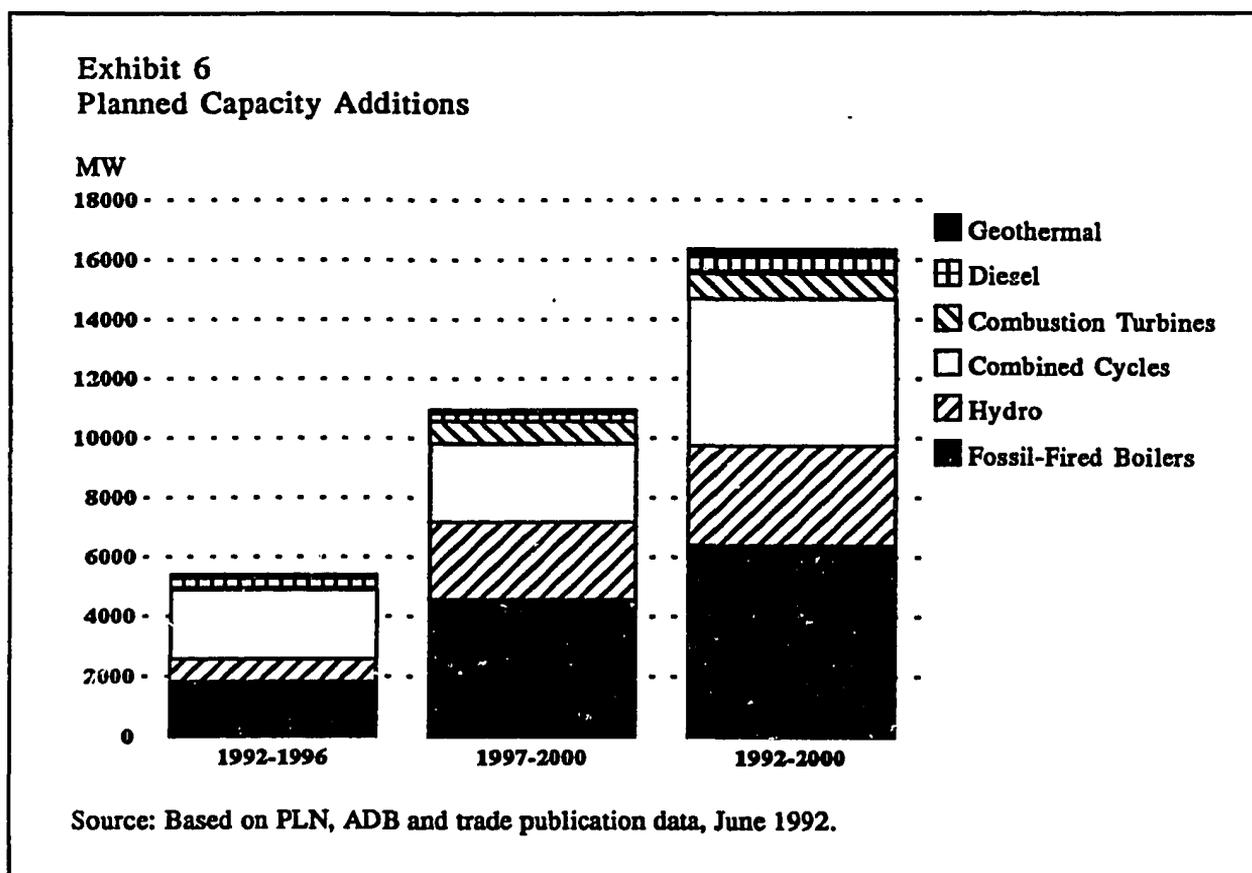
The capital requirements for the current national power development plan indicate that power generation and transmission network construction costs are estimated to be over \$2 billion per year or almost \$22 billion through 2000/01, excluding price escalations and interest

⁷ *Subsector Study: The Indonesian Market for Electric Power Generating Equipment and Parts*, U.S. Department of Commerce and Foreign Commercial Service, U.S. Embassy, Jakarta, Indonesia, May 1992.

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during construction. However, for 1992-1996, the total market for power generation equipment and services is estimated at \$5.9 billion, of which \$5 billion would be imported. The U.S. share of this import market is estimated at 25 percent or about \$1.25 billion (Exhibit 5).

PLN plans to add some 3,900 MW of electric generating capacity by 1996, while the private sector is anticipated to add another 1,500 MW of capacity. Most of this capacity will be combined cycle units (two plants totalling 830 MW and 1,480 MW of private power) and fossil-fired boilers (1,830 MW). Geothermal and hydroelectric plants will contribute 135 MW and 740 MW, respectively.



For the period 1997-2000, approximately 11,000 MW of new electric capacity will be added, both by PLN and private power developers. Almost 42 percent of this new capacity will consist of fossil-fired steam boilers, 31 percent will come from combustion turbines and combined-cycle units, and 24 percent from hydro units. The remaining 3 percent will come from geothermal plants and diesel powered generator sets.

Diesel engine generators are widely used among industry, commercial business, and government installations. These are imported as well as locally manufactured under license from foreign equipment suppliers. The after-sales market for engines and alternator spare parts is well developed, and this equipment is available nationwide.⁸ Indonesia does manufacture diesel generator sets for small industry and for back-up power purposes. Power shortages have also led the Indonesian government to exempt from import duties diesel generators for industrial use.

Currently, there is only limited domestic company involvement in supplying utility-grade power generation equipment. Indonesian companies like PT Bimantara, PT Salim, and PT Bakrie & Brothers are expected to enter the market in the near future, but have only limited experience in developing, building and testing state-of-the-art utility-grade power plant equipment. As shown in Exhibit 7, major suppliers of power generating equipment at this time include the U.S., Japan and Germany. Data for the 1991 import market indicate that the U.S. held the largest share at 27.3 percent, followed by Japan (23.5 percent) and Germany (17.4 percent). Competition from Japan is mostly in the form of trading conglomerates who have a strong local presence and offer attractive concessionary financing. Other importers include the People's Republic of China, Benelux, Singapore, the U.K., France, Taiwan, South Korea, and Italy.

Most major power generation equipment suppliers, engineers and contractors are present in Indonesia through representatives, project offices, joint ventures, and licensees. Further, over ten U.S. engineering, procurement and contracting (EPC) companies were active in the Indonesian electric power construction market during 1991.⁹ On an overall basis, Indonesia ranked the highest among ASEAN countries for U.S. EPC company activity, attracting a total of 43 firms that work in a variety of industrial sectors.

⁸ FINESSE Workshop, "Financing of Energy Services for Small-Scale Energy Users," Malaysia, October 1991, pg. 123.

⁹ "Review of the Top 500 International EPC Contractors," *Engineering News Record*, McGraw Hill, April 6, 1992.

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Exhibit 7 Selected Power Sector Projects in Indonesia

Major Equipment	Est. Project Schedule	Major Supplier	Country of Origin	Approx. Project Value
V 94 gas turbine, heat recovery boilers and steam turbine for 400 MW Belawan plant	1991-1992	Siemens KWU, Deutsche Babcock, Aalborg Ciseriv	Germany Denmark	\$250 million
2x26 MW MS50001 gas turbine generator sets for Minas power plant at Rumbai	1992	General Electric	U.S.	\$14.4 million
1,500 MW combined cycle 3x (3x105 MW gas turbine+185 MW steam turbine) for Gresik combined cycle plant	1992-1994	Mitsubishi Heavy Industries (prime), Siemens, CMI	Japan Germany Belgium	\$1 billion
GT 13E gas turbines (6x150 or larger) for 1,170 MW Tanjung Priok plant	1992-1994	ABB and Marubeni consortium	Europe Japan	\$700 million
60 MW Tanjung Batu gas and steam operated station in E. Kalimantan	1991-1994/5	n.a. (loans provided by the British Govt.)	n.a.	\$66 million
Three PG 9161E GE gas turbines, heat recovery boilers, steam turbine generator, cooling towers, and steam-side equipment for 450 MW Muara Karang plant	1992-1995	Sumitomo, General Electric	U.S. Japan	\$200-\$300 million
Two turnkey 600 MW coal-fired steam generating plants, and precipitator for Paiton plant	1997	Mission Energy, General Electric, Mitsui, local partner	U.S. Japan Indonesia	\$1.8 billion
Feasibility study for a proposed 3x600 MW Bukit Assam coal-fired plant at mine mouth	1992	Japan Elec. Power Dev. Co. & Tokyo Elec. Power Services	Japan	n.a.

Source: Based on data compilation from trade literature, June 1992.

PLN has undertaken the development of at least six new projects during the 1990-91 time period. The projects include the upgrading and expansion of the 117 MW Belawan simple cycle dual-fuel power station to a 400 MW combined-cycle power plant. Also, the Euro/Japanese consortium of ABB and Marubeni Corp. has signed a letter of intent to supply prime movers to the 1,170 MW Tanjung Priok combined-cycle power station. Recently, the Mission Energy Company (U.S.), heading an international consortium, was awarded the 2x600 MW coal-fired Paiton project. The Paiton project is representative of the build-own-operate (BOO) concept developed by PLN in order to meet its growing electricity needs.

According to the DOC, the total market for power generation equipment in Indonesia has grown steadily, from \$276 million in 1989 to almost \$667 million in 1991. During this period, imports from the U.S. increased over 300 percent, from \$51 million to \$168 million. Further, the average annual growth of power generation equipment and components was around 34 percent during the 1986-1991 period. This market increased by only 23 percent in 1990, but grew by 120 percent during 1991. This sudden increase may be attributed to the sales of gas turbine units for the 450 MW Muara Karang plant and additions at the P.T. Caltex Pacific power plant at Rumbai.

Indonesia is the Asian Development Bank's (ADB) largest borrower, with over \$1.1 billion in loans programmed for 1992. The ADB is providing \$350 million for the 1,800 MW Suralaya project in West Java (Power XXII scheme). This is the largest power sector loan ever granted by the ADB. During 1991, Indonesia received close to \$300 million in loan funds for the Power XXI project. However, ADB lending to the power sector may have peaked, as Indonesia can now borrow from commercial banks. PLN is very familiar with ADB procedures and requirements, having implemented 17 ADB power sector loans since 1971.

Power generation equipment is procured chiefly through international competitive bidding for World Bank and Asian Development Bank-funded projects. Both these institutions are encouraging private sector participation in the power sector. Private power projects will look for the least-cost vendor that can offer attractive export credit financing. The U.S. Export-Import Bank has targeted Indonesia and electric power generation for its mixed credit "war chest."

Market Entry Strategy

Indonesia's largest end-user and purchaser of electric power generation equipment is PLN. This utility holds U.S. equipment manufacturers in high regard for their product quality, especially high-technology turbines and environmental controls.

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U.S. private power project developers have seen initial success in participating in the market for PLN power projects that are being turned over to the private sector on a BOO basis. U.S. companies should work closely with PLN's private power development team and Japanese trading companies that have an historic presence in the Indonesian market. U.S. firms, in particular, have a significant experience advantage in developing large fossil-fired projects, as demonstrated by Mission Energy's recent success in being awarded the 1,200

**Exhibit 8
Indonesia Market Entry Strategy**

<p>Short-term</p>	<ul style="list-style-type: none"> ▶ Seek out and collaborate with U.S. developers and Japanese trading companies active in power sector projects. The Mission Energy Company led a consortium (which included the Mitsui Company of Japan) that won the landmark 1,200 MW Paiton BOO project. ▶ Track bidding list for PLN's BOO private power program and seek local technical and business partners; they are very important to conducting business in Indonesia. Key information is located at the Technical Working Group of the DGENE's Private Power Team in Jakarta. ▶ Take advantage of U.S. Eximbank's commitment to the ASEAN region and obtain country marketing information, funding for prefeasibility studies, and export financing and insurance. Other market information sources include USAID/Indonesia's Private Power Program and the U.S. Trade and Development Program.
<p>Long-term</p>	<ul style="list-style-type: none"> ▶ Obtain joint venture or licensee agreements with Indonesian manufacturers to increase the domestic production and assembly of smaller power generation equipment.

MW coal-fired Paiton project. PLN has prepared solicitation documents for five other projects: two geothermal projects at Bandung, a 1,200 MW coal-fired project at Tunjung Jati, a 400 MW project in West Java, and the 100 MW coal/peat Pontianak project.

The Indonesian power equipment and services market is dominated by few large players; however, this may change over time as opportunities in private power and small generating plants (under 10 MW) emerge. Competition is considered to be low to moderate given the few large players and expanding market size. Large lending programs in the Indonesian power sector by the ADB and World Bank will further expand the number of power project bids through international competition. These multi-lateral development banks have well-organized bidding procedures that should be tracked by prospective suppliers.

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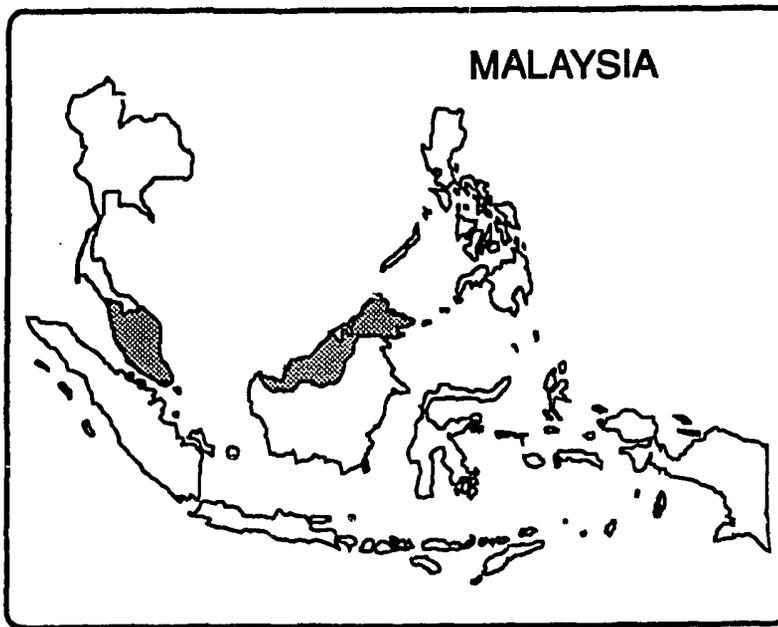
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Malaysia

Peninsular Malaysia's economic growth over the last thirty years has brought about a tremendous expansion of its electric system. In 1991, the country's real GDP grew by almost 8.2 percent, driven chiefly by a strong manufacturing sector. With an economic expansion rate of over 5 percent predicted for the early 1990s, Malaysia's demand for electricity is anticipated to remain high.

Malaysia's supply and transmission networks offer tremendous scope for additions and efficiency improvements. The recent stock offering of its national utility, Tenaga Nasional Berhad (TNB), has created great interest among foreign investors, particularly the Japanese. Electric power equipment manufacturers and design engineering companies can expect to see a total power generation and services market estimated at \$4.4 billion through 1996; of this amount, approximately 90 percent (\$3.96 billion) will be imported. Based on past experience, the U.S. could capture 5 percent of this market (\$198 million) over the same period. To attain this market share, U.S. firms should market to the large Japanese companies that bid turnkey projects. The repowering/rehabilitation market is well suited for U.S. companies that have a demonstrated track record in this area.

Power Sector Overview

The Malaysian power sector consists of three autonomous government-owned public utilities:

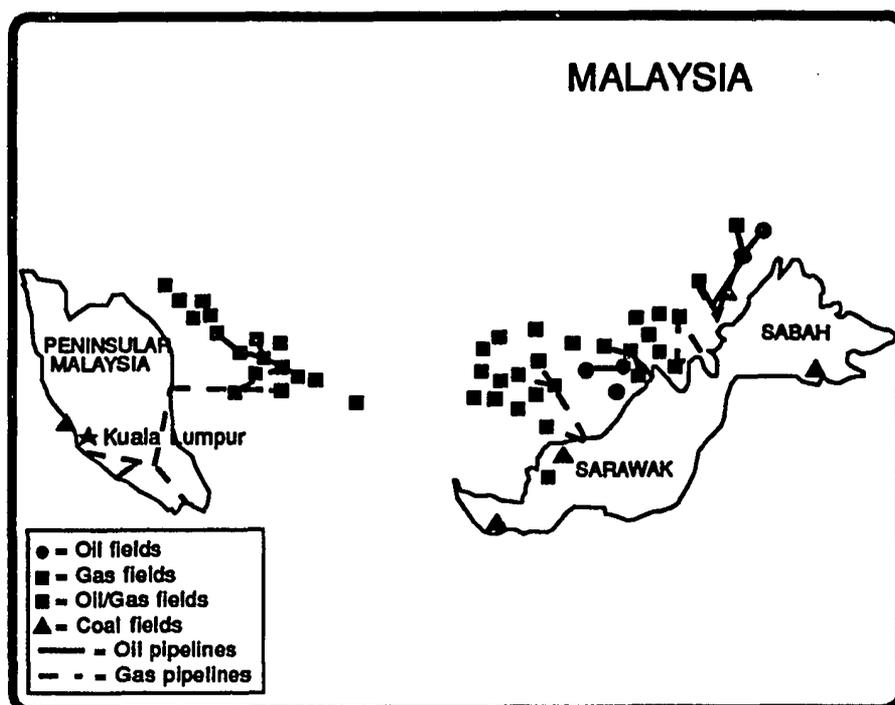
- Tenaga Nasional Berhad (TNB), formerly the National Electricity Board of the States of Malaya, is responsible for the generation, transmission, and

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distribution of electric power in peninsular Malaysia, which is home to more than 80 percent of the country's 18 million people.

- Sabah Electricity Board (SEB) supplies power to the Sabah regions in Eastern Malaysia.
- Sarawak Electricity Supply Company (SESCO) provides power to the Sarawak region in eastern Malaysia.

TNB, SEB, and SESCO are all under the jurisdiction of the Ministry of Energy, Telecommunications, and Posts (METP). The METP formulates national energy supply policy and makes investment decisions for the Malaysian power sector. Other licensees operate electricity supply plants in remote areas, but TNB is being extended as part of the national electrification system.



Malaysia possesses four major energy resources: coal deposits, hydroelectric potential, natural gas, and some small oil fields. Coal is available in small quantities on peninsular Malaysia (about 8.5 million tons). The country's reserves of lignite and brown coal are estimated to be around 311 million tons and are mostly found in peninsular Malaysia. The Sabah and Sarawak regions possess about 30 million tons of recoverable reserves of coal. Most of the coal used for power generation is imported from Australia, China and Indonesia.

At present, such major oil companies as Exxon and the Royal Dutch/Shell Group are actively developing the oil and gas industry with Petronas, Malaysia's state-run oil company. Oil production is running at around 629,000 barrels per day, with current reserves estimated at about 3 billion barrels.

The nation's natural gas reserves were estimated at 56.5 trillion cubic feet (tcf) in 1990 and annual production totalled about 0.61 tcf, making Malaysia the second ranking Asian producer after Indonesia. Malaysia is shifting to natural gas from oil, given the fact that on an energy equivalent basis, its gas reserves are three times that of its oil reserves. Malaysia currently exports liquified natural gas to Japan, and began selling piped gas to Singapore in 1992.

Malaysia's power demand grew at 8 percent annually during the late 1980s, and is expected to continue growing during the early 1990s as industrialization (especially high-technology plant construction) continues, incomes rise, and urbanization trends persist. TNB's generation planners expect demand to grow between 9.5 and 12 percent a year through 1995.¹ The National Chamber of Commerce and Industry of Malaysia (NCCIM) expects a lower annual growth rate in electricity demand of 9.5 percent until 1995.²

The 1991 installed electric power generation capacity in Malaysia was 5,130 MW; the supply mix was 1,245 MW hydro plant (24 percent), 2,530 MW fossil-fired (49 percent), and 1,270 MW combined cycle (25 percent). At present, all of TNB's thermal steam

¹ Estimates provided by Deputy General Manager, Development Planning and Research Department, Tenaga Nasional Berhad, Malaysia, February 1992.

² The Kuala Lumpur-based NCCIM is a non-profit entity that represents the interests of Malaysian industry and trade to the Government of Malaysia. The NCCIM expects that hydropower will be exported from neighboring Sarawak to the mainland. These electricity exports would be derived from hydro facilities that are slated to expand.

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stations burn residual fuel oil only; combustion turbines burn either diesel or medium-grade fuel oil; all of the country's combined-cycle stations are powered by natural gas.

Current Situation

Malaysia leads the ASEAN countries in the effort to privatize government entities. The National Electricity Board, the largest, most visible company in Malaysia, was privatized on September, 1, 1990, and renamed Tenaga Nasional Berhad. TNB is faced with the challenge of solving the chronic power shortage looming for peninsular Malaysia. Power shortages have caused losses in heavy manufacturing output and are beginning to worry potential foreign investors, especially in the electronics fabrication industry.

The future of TNB is very bright. The utility has been empowered to bring about sweeping changes in the way it manages itself: it will sell shares to the public this year and raise electricity tariffs as well. During fiscal year 1989-90, TNB posted a pre-tax profit of \$313 million. This level of financial performance made TNB the most profitable company on the Kuala Lumpur stock exchange. The privatization is expected to raise \$1.3 billion and when fully listed, the electric utility will account for 11 percent of the country's market capitalization.

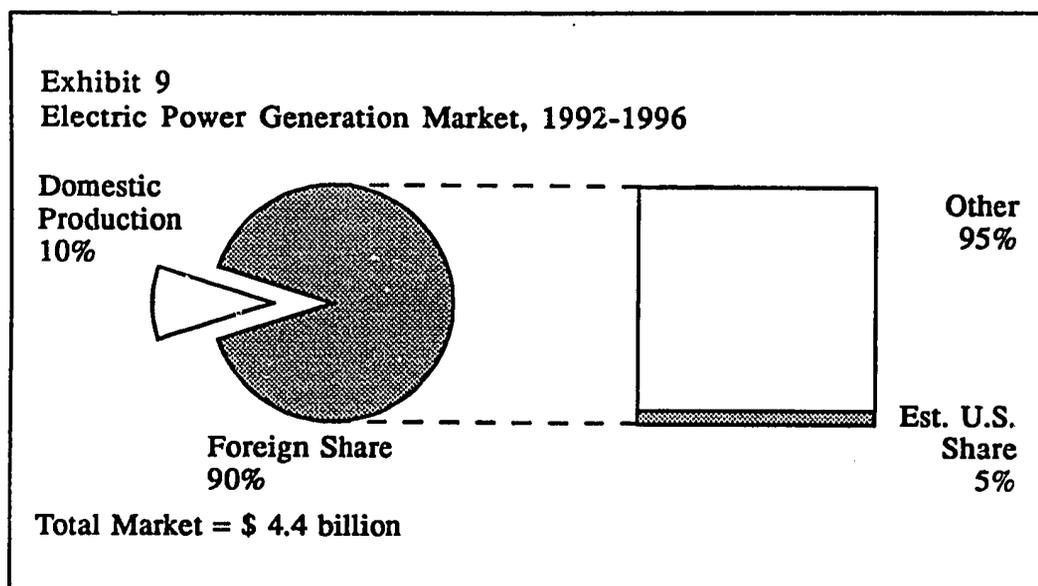
TNB invested close to \$878 million during 1991 in generation, transmission and distribution network capital projects. This utility's capital expenditures are expected to reach an average of \$926 million per year by 1996. TNB is also pursuing technologies that will make large bulk transfers possible between the peninsular grid and the Sarawak and Sabah systems. This will enable TNB to build larger generation unit sizes and take advantage of economies of scale, providing lower rates to its customers. One such scheme, the proposed 2,400 MW Bakun hydroelectric project envisioned for Sarawak, would use a 650 km high-voltage DC cable line to bring power to the peninsula.

SESCO's financial performance has been satisfactory, mainly due to high tariff rates and growing power demand in its service area. SESO has been able to meet the basic financial requirements stipulated by the Asian Development Bank (ADB) in order to receive concessionary loans.

Power Sector Market Assessment

Malaysia's expansion plan will probably proceed according to schedule given the country's strong financial performance and access to foreign capital. Further, it is expected that Malaysia will continue to enjoy over 5 percent economic growth due to its strong investment climate and stable political situation. Malaysia maintained a comfortable foreign exchange reserve position through 1991. Debt service absorbed only 11 percent of its export earnings, further augmenting the central bank's stable financial picture.

Malaysia imports most of its utility-grade power generation equipment. This trend is not expected to change in the near future: a 90 percent share of the estimated \$4.4 billion Malaysian power generation and services market anticipated through 1996 will be taken by foreign firms. Strong traditional ties with the U.K. and emerging relationships with Japanese power sector companies and trading conglomerates imply that U.S. firms will have to compete fiercely for orders (the U.S. can expect to hold a 5 percent share -- \$198 million -- of the foreign market; see Exhibit 9). However, the U.S.-based consulting firm, Arthur D. Little, is assisting TNB in its privatization process, demonstrating that TNB values U.S. expertise in regulatory analysis and management consulting services.



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There are significant opportunities for power plant rehabilitation in TNB's plants. The majority of the work lies in the repowering of thermal facilities. Upgrading boilers and turbines to dual firing is a priority. TNB estimates that 300 MW of dual oil/gas capacity and 120 MW of oil-fired boilers will undergo complete rehabilitation by 1995. Other rehabilitation opportunities include the 40 MW Chenderoh hydro project, which is slated for 1995. Petronas, the national hydrocarbon company, is expanding its operations and may offer smaller repowering project opportunities.

During the 1992-1996 period, 4,882 MW of new capacity will be added. These additions consist of 1,000 MW (21 percent) in fossil-fired boilers, 1,726 MW (35 percent) in combined-cycle power plants, 1,396 MW (29 percent) in combustion turbines, and 760 MW (16 percent) in hydroelectric capacity (Exhibit 10). TNB is still working on the details of the 1997-2000 expansion plan, which will depend on the results of the privatization process and the country's economic performance over the next two years. However, it is understood that most future generation will be natural gas and coal based. The future of nuclear power still remains at the policy level and will not be feasible in the 1997-2000 horizon.

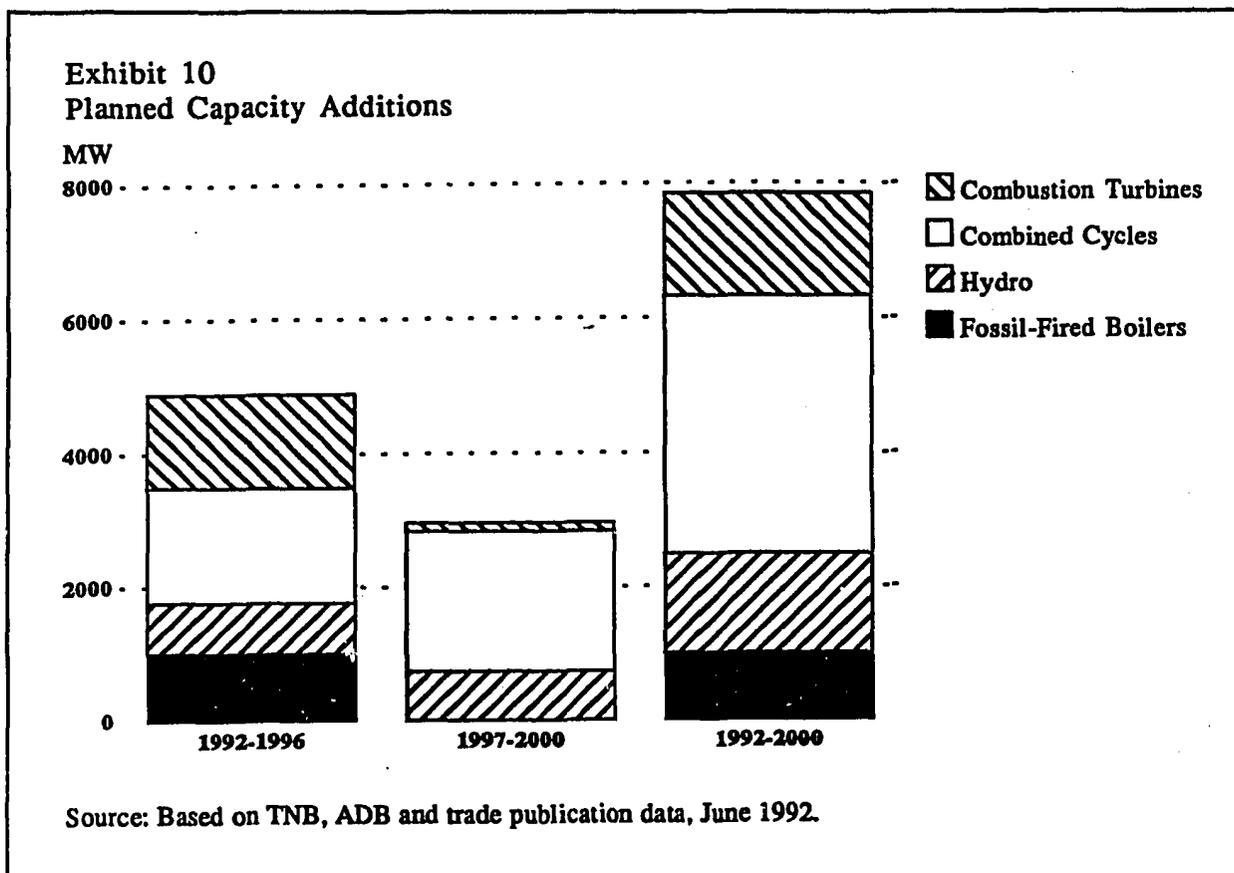
Exhibit 11 provides an overview of the power generation equipment and engineering and contracting company activity for Malaysia during 1990. It can be seen that U.K. equipment suppliers and engineering firms are very active, followed by Japanese trading companies, which have recently captured power projects on a turnkey basis for the first time in Malaysia.

The 600 MW Pergau hydropower project contract was awarded to a consortium made up of Balfour Beatty (U.K.) and Cementation International. It represents the largest single construction project in the ASEAN region. The project comprises an underground powerhouse containing four vertical shaft generators coupled to four Francis hydro turbines.

A private power developer, Hopewell Holdings (Hong Kong), has indicated that it is nearing a \$1 billion, 900 MW power project deal with a construction consortium made up of YTL Malaysia, TNB, and the World Bank/International Finance Corporation. This project presumably would be a coal-fired non-utility plant selling its output to the grid.

The existing electric power capacity at the 240 MW Pasir Gudang power station will be expanded by the addition of the two new ABB (Sweden/Switzerland) gas turbines and the subsequent conversion to combined-cycle operation. A second 300 MW combined-cycle block will be added later. Bids for this work have been prepared by Black and Veatch (U.S.), Lahmeyer (Germany), and Ewbank and Preece (U.K.). The Asian Development Bank is providing \$203 million for the Pasir Gudang combined-cycle power plant. Pasir

Gudang will be followed by a \$53 million lending program to SESCO to build the 114 MW Kuching and Bintulu Stations slated for commissioning in 1993 and 1995, respectively. The ADB is also pursuing assistance in the private sector, pushing for build-own-operate (BOO) and build-own-transfer (BOT) schemes as possible models for Malaysia.



Natural gas developments are promising in Malaysia, especially for positioning plants on the western coast of the peninsula where reticulated gas suppliers are being utilized in the conversion of several units to natural gas including the Jaafar, Sultan Iskandar, and Sultan Salahudin power plants. U.S. firms can position themselves for the next stage of new TNB plants and repowering opportunities in the expanding hydrocarbon sector.

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Exhibit 11
Selected Power Sector Projects in Malaysia

Equipment	Project Date	Major Supplier	Country of Origin	Approx. Project Value
Four generators and four GEC-Alsthom turbines for 600 MW Pergau hydropower plant	1992-1996	Balfour Beatty and Cementation Intl., Kerjaya Sendirian Berhad	U.K. Malaysia	\$720 million*
900 MW power station probably coal-fired boiler	under consideration	Hopewell Holdings, YTL, TNB, Intl. Finance Corp.	Hong Kong, Malaysia	\$1.1 billion
Seven turbines for Paka, Pasir Gudang, and Connaught Bridge locations**	1992-1996	NEI-Parsons, ABB Gas Turbines Ltd.	U.K.	\$400 million
148 MW GT13E gas turbine and heat recovery boilers for Connaught Bridge power plant	1991	NEI, ABB Gas Turbines Ltd., CMI	U.K.	\$60 million
Three MS6001B gas turbine gensets for SESCO's 114 MW (3x38 MW) Kuching and Bintulu power stations	1993, 1995	Mitsui (prime contractor), General Electric	Japan U.S.	n.a.
Combined-cycle Pasir Gudang 300 MW power plant including auxiliary equipment	1992-1994	Competitive bid (ADB funding)	n.a.	\$200 million loan
Combined-cycle block and transmission extension for 300 MW Paka power station	1992-1993	Competitive bid (World Bank funding)	n.a.	est. \$400 million

* This project is funded by U.K. ODA/concessional aid grants of \$540 million.

** This project includes refurbishing work.

Source: Based on data compilation from trade literature, June 1992.

Market Entry Strategy

The Malaysian market represents a new field for U.S. suppliers; it has traditionally been dominated by the U.K., along with some Japanese and European suppliers. However, there is a good probability that U.S. turbine supply companies will experience success similar to that achieved by the U.S. electronics and semiconductors industry in Malaysia.

The U.S. Embassy in Kuala Lumpur is very active in directing interested U.S. firms into Malaysia. The commercial department recently conducted an electric power mission and obtained a favorable response from TNB and Malaysian industry.

Exhibit 12
Malaysia Market Entry Strategy

<p>Short-term</p>	<ul style="list-style-type: none">▶ Actively seek TNB and Petronas repowering projects. Gas supply pipelines are being completed on schedule; consequently, repowering, and fuel conversion from oil to natural gas will take place at the Paka station, and the development and procurement of a 300 MW combined-cycle unit will be initiated.▶ Target cooperation agreements with Japanese trading companies active in TNB power sector projects.▶ Work closely with U.S. engineering and consulting companies.
<p>Long-term</p>	<ul style="list-style-type: none">▶ Obtain joint venture or licensee agreements with Malaysian manufacturers for dual-fired conversion technologies.

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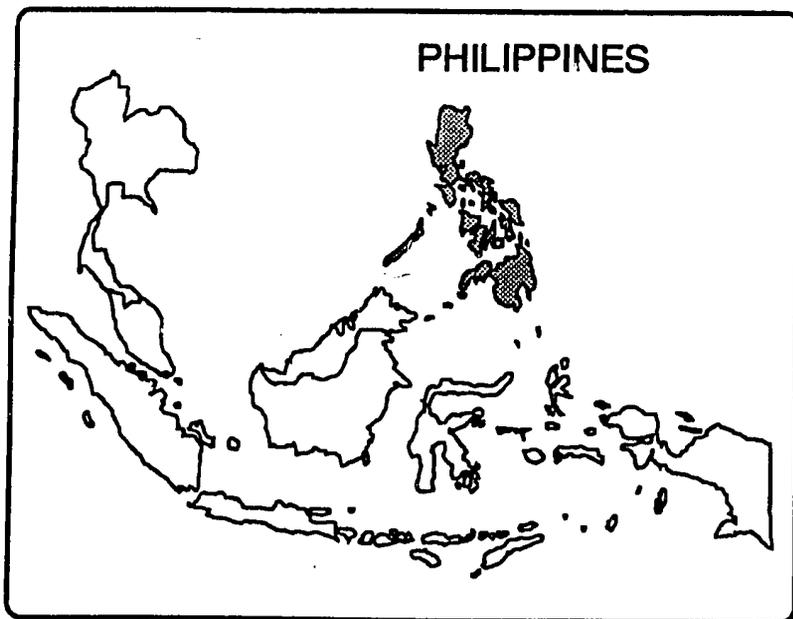
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Philippines

Electricity supply in the Philippines is dominated by the state-owned National Power Corporation (NPC). The Philippine government's objectives for the power sector focus on reducing oil imports for electricity generation and the development of geothermal and renewable energy resources. The government is also aggressively promoting the private development of power projects to attract additional capital and to provide relief from the country's chronic power shortages.

The Philippine market for power supply equipment and design engineering services is estimated at \$3.6 billion through 1996; almost 90 percent (\$3.2 billion) of this will be imported. Based on past experience, the U.S. can expect to take an almost 40 percent share of this market (about \$1.3 billion) over this period. To gain this market share, U.S. firms must aggressively track the National Power Corporation's inventory of potential build-own-transfer (BOT) projects. In addition to conventional fossil-fired systems, there is a good potential for the export of geothermal steam turbines and renewable energy resource-based equipment in the Philippines.

Power Sector Overview

The National Power Corporation, which is under the Office of the President, is a government-owned electric utility responsible for the generation and transmission of bulk power in all of the country's major island grids. Approximately 85 percent of the Philippine's generating capacity is owned and operated by NPC.

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Overall, NPC-generated electric power also represents 85 percent of final electricity consumption in the Philippines. The remainder is provided by the Manila Electric Company (MERALCO) (2 percent), other private electric companies (5 percent), rural electric cooperatives (2 percent), and industry auto-generation (7 percent). NPC's total installed capacity was slightly over 6,100 MW in 1991.

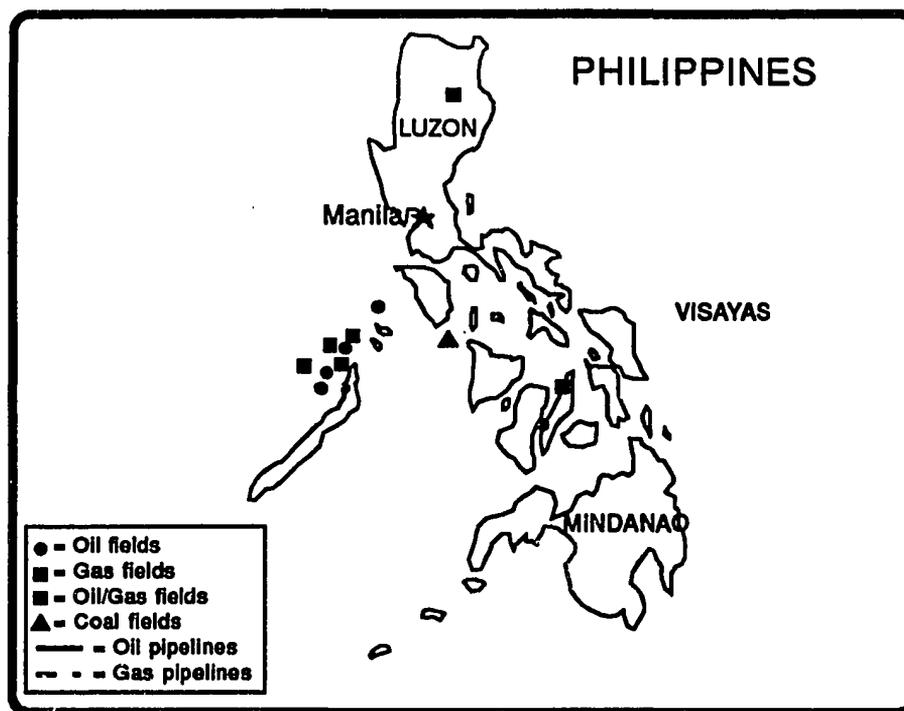
Twenty-four privately and municipally owned utilities distribute power to Philippine urban centers. The largest of these is MERALCO, a privately held power distribution company that supplies electricity to the metropolitan Manila area. The National Electrification Administration (NEA) is responsible for rural electrification; it falls under the jurisdiction of the Department of Environment and Natural Resources (DENR). The Philippine National Oil Corporation (PNOC) develops oil and natural gas resources, including geothermal energy, and controls more than 50 percent of the petroleum refining industry.

The Philippine Office of Energy Affairs (OEA) was created in June 1986, and has primary responsibility for the planning, monitoring, and implementation of policies and programs in the energy sector, including the power subsector. OEA also serves as the Secretariat to the Energy Coordinating Council, which was created in 1988 to coordinate the activities of the principal energy policy implementing agencies in the Philippines (NPC, NEA, PNOC, and OEA). The Energy Regulatory Board is responsible for energy pricing, as well as the regulation of all private electric utilities in the country, and coordinates its sales and distribution activities with NPC. The Environmental Management Bureau (EMB) is part of the DENR and is responsible for issuing environmental compliance certificates for electric power generating facilities.

The Philippines has only modest amounts of indigenous fossil energy resources. The country's proven petroleum reserves are estimated at 4 million tons, its natural gas deposits are considered sub-commercial, and its total coal resources are estimated at about 1,500 million tons, with the largest deposits located on the small island of Semirara and in the Cagayan Valley of northern Luzon. The International Finance Corporation (IFC) is taking a 15 percent stake in the West Linapacan oil exploration project off Palawan. The West Linapacan consortium will undertake the first phase of this project (estimated at \$48 million), which is expected to produce 15,000 to 20,000 barrels of oil per day. The total estimated petroleum reserves in the area are 109 million barrels.

By contrast, hydropower resources in the Philippines are quite substantial, with a theoretical power potential of over 10,000 MW. However, the development of these resources is relatively costly due to the distance of the resource sites from the major

transmission grids and load centers. The OEA has a well-developed inventory of potential hydropower sites in the Philippines; it is available to prospective developers.



The country's major domestic energy source is geothermal steam. While the Philippines' geothermal reserves have not been fully evaluated, they could exceed 8,000 MW. Based on current information, there are about 4,431 MW of probable reserves, 1,640 MW of which have been tested. However, only 888 MW of electric capacity has been installed, giving the Philippines the second largest geothermal-based electric capacity after the U.S. Luzon accounts for about 3,000 MW of the country's total geothermal potential; however, only 660 MW is currently being utilized. Most of the remaining reserves are on the island of Leyte, which has a potential of 2,000 MW, of which 400 MW is available from the Tongonan field alone.

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The Japan Export-Import Bank has offered \$150 million to fund the development of the Leyte A and B geothermal projects. However, these projects have been delayed until 1997. NPC has geothermal steam supply contracts with PNOC at Tongonan and Palimpinon (110 MW each), as well as with Philippines Geothermal Inc., a subsidiary of UNOCAL (U.S.), at Tiwi and Makiling-Banahaw (330 MW each). PNOC plans to invest \$700 million in geothermal development over the next five years and is entertaining joint ventures with foreign firms. PNOC's geothermal program calls for 435 MW in new geothermal capacity to be added by 1995.

In the 1960s and early 1970s, the demand for electricity in the Philippines grew at average annual rates of well over 15 percent. The oil price shock of 1973 and its corresponding electricity tariff increases resulted in a slowing of electricity demand growth, which averaged less than 10 percent until the end of the 1970s. Between 1980 and 1984, annual electricity demand growth averaged about 7 percent, despite another oil price shock in 1981.

However, during the 1984-1986 period, electricity sales growth was flat or even negative due to poor economic conditions and the serious draught in Mindanao in 1985. The economy gradually improved and electricity sales increased to 9.6 percent in 1987 and 10.6 percent in 1988. The revival of the industrial sector, one of the major forces behind the economic upturn, resulted in that sector's electricity consumption increasing to over 12 percent in 1988.

The government realized as early as 1987 that public funds alone were insufficient to fully support its power expansion program, given the expected electricity demand growth. NPC was thus encouraged to look to private sources of project financing as a means of meeting the power deficit.

Philippine Executive Order 215, issued in 1985, eliminated NPC's monopoly in power generation and set forth a policy to encourage private power development based on the U.S. Public Utility Regulatory Policies Act (PURPA) model. The Philippine private power program provides for cogeneration and small power systems based on indigenous energy resources. It also provides for large "block power systems," which are units taken out of the NPC Power Development Plan (PDP).

Current Situation

NPC comprises seven grids in three regions: the Luzon grid (installed capacity of 4,391 MW), five island grids in the Visayas area (aggregate capacity of 664 MW), and the

Mindanao grid (installed capacity of 1,053 MW). The Luzon grid accounted for over three-quarters of the nation's total electricity sales during 1989. The majority of NPC's 6,108 MW of capacity is oil-fired (41 percent), while hydro (37 percent), geothermal (15 percent), and coal-fired (7 percent) make up the rest.

At present, the low reliability of the country's power supply is a major issue. The OEA estimated that power outage costs to the Philippine economy in 1989 alone were around \$264 million in lost production and an additional \$430 million in foregone workers' wages. As a result, many industries and businesses have purchased backup diesel generator sets. The Philippine Board of Investments reports that over 600 MW of diesel genset capacity has been purchased and imported under its duty-free policy, which was initiated in direct response to the power shortage situation.

The country's electric power supply situation continues to be plagued by high outage rates for four major reasons: the operation of gas turbines beyond their rated capacities for extended time periods, an urgent need to rehabilitate old oil and hydro generating units, an increasing peak demand for electricity, and a chronic shortage of replacement parts and trained maintenance crews. Other reasons for electricity outages include: delays in planned capacity additions due to financial constraints and public opposition; and transmission line and substation failures, some of which have been caused by natural disasters such as the typhoon on Cebu, the earthquake and subsequent mudslides on Luzon, and the most recent drought on Mindanao.

The combination of an unreliable power supply system and the increasing cost of power, when available, will drive industrial and commercial establishments to look for alternatives. As a result, the NPC's 1991 PDP is designed to alleviate the effects of the power crisis by addressing the following issues:

- actively solicit the private sector in the implementation of power generating projects
- expand the country's electric power transmission and distribution systems
- continue to develop energy resources such as oil, geothermal, natural gas and coal
- balance power supply and demand at a reliability level acceptable within the country's development plans

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- minimize the environmental impacts of power projects.

At the end of 1991, there were 17 projects totalling over 2,000 MW of private generating capacity in some stage of development. The first private power project, the Hopewell Holdings (Hong Kong) Navotas 210 MW gas turbine project near Batangas, was commissioned in 1991 using rehabilitated Westinghouse Electric (U.S.) gas turbines. The projects under development range in size from the 1.2 MW Irian mini-hydro project to the 700 MW Pagbilao coal-fired project.

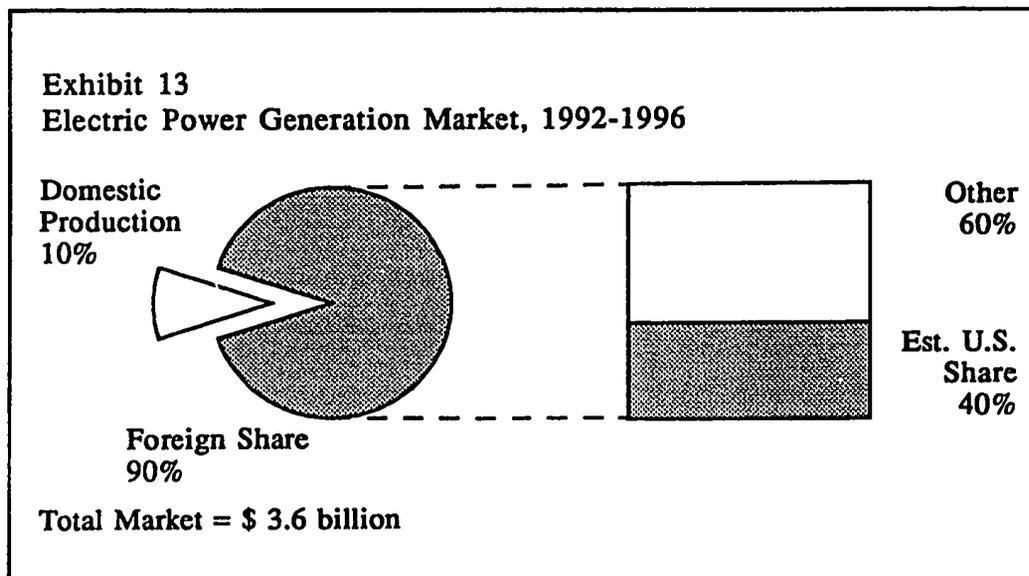
Power Sector Market Assessment

The Philippines is under severe pressure to manage its growth in electricity sales and peak demand. The forecast annual demand growth for 1992-1995 is expected to be at least 7.6 percent (Luzon, 7.1 percent, Visayas, 10.7 percent, and Mindanao, 7.9 percent).¹ For the period 1996-2000, this growth is expected to be slightly higher at 7.7 percent (Luzon, 8.2 percent, Visayas, 6.5 percent, and Mindanao, 6.5 percent). Forecasts developed by NPC show that the country's total electricity generation capacity will grow at an average annual rate of around 6 percent during the 1989-2000 period. According to NPC, annual electricity sales will more than double, increasing from about 26,000 GWh to 43,500 GWh over this period.

NPC estimates that over \$6.4 billion in new investment for generation and transmission projects will be needed for the period 1991-2000. Over the period 1992-1996, the country's total power generation market will be \$3.6 billion. The lion's share of this market (90 percent) will go to foreign equipment suppliers and engineering services firms. The estimated U.S. share of the foreign market will be 40 percent (\$1.3 billion) as shown in Exhibit 13.

Between 1992 and 1996, NPC plans to add 1,791 MW of new capacity: 595 MW of geothermal, 520 MW of combined cycles, 300 MW of fossil-fired boilers, 166 MW of diesel-fired generation, 130 MW from combustion turbines, and 80 MW from hydro. During this time, the private sector is expected to add some 950 MW of fossil-fired steam boilers.

¹ National Power Corporation, *1991-2005 Power Development Program*, Diliman, Quezon City, Philippines, September 1991.

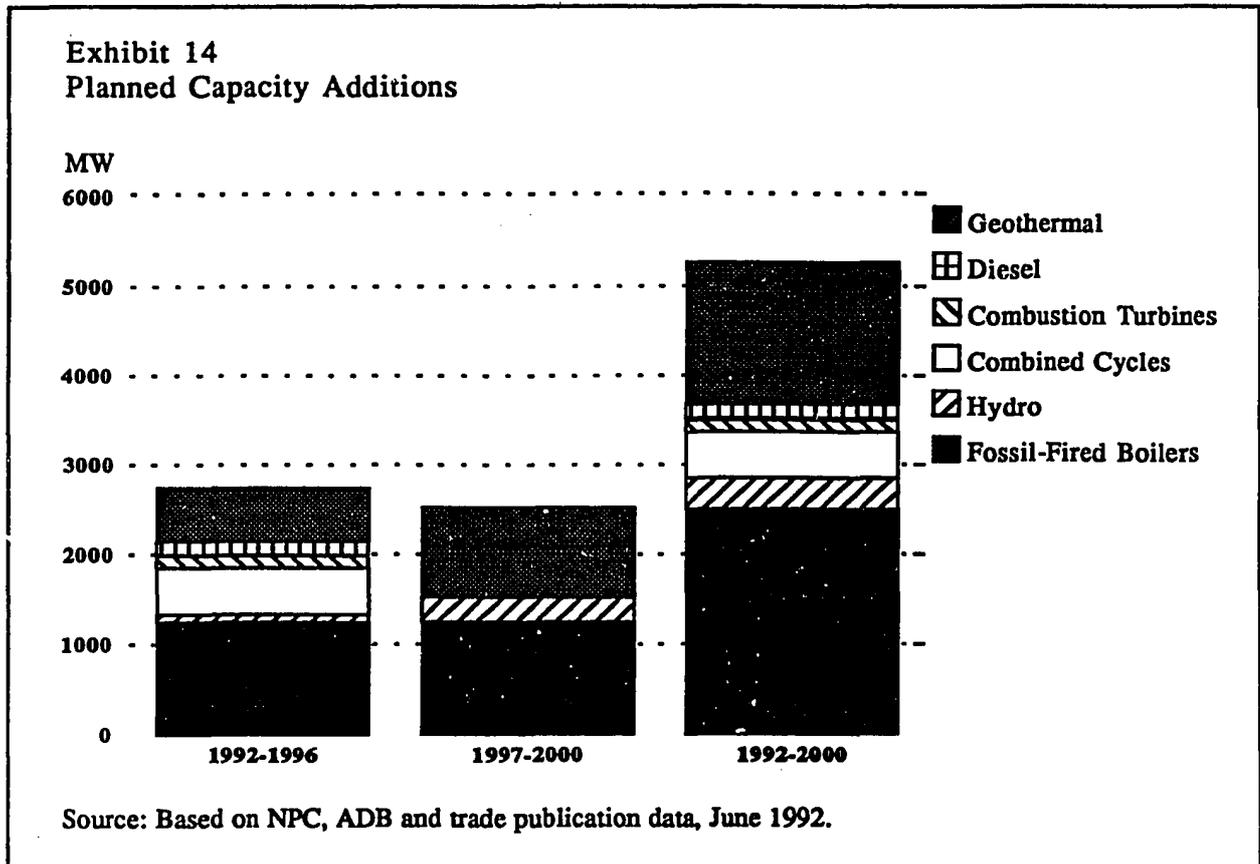


For 1997-2000, the pattern of additions looks quite different. NPC plans to install over 2,500 MW of new electric generating capacity: 1,250 MW in fossil-fired steam boilers, 1,000 MW in geothermal capacity, 268 MW in hydro electric capacity, and 6 MW in diesel units. Private power is estimated to provide a significant portion of the total capacity added during this period.

For the entire 1992-2000 period, NPC's 1991 Power Development Plan indicates that the utility plans to add over 5,262 MW of new generating capacity. The bulk of this capacity will come from geothermal steam (30 percent) and fossil-fired boilers (47 percent). Geothermal capacity is expected to nearly triple during this period from 888 MW to 2,483 MW, while coal-fired electric capacity is expected to increase from 2,665 MW to 4,215 MW (Exhibit 14).

Utility-grade power generation equipment for the Philippine power sector is almost all imported. Mini-hydro turbines and generators and other relatively less sophisticated equipment are sometimes manufactured locally, typically assembled from imported- (70 percent) and locally-made parts (30 percent). Philippine companies claim they can assemble and supply turbines and generators of any size required by the NEA for mini-hydro projects. In small diesel powered units (ranging from 25 to 1,000 kW), U.S. manufacturers enjoy a

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reputation for reliable and high-quality equipment. In 1985, the U.S. market share for small diesel generator sets was 65 percent; the main suppliers were Caterpillar, Cummins, and General Motors.

The Philippine government has approved NPC's construction budget for three power plants this year at a total cost of almost \$672 million. NPC has indicated that it will contract a number of firms to build the power plants, including Morrison-Knudsen Corp. (U.S.), Asea Brown Boveri (ABB, Switzerland), and Marubeni Corp., Kawasaki Corp., and Mitsui Engineering and Shipbuilding Co. (Japan).

Also, Hopewell Energy International Ltd. (Hong Kong) recently signed an agreement with NPC to build and operate the \$650 million, 700 MW coal-fired Pagbilao project (Exhibit 14) and a 100 MW gas-fired plant on Mindanao island. British Electricity International heads a joint venture that is developing a \$150 million, 300 MW coal-fired BOT plant at Batangas. Last, NPC also signed a contract with a Mitsui & Co.-led consortium for two barge-mounted diesel-fueled gas turbine units with 200 MW of capacity off the coast of Mindanao, estimated to be worth \$200 million.

A Japanese consortium led by Marubeni and Mitsubishi has signed a \$270 million contract with NPC to supply 10 modular units of 20 MW each, which will be installed in various geothermal fields (Apo, Bulusan, Cagua, and Del Gallego). The Japan Export-Import Bank is providing the financing. The New Zealand-based Leyte Geothermal Power Inc., a subsidiary of the Power Design Builder Group of New Zealand, plans to tap the Tonganan geothermal reservoir and install high-voltage transmission lines to the capital. The Geothermal Act, which is now moving through the Philippines Congress, could spur new investment in geothermal resource development and generating capacity. The bill classifies geothermal as a tax-exempt pioneer area."

A number of coal-fired units are awaiting environmental clearance from the EMB (Calaca 2 in Batangas and the ADB-financed Masinloc 1 in Zambales). The Agus 1 hydro stations in Lanao del Sur and the geothermal stations Bacon Manito 1 in Albay-Sorgoson, Palimpinon 2 in Negros Oriental, and Mt. Apo in Mindanao have received their Environmental Compliance Certificates from EMB. However, both the Agus 1 and Mt. Apo projects have been stalled due to local opposition.

The ADB has fully backed the \$441 million Masinloc 1 (Power XVI project) thermal plant. However, there are no other power project loans planned for the immediate future. The Power XVI project for expanding MERALCO's system will be co-financed by the World Bank, International Finance Corporation (IFC), the Japan Development Fund, and the German Development Fund. Also, the Power XVIII loan to expand the Masinloc station by 300 MW will be considered later, possibly around 1995.

NPC is offering some of its existing power plants to the private sector under lease-operate or rehabilitate-operate-transfer (ROT) schemes. The actual sales of several plants are being contemplated -- Naga thermal plant in Cebu, Calaca I in Batangas, Malaysia I-II, and Tiwi geothermal plant. Hopewell Holdings of Hong Kong has expressed interest in Calaca I and Ontario Hydro is interested in Naga I. NPC has identified 17 power plants that will have to be retired over the next 17 years, many of them in the 1990s, because they are

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nearing the end of their design life. The plants targeted have a total capacity of 2,514 MW, with nearly half located on Luzon.

The Philippines government continues to encourage private power development. In June 1992, the National Economic Development Authority board approved four "fast track" BOT project proposals recommended by the NPC:

- the Hopewell 100 MW gas-fired project on Mindanao
- the 140 MW ESI Power Corp. project
- the 110 MW diesel plant Enron is developing outside Manila
- a 140 MW combined-cycle project developed by Ace Indonesia.

These projects are in addition to the Hopewell 700 MW coal-fired Pagbilao power plant, and the Marubeni Corp. and ABB 300 MW combined-cycle plant on Luzon. NPC will also issue RFPs for three 300 MW coal-fired plants to be developed on a BOT basis on Luzon; they will be commissioned no later than 1997. The 300 MW Calaca 2 project, currently under development by NPC, may be offered to private developers as part of a privatization scheme. Last, NPC is inviting bids for 45 small hydropower projects to be built on a BOT basis. The units range in size from 5 MW to 50 MW.

Exhibit 15
Selected Power Sector Projects in the Philippines

Major Equipment	Project Date	Major Supplier	Country of Origin	Approx. Value
Tongonan Project: 3x55 MW unit 2, 3x55 MW unit 3, 2x55 MW unit 4	1992-1995	Power Design Builder Group	New Zealand	\$509 million
Four MS6001B combustion turbines for 200 MW Navotas BOT power plant	1991	Hopewell Holdings, Westinghouse, Ewbank Preece	Hong Kong, U.S., U.K.	\$45 million
Pagbilao Grande (2x350 MW) 700 MW coal-fired power plant	est. 1996	Hopewell Holdings	Hong Kong	\$650 million
Ten modular units of 20 MW each for various geothermal fields	1992-1996	Marubeni Corp. and Mitsubishi Corp.	Japan	\$270 million
Barge-mounted 200 MW gas turbines for Mindanao power station	1992-1994	Mitsui & Co. consortium	Japan	\$200 million
300 MW coal-fired power plant at Batangas	n.a.	British Electricity International	U.K.	\$150 million
300 MW combined-cycle power plant at Cavite	1992-1995	Altresco Inc.	U.S.	n.a.
Construction work at three NPC power plants	1992	Morrison Knudsen, Boise, Marubeni, Kawasaki, ABB, Mitsui & Co.	U.S. Japan Europe	est. \$672 million
22 MW natural gas/diesel fuel pilot power plant at PNOC project site at San Antonio, Isabela	bids due May'92	not determined	n.a.	n.a.
45 mini hydros ranging from 5 MW to 50 MW each funded by development banks	current NPC bids	ADB, World Bank, Japan OECF	n.a.	\$5-\$50 million each

Source: Based on data compilation from trade literature, June 1992.

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Market Entry Strategy

The Philippines has provided U.S. equipment suppliers with the largest market share (often in the 40 percent or more range) of any ASEAN country. The Philippine government has stressed the importance of diversifying their fuel resource base for the power sector. This will enable U.S. suppliers of dual-firing and renewable energy equipment to find emerging markets in the Philippines.

The NPC and NEA are encouraging private power development as a means to improve and expand the country's existing power supply. NPC maintains a list of potential private power project sites and developers, which is a good source of information on projects that are being solicited. Further, there are many U.S. developers active in the Philippine market that can be contacted through the foreign commercial service of the U.S. Embassy.

Exhibit 16 Philippine Market Entry Strategy

Short-term	<ul style="list-style-type: none">▶ Actively track NPC private power solicitations. These solicitations are listed as BOT opportunities on a regular basis.▶ Rehabilitate existing oil and coal power plants.▶ Follow U.S. engineering and consulting companies active in the energy resource exploration and development area.
Long-term	<ul style="list-style-type: none">▶ Develop equipment sizes that best meet the needs of the Philippine geothermal industry.

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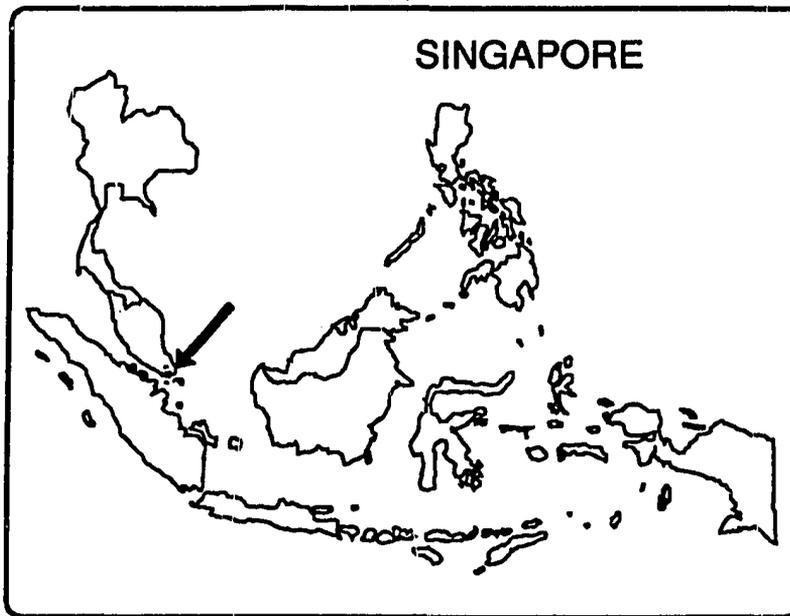
Philippines

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Singapore

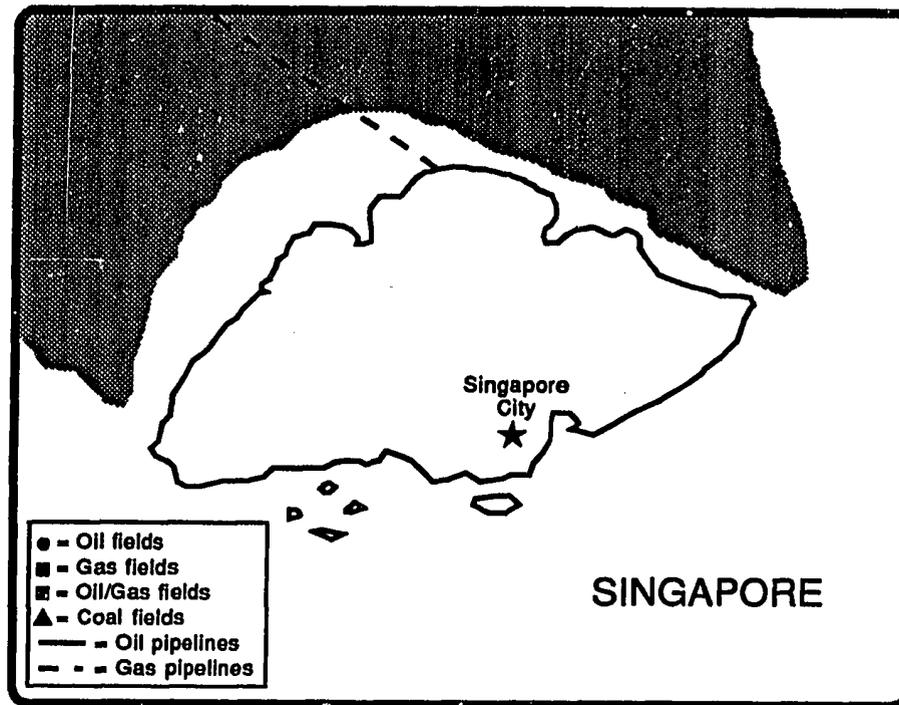
Singapore's electricity supply is primarily met by petroleum imported from the Middle East and Indonesia. The major energy objectives of the Singapore government are to diversify its fuel for power generation and to maintain its petroleum refineries' position as among the most cost-competitive in the world. To achieve these objectives, the Singapore Ministry of Trade and Industry is vigorously promoting the construction of new power plants and working to ensure that its future generation plants can fire both natural gas and oil. The nation's electric utility, Singapore Public Utilities Board, is financially sound, capable, and provides excellent service to the country's largely urban population and industrial users. At present, there is only a moderate level of activity planned in power plant procurement for the next five years.

Electric power equipment makers and design engineering companies can expect to see Singapore's total power generation and services market reach an estimated \$1.6 billion through 1996. Imports should account for at least 90 percent of this market. The U.S. stands to gain an approximate 25 percent share of the import market (about \$360 million) over the same period. To realize this market share, U.S. firms must market directly to Singapore's Public Utilities Board, and investigate the repowering and rehabilitation market.

Power Sector Overview

Singapore, with a total land area of approximately 600 square kilometers, has little in the way of power resources. It attains virtually all of its power supply from imports, including petroleum from the Middle East and Indonesia, and gas via a pipeline from peninsular Malaysia. Nonetheless, this small island state has one of the most advanced and efficient

Singapore



electricity supply system in the ASEAN region. While energy policy is the responsibility of the Ministry of Trade and Industry (MTI), the executing energy sector institutions have almost complete operations and procurement autonomy.

A single state-run electricity, gas and water utility, the Singapore Public Utilities Board (PUB) possesses a single grid and serves almost 100 percent of the population. The PUB provides electricity generation, transmission and distribution services to Singapore island and to the larger islands of Pulau Ubin and Pulau Tekong Besar. The privatization of the PUB is being discussed as a way to further improve the utility's efficiency.

Current Situation

In the ASEAN region, Singapore provides exceptional electricity service to its 2.7 million inhabitants. This nation experienced an incredible 15 percent average annual electricity demand growth from the mid-1970s to the mid-1980s. This growth has now been reduced to around 7 percent annually. Growth in light industrial activity and the service industries has

Singapore

accounted for most of the continued growth in power demand. Electricity demand projections for the next five years are in the 5 to 6 percent range.

The PUB's 1991 installed electric power generation capacity was 3,627 MW: 3,116 MW in fossil-fired boilers and the remaining 511 MW in combustion turbines. Non-utility power generation is very small and is not slated to grow substantially.

In response to the Singapore government's proclamation of maintaining a clean, healthy environment for its citizens and reducing its dependence on imported oil, the country's Energy Ministry plans to convert several electricity generating stations from oil-fired to natural gas-fired units. Singapore will achieve these objectives by initiating power plant fuel conversions, engaging in natural gas contracts via pipeline from Peninsular Malaysia, and importing LNG from Indonesia. Singapore PUB's procurement activity is centered around dual oil/gas-fired steam units and the conversion of fossil steam units to natural gas.

Singapore's PUB is in very good financial health, having turned a record \$200 million in profit during fiscal year 1991. Singapore also has a fully convertible currency and maintains a modest trade surplus. Further, an active domestic stock market and the presence of major foreign investors augments the country's financial prospects.

Singapore imports most of its utility-grade power generation equipment (thermal units) for the power sector. However, there are several domestic manufacturers of electric motors/generators and other electrical apparatus for the industrial power market. This situation is not expected to change in the near future.

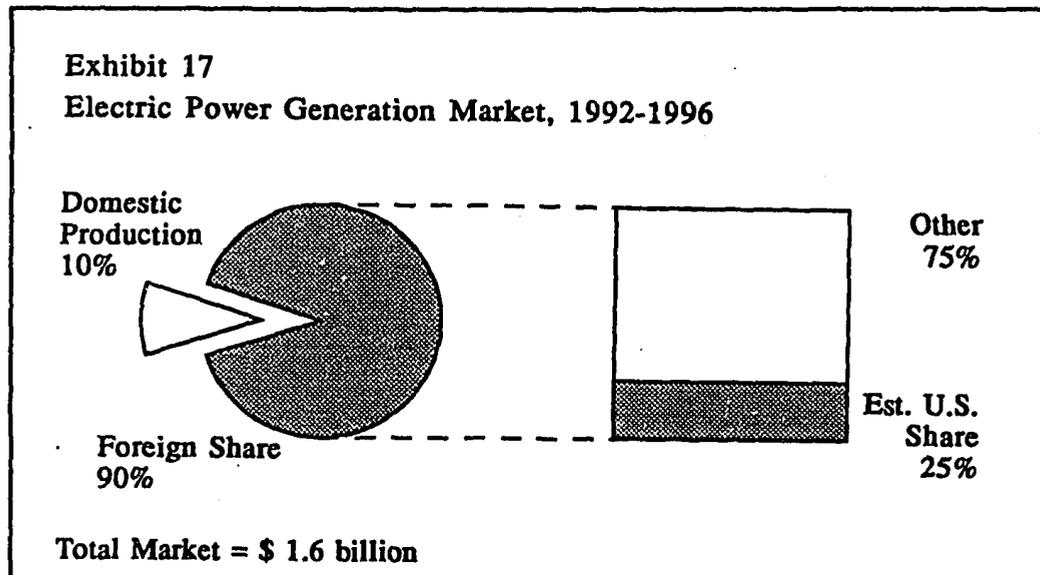
Power Sector Market Assessment

Singapore's PUB plans to spend some \$487 million through fiscal year 1993 on a broad range of power sector programs. These plans encompass the conversion of power plants from oil to gas and improving transmission and distribution systems, including civil works for gas transmission. Between 1992 and 1996, Singapore will spend an estimated \$1.6 billion on equipment and services for this sector. The U.S. stands to gain about one-quarter of the foreign share of this market, or about \$360 million (Exhibit 17).

Exhibit 18 displays the Singapore PUB's planned electricity supply additions by fuel and generating type through the year 2000. During the 1992-1996 period, the PUB is expected to add 1,256 MW: 1,000 MW in fossil-fired boilers and 256 MW in combustion turbines.

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Over the latter half of the decade, the PUB is slated to build one 500 MW fossil-fired steam plant, which will most likely be oil/gas-fired or gas-fired.

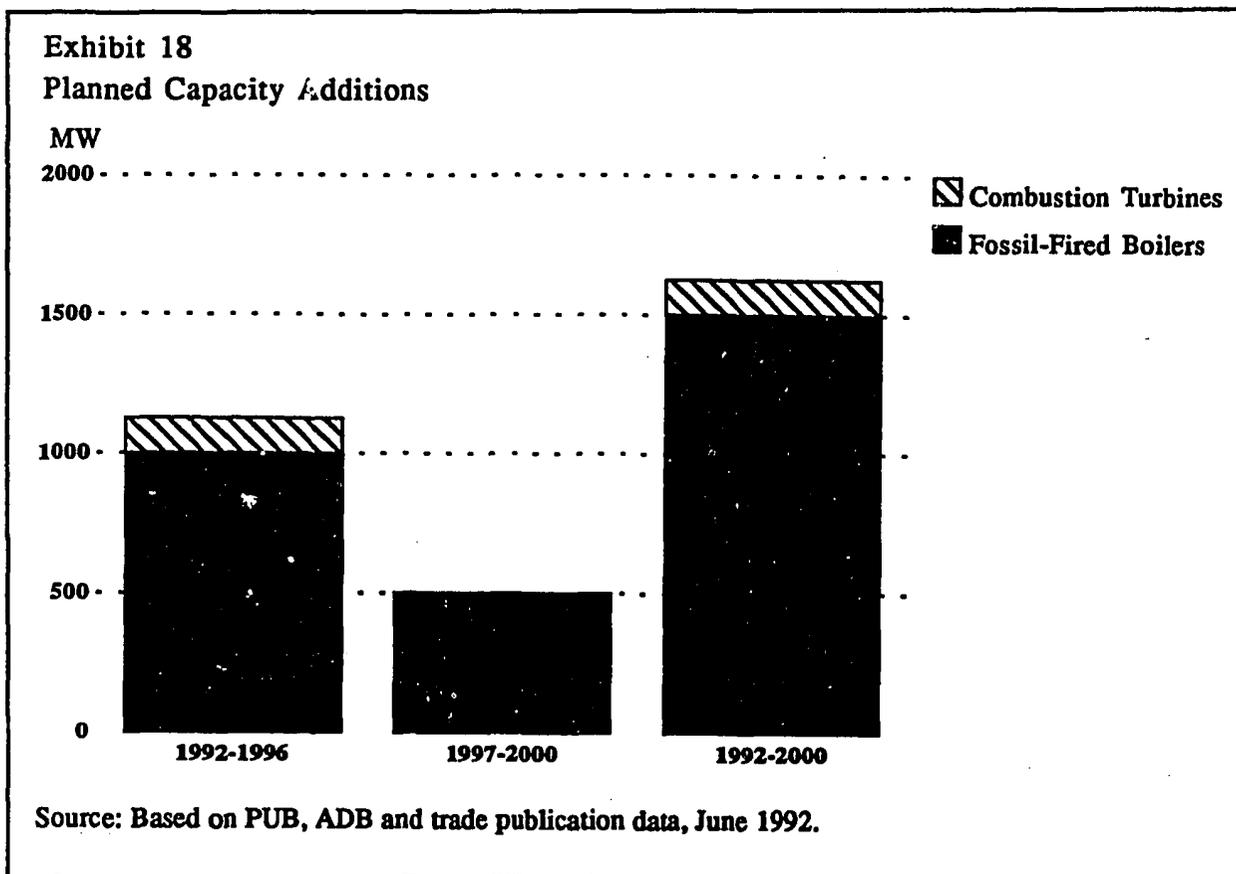


The Singapore market for power generation equipment is traditionally dominated by British and Japanese suppliers, although U.S. firms have played an active role in designing the PUB's privatization program. Japanese firms are emerging as a major force as a result of their cost competitiveness and domination in certain market segments. Some of the major Japanese suppliers to Singapore's PUB have been the Marubeni Corporation and Meiden Singapore. The large European suppliers include Cogalex and ABB Singapore Pvt. Ltd.

The technical and management consulting firm of Arthur D. Little (U.S.) is providing assistance to the PUB in its privatization. Exhibit 19 displays an overview of the power generation and engineering, procurement, and contracting company market for Singapore during the 1990-1991 period. As this exhibit shows, U.S. firms have not been very active in the Singapore equipment market.

In the case of technical and management services, the competition from Singapore PUB's own subsidiary, the Power Plant Consultancy Division, can be formidable. This firm provides electrical engineering services, design engineering, contracting and supervisory

services for Singapore's power industry. However, specialized services such as integrated resource planning, organizational and regulatory analysis, and demand-side management are still insufficient locally.



Market Entry Strategy

Most U.S. vendors have been exposed to the Singapore market at some level. Singapore's PUB is a sophisticated client that places high value on technical reliability and customer service attributes in potential equipment suppliers. Power generation items not manufactured locally may be imported duty free; however, the government has slated power turbines, transformers, distribution equipment, and circuit breakers for local manufacture. Singapore

Singapore

Exhibit 19
Selected Power Sector Projects in Singapore

Equipment	Project Date	Major Supplier	Country of Origin	Approx. Project Value
Oil-free turbo compressors for Senoko Waste/Energy plant	1991	CompAir Broom Wade (subcontract from Mitsubishi Heavy Industries)	United Kingdom	n.a.
Natural gas fuel supply engineering works	1991	Osaka Gas Engineering	Japan	\$3 million consulting fee and \$23.1 million construction cost
Privatization consulting services to Singapore PUB	1991-1992	Arthur D. Little, Inc., DBS Bank, Khattar Wong & Partners	U.S. Singapore	n.a.
3x250 MW reheat boilers for gas and oil firing for PUB Pulau Seraya Power Plant Stage 2	1992-1995	not yet determined	n.a.	\$500 million
3x250 MW reheat steam turbine generators for PUB Pulau Seraya Power Plant Stage 3	1994-1997	not yet determined	n.a.	\$550 million

Source: Based on data compilation from trade literature, June 1992.

Singapore

PUB's projects are conducted on an international competitive bid basis, with preferential treatment given to bids using local manufacturers of ancillary equipment.

The common practice among most foreign equipment suppliers in Singapore is to build contacts and set up joint venture agreements with local distributing agents or, if the market is large enough, set up a branch office in Singapore. New products or model upgrades must first be marketed through local distributors, who are usually well informed about the current preferences of the Singapore PUB. Technical consulting services offer good potential for U.S. firms, as the U.S. is widely regarded as the leader in natural gas-fired generation and regulatory issues.

Exhibit 20 Singapore Market Entry Strategy

Short-term	<ul style="list-style-type: none">▶ Actively seek Singapore PUB steam boiler and turbine projects. Bidding procedures for the Pulau Seraya plant are on-going. Other end-users include the Public Works Department, Port of Singapore, and the Jurong Town Corporation.▶ Contact relevant local equipment makers and Japanese trading companies active in power sector projects.▶ Work closely with the PUB for technical and management consulting work. Price is an important variable.
Long-term	<ul style="list-style-type: none">▶ Pursue joint venture and technology transfer possibilities with Singapore equipment firms, especially in dual oil/gas systems technology. The Singapore government stresses the need to develop indigenous power equipment industries geared for re-export.

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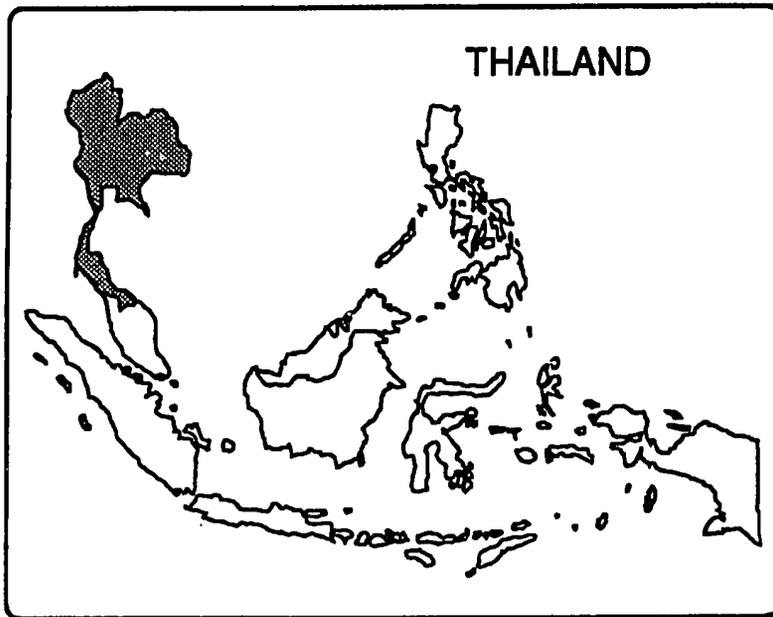
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Thailand

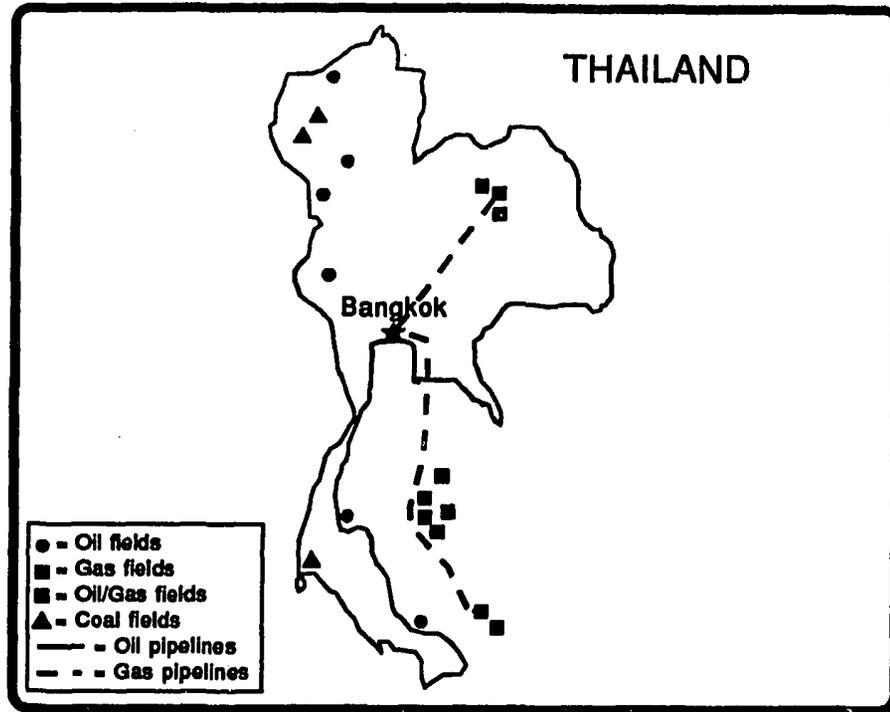
Thailand is in the midst of an unprecedented economic boom. Its 7.5 percent real GDP growth during 1991, driven chiefly by a strong manufacturing sector, suggests continued growth in electricity demand. Thailand's electricity supply system offers tremendous scope for additions and efficiency improvements. Despite the estimated \$34 billion needed to upgrade the electricity sector's infrastructure through 2000, the Electricity Generating Authority of Thailand (EGAT), the large state-owned utility, is confident that it can meet these formidable capital requirements from internal resources, international development banks, and the emerging private power development community.

The Thai market for power supply equipment and design engineering services will be approximately \$4.2 billion through 1996. Almost 90 percent (\$3.8 billion) of this market will be for imports. The U.S. could realize nearly 15 percent of this market, or about \$567 million, over the same period. To gain this share, U.S. firms must aggressively track build-own-lease projects sponsored by EGAT and cogeneration opportunities with industry.

Power Sector Overview

The Thai government has made explicit commitments to improve the country's infrastructure and to maintain its momentum toward becoming a newly industrializing country (NIC). Expanding the electric power system is one of the government's priorities. In addition, Thailand has recently initiated an electricity conservation program in the residential, commercial, and industrial sectors. Finally, the government aims to adjust energy prices to better reflect production costs and to promote competition in the energy market.

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Although Thailand's oil production is small at present, its natural gas production is substantial. Its 1990 production of 0.63 trillion cubic feet (tcf) is anticipated to double by 1996, and its proven reserves are estimated at almost 19.4 tcf. About 95 percent of Thailand's gas comes from an off-shore concession in the Gulf of Thailand. This concession was developed by Union Oil Company of California (UNOCAL). The remaining 5 percent is produced by Shell Oil on-shore at Sirikit in the north.

Thailand has very rapidly increased its use of domestic natural gas in the power sector by converting some of its existing oil-fired plants, and has plans to install gas-fired combined-cycle plants. The government has also promoted natural gas use in the industrial sector. However, there is considerable uncertainty regarding the future expansion of domestic gas supplies to EGAT, as the output from on-shore fields is expected to level off after the year 2000.

Thailand's total proven lignite reserves are estimated at 1,017 million tons. Lignite production in 1990 reached 12.5 million tons and is expected to increase to 36 million tons by 2001. Most of the nation's coal/lignite resources are in the Mae Moh basin in the north.

Thailand

Hydroelectric power projects accounted for approximately a quarter of Thailand's total electricity consumption during 1990. Its current hydropower potential is estimated to be around 10,500 MW; of this, only about 2,400 MW of capacity are currently installed and 516 MW are under construction.¹

The power generation sector of Thailand consists of three state-owned enterprises. A single state-run utility, EGAT, dominates the power sector. It was formed in 1969 to rationalize and consolidate three formerly independent regional state enterprises, and comes under the jurisdiction of the Office of the Prime Minister. EGAT is responsible for generation and transmission, and sells bulk power to the other smaller utility systems and large industrial customers. One of Thailand's most respected government enterprises and one of Asia's most efficient utility systems, EGAT also enjoys a favorable reputation with the international development banks and can secure loans for investment at favorable rates.

The Metropolitan Electricity Authority (MEA), established in 1958, is a state-owned enterprise under the jurisdiction of the Ministry of Interior. It distributes retail electricity to customers in the Bangkok area and to the neighboring provinces of Nonthaburi and Samut Prakarn. MEA supplies over 1.3 million customers (about 13 percent of Thailand's population) in the country's major industrial region. It is also responsible for the construction of substations, sub-transmission lines, and other facilities necessary to carry out its distribution function.

The Provincial Electricity Authority (PEA) was established in 1960 and is also under the jurisdiction of the Ministry of Interior. It distributes electricity to 6.6 million customers who are outside MEA's service territory (MEA thus covers about 99 percent of Thailand's total land area). Although 95 percent of its customers are residential, PEA is increasingly marketing to commercial and light industrial customers. It is also responsible for the implementation of the Thai rural electrification program.

Current Situation

Political instability has plagued Thailand since the military coup in early 1991. Recently, King Bhumipol has intervened to prevent a further deterioration of political authority and its impact on tourism, Thailand's largest single source of foreign exchange (tourism accounted

¹ This estimate excludes the hydroelectric potential of the Mekong and the Salween River basin. The Mekong River, bordering Laos, offers an estimated hydro potential of nearly 20,000 MW. No information is available on the Salween River basin potential.

Thailand

for 5 percent of Thailand's GDP in 1990/1991). General election have now been set for September 1992.

A stated objective of the Thai government is to gradually relinquish its control of EGAT and permit greater participation by private power developers. This would allow EGAT to finance construction projects through international capital markets. EGAT is already reorganizing itself according to the government's regional building program: its northern region contains the Mae Moh lignite power plant and deposit; the central region encompasses Bangkok, the country's largest load center; and the southern and eastern regions contain much of the nation's new combined-cycle power plant capacity.

In 1991, Thailand's 114 generating units had an installed capacity of 9,610 MW. Its power generation fuel mix was 50 percent thermal (primarily gas-fired), 25 percent hydroelectric, 24 percent gas turbines/combined cycles, and about 1 percent diesel. Thailand imports most of its oil and some coal to meet its power sector needs. Cogeneration provides a further 400 MW of electric power, primarily to Thai industry. At present, EGAT does not purchase any power from these cogenerators, who are small and often produce just enough power for themselves. Further, EGAT does not have an established mechanism for power purchases. However, this situation is changing: Thai Olefins, a large downstream petrochemical concern, is planning a cogeneration venture that will sell excess power to EGAT.

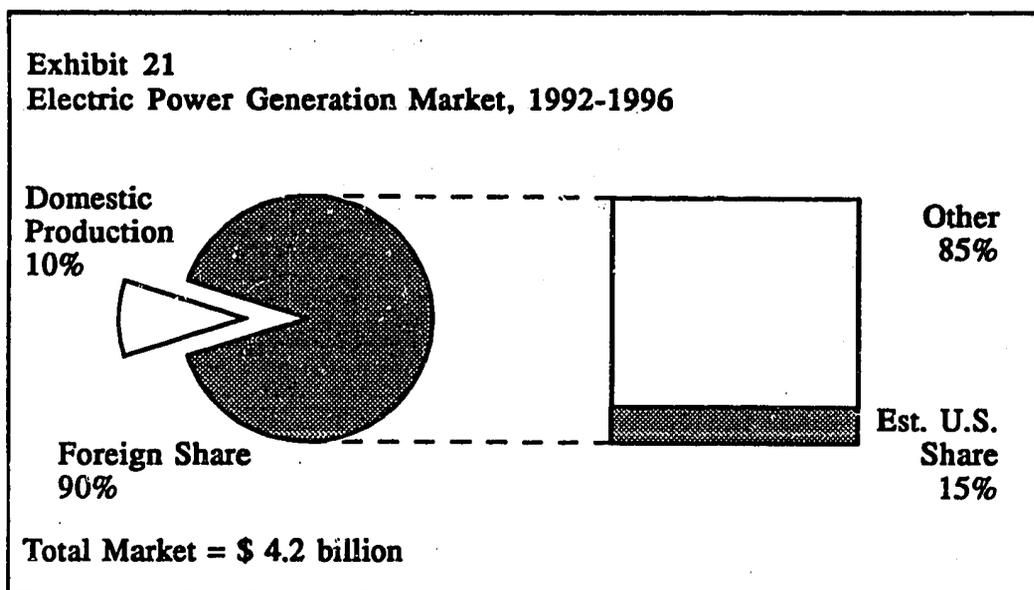
Electricity demand continues to show strong growth in Thailand, fluctuating from a low of 5 percent to a high of almost 20 percent in the last decade, depending closely on economic growth and energy prices. Per capita electricity demand has jumped dramatically over the past thirty years, with per capita sales increasing from 19 kWh in 1961 to 681 kWh in 1990. During 1990, industrial electricity consumption increased by almost 17 percent over 1989, the largest single increase in the last 12 years. Demand growth for 1991 was 10 percent. EGAT expects to struggle in order to keep pace with this situation; its reserve margin has sometimes been as low as 6 to 10 percent, compared to a target reserve margin of at least 16 percent. Power demand in Thailand is expected to grow by 10 percent from 1992-1996, and 8 percent from 1996-2000.

Non-utility generation is expected to play an important role in the Thai power market over the next ten years. EGAT has set aside about 1,750 MW of natural gas-fired and coal capacity for private power development in its latest expansion plan. The first phase of the 2,800 MW Ao Phai project has been slated for development by the private sector. This phase will consist of a 2x700 MW installation to be commissioned by 1997. The remaining capacity will be natural gas-fired, and will be built by industrial cogenerators who will sell excess power directly to EGAT.

Environmental concerns over air quality, hydro reservoir engineering, and the relocation of communities are rising and, together with capital availability, will constitute the major constraints to electricity supply expansion. The World Bank, Asian Development Bank, and Japan Overseas Development Agency (ODA) are investigating air quality in urban areas and water reservoir quality. In the power sector, the main opposition from environmental groups is towards hydro development (e.g., the Pak Mun hydro project), not the government's ambitious lignite program. However, lignite consumption is expected to grow to 27 million tons by the year 2000 in the power sector alone, and imported coal supply may rise from less than 1 million tons in 1990 to almost 25 million tons by 2010.

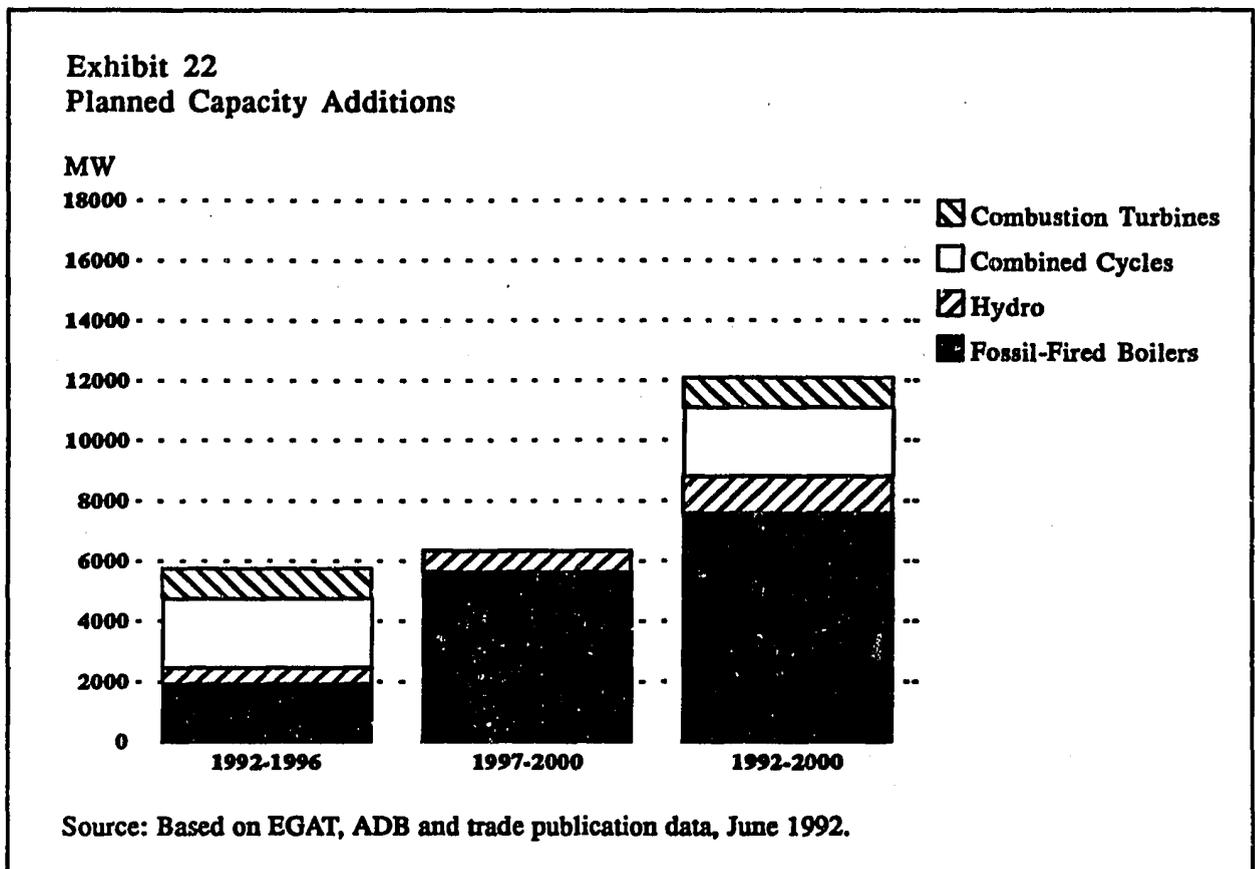
Power Sector Market Assessment

Through 1996, the Thai market for power supply equipment and design engineering services is estimated at around \$4.2 billion; imports will supply almost 90 percent of this market, at a total value of \$3.8 billion. In 1990, Japan captured the lion's share (44 percent) of the Thai import market for power generation equipment, followed by France (18 percent), the U.S. (9.6 percent), Canada (8.6 percent), and Belgium (7.5 percent). Because of Japanese domination, the U.S. could take a 15 percent share of the equipment and services market through 1996, with an estimated value of \$567 million (Exhibit 21).



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EGAT is slowly building its way out of the reserve margin squeeze brought on by tremendous demand growth over the last decade. In 1991/92 alone, EGAT has installed about 1,000 MW of simple cycle combustion turbines and 600 MW of lignite-fired boiler capacity. An aggressive building program is planned, concentrating on natural gas-fired combined cycle plants for the 1992-1996 period, and coal and hydroelectric capacity during the 1997-2000 period (Exhibit 22).



During the 1992-1996 period, over 5,755 MW of capacity will be added. Forty percent of these additions will be natural gas-fired combined cycle power plants (2,289 MW), 34 percent fossil-fueled boilers (1,950 MW), 9 percent hydro (516 MW), and 17 percent combustion turbines (1,000 MW). The pattern of additions for 1997-2000 will be

quite different. About 89 percent of the 6,336 MW of new capacity will be coal- and coal/lignite-fired boilers, with hydro comprising the remaining capacity additions.

Most of the prime movers (thermal and hydroelectric units) for these projects will be imported. This procurement trend is not expected to change in the near future. Although Thailand manufactures small diesel sets for back-up power purposes and provides design engineering and construction services, it does not yet have full-fledged indigenous utility-grade manufacturing capability.

The power generation and engineering, procurement and contracting company (EPC) market in Thailand is characterized by a range of diverse players (Exhibit 23). The U.S. Department of Commerce reports that U.S. power generation, transmission and EPC services enjoy a superior reputation among Thai industry.²

Because EGAT faces some constraints in raising public debt for power expansion, it favors suppliers who can provide export credits and bring private capital to a project. Such U.S. firms such as General Electric have teamed up with Mitsubishi Heavy Industries under Mitsui & Co.'s prime contract for the Nam Phong combined-cycle project to serve the metro Bangkok area. This mode of operation is often successful when the U.S. cannot arrange supplier credits to the same extent as Japanese and European companies. Further, the U.S. Export-Import Bank has targeted Thailand's electric power sector for its soft loan "war chest" financing.

EGAT's natural gas-fired projects are being implemented rapidly. GE-Power Generation (U.S.) is supplying the turbines for the 300 MW, \$790 million Nam Phong power station, which is receiving loans from the Asian Development Bank (ADB) and financing from the U.S. and Japanese Export-Import banks. In addition, the French government provided soft loans and financing for the fourth phase of the Rayong combined-cycle power plant in South Bangkok. The gas turbine equipment was supplied by GEC-Alsthom, which had also supplied equipment for the first three stages of the Rayong power plant. Other key contractors include Marubeni Trading Co. (Japan), Cockerill Merrill Industries (Belgium) and Merlin Gerrin (U.K.).

Thailand has received a constant flow of ADB funds for its power sector. The ADB is currently providing \$109 million and additional technical assistance for the 7th Power

² The Department reports that for 1991, Thailand presented a \$795 million market for power generation equipment. This analysis was based primarily on import/export statistics from the Thai Customs Department and Department of Business Economics.

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Exhibit 23
Selected Power Sector Projects in Thailand

Equipment	Project Date	Major Supplier	Country of Origin	Approx. Project Value
Lignite-fired Mae Kham 300 MW power plant	n.a.	n.a.	Thailand	\$600 million
Coal-fired Ao Phai 1,400 MW plant (long-term: 2,800 MW)	1994-1998	Bids being sought	Thailand	\$3.5 billion
Two GE MS9001E 121 MW gas turbines and one 113 MW steam turbine generator for Nam Phong 355 MW combined-cycle power plant	1991-1994	Mitsui & Co. (prime), Mitsubishi, General Electric	Japan U.S.	\$790 million (GE \$50 million)
Pak Mun 4x34 MW hydro project	1992-1996	Italy-Thai consortium (Vianini Thai), Voest-Alpine	Thailand Italy Austria	\$264 million
Two PGT25-powered gas compression packages for Bongkot plant (2x23 MW)	1992-1993	Nuovo Pignone (ADB financed)	Italy	n.a.
Four MS9001E gas turbines, two TS9001E gas turbines, and heat recovery boilers for Rayong combined-cycle plant	1991-1995	GEC-Alsthom, Marubeni, CMI, Merlin Gerrin	France U.K./ Belgium	n.a.
Bang Pakong 800 MW combined-cycle power plant	1991-1993	Siemens, Black & Veatch, Deutsche Babcock AG, CMI	Germany U.S., U.K./ Belgium	n.a.
Bhumipol hydro plant refurbishing and generator uprating	1991-1993	Elin Energieversorgung GmbH	Austria	est.\$10 million

Source: Based on data compilation from trade literature, June 1992.

Project (substation and distribution) for Bangkok, Nonthaburi and adjoining areas. It is also lending \$52 million to the Bongkot power sector gas compression plant.

There is significant pressure from the ADB, World Bank and the Thai government to privatize EGAT and to promote private power project development. The privatization of EGAT is being discussed, but will take several years to accomplish. However, EGAT is interested in financing the construction of power plants through separate subsidiaries for each plant. These plants will then be sold through a public stock offering. The resulting new corporations will own, operate and maintain the power plants. Thailand has targeted for privatization three large plants totalling 2,500 MW in their expansion plan: the 1,232 MW Rayong gas-fired combined cycle turbine, the 600 MW Khanom plant, and the 700 MW Ao Phai coal plant. In all, 4,600 MW of coal- and gas-fired projects that are either built or proposed will follow this development pattern.

The EGAT Power Development Plan (PDP) refers to several thermal and hydro projects slated for development during the 1992 to 2000 planning cycle.³ The thermal development program is very ambitious. The 400 MW Wang Noi gas turbine project is slated for commissioning during March 1995. Further, Thailand's lignite program will be stepped up to accommodate the needs of the 2,400 MW Lampang lignite power scheme. This extensive program involves eight 300 MW units, planned for commissioning between November 2001 and July 2005.

The hydro projects included in the PDP are the 500 MW pumped storage Lam Takhong project (planned for commissioning in October 1997) and the 160 MW Mae Lama Luang project (planned for commissioning in February 1999). Two additional hydro power projects are expected to be commissioned after the year 2000: the 26 MW Mae Taeng (October 2000) and the 300 MW pumped storage Nam Khek (April 2003).

Market Entry Strategy

Thailand offers one of the largest markets in the ASEAN region for power generation equipment and related services. This country is rapidly advancing towards the status of a newly industrializing country, while still retaining large under-developed sectors. Most U.S. steam generating plant equipment makers and turbine generator manufacturers have some exposure to EGAT and the smaller Thai electric utilities.

³ EGAT Power Development Plan (1992-2001), System Planning Department, April 1992.

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The most appropriate entry strategy for the Thai market is to work with the large multi-lateral and bi-lateral development agency projects, and to approach EGAT's private power development program with projects that meet the Thai government's objectives. The multi-lateral development banks offer information on their activities and on international competitive bidding on all projects that have an import component.

EGAT is actively seeking consultants to assist it in privatizing subsidiary companies. The U.S. experience in the regulatory, financial and managerial aspects of such an organizational transition is highly valued by EGAT. U.S. companies must capitalize on this advantage by aggressively marketing their extensive domestic and international experience.

Exhibit 24 Thailand Market Entry Strategy

Short-term	<ul style="list-style-type: none">▶ Actively seek EGAT projects that are likely to be awarded to the private sector.▶ Follow the privatization efforts of EGAT and subsidiaries: finance/management consulting work during transition.▶ Target industrial cogeneration projects, especially those in energy-intensive industries (e.g., cement, steel, petrochemicals).▶ Work closely with U.S. engineering, oil/gas and coal resource exploration and development companies.
Long-term	<ul style="list-style-type: none">▶ Seek joint venture or licensee agreements with Thai manufacturers for the assembly of components and generator sets.

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Conclusions

The economies of the ASEAN member countries are among the strongest in the developing world, with sustained annual growth rates of up to 10 percent. The region's continued urbanization and industrialization will ensure a strong demand for electricity through at least the end of the century.

The market for power generation equipment and related services in ASEAN is both large and robust. For the first half of the 1990s alone, the ASEAN market for power plant equipment is estimated to exceed \$20 billion; about 90 percent of this market will be imported.

Emerging Trends

Five trends have emerged in the ASEAN power sector that will shape future project development in the region:

- A variety of fuel sources for power generation is increasingly available.** The ASEAN region has a number of indigenous fuel resources, including natural gas, coal, geothermal and hydro in addition to oil. The increased availability of natural gas in the power sector, in particular, bodes well for the installation of natural gas-fired steam boilers and turbines. This trend is evidenced by the large share of gas-fired capacity in the region's electric utility expansion plans.

- The region's forward looking energy policies will present new project development opportunities.** Many of the ASEAN economies have allowed domestic capital markets to emerge and have attracted substantial foreign capital to the region. This, combined with progressive privatization and

Conclusions

private power policies, has resulted in a tremendous demand for power and a variety of new options for power project development.

- Environmental concerns are on the rise.** Environmental concerns raised by local and international environmental organizations, in combination with pressure from multi-lateral development banks, are shaping technology selection, project design and location. The expected strengthening of national environmental agencies will make environmental clearances for controversial power projects more difficult to obtain.
- International competition is fierce in the power generation equipment and services markets.** U.S. companies are beginning to face competition from beyond Europe and Japan, with suppliers from India, Brazil, Hong Kong and South Korea entering the ASEAN market. Large Japanese trading conglomerates, which are beginning to dominate the equipment supply market, have put together international packages of equipment and services when bidding projects.
- There is an increasing need for high-level management and technical services.** As the ASEAN countries embrace free market principles and begin to deregulate their power industries, new concepts such as privatization and integrated resource planning will offer opportunities for U.S. consulting companies.

Over the next decade, power generation equipment needs will vary within the ASEAN region. Exhibit 25 summarizes the opportunities for different types of prime movers in terms of major market segments. The criteria used to grade the market segments each country represents are based on the relative share of the total electric capacity expansion market in each country:

Concentration	Market Grade
greater than 40%	major: ●
20% to 39%	medium: ⊖
less than 20%	small: ○
not included	none: blank

Conclusions

As Exhibit 25 shows, with the exception of Malaysia, fossil-fired boilers will continue to be the most attractive market in the region, due in large part to past experience with the equipment and the "first cost" mentality among many ASEAN utilities. Thailand and Indonesia will constitute almost 70 percent of all fossil-fired boiler construction activity in ASEAN through 2000. Combined-cycle plants and combustion turbines will account for an increasing share of new capacity additions. Hydro turbines and geothermal power systems will be limited by their site-specific nature. Unlike fossil energy projects, hydro projects must be developed as packaged projects, including hydro resource development. Diesel generators represent the smallest share of the market and local manufacturing capability will limit the extent of imports. The success of U.S. companies in entering or expanding their share in all of these equipment markets will depend heavily on their access to project financing.

Exhibit 25
Summary of Power Equipment Opportunities

Equipment Market Segment	Indonesia	Malaysia	Philippines	Singapore	Thailand
Fossil-fired boiler	●	○	●	●	●
Combined cycle plants	⊖	●	○	○	⊖
Combustion turbines	○	⊖	○		○
Hydro turbine	⊖	⊖	○		○
Geothermal unit	○		⊖		
Diesel generator	○		○		

New opportunities are also emerging in the area of power sector services. Exhibit 26 summarizes the opportunities for different types of services in ASEAN. U.S. energy, procurement, and contracting companies have been successful in competing in the ASEAN market, even when most equipment comes from foreign suppliers. U.S. firms are very competitive in the "higher end" services, particularly those requiring sophisticated engineering techniques and computer modeling.

Conclusions

Several of the ASEAN countries appear interested in demand-side management and integrated resource planning. Finally, U.S. consultants have been called upon to advise ASEAN governments and utilities in regulatory reform, pricing, and privatization work. The outlook for these services in ASEAN is promising.

Exhibit 26
Summary Power Sector Services Opportunities

Power Plant Project Services	Competitiveness	Comments
Feasibility Studies	low*	Local expertise is often adequate
Design Engineering	low	Local expertise is often adequate
Detailed Engineering	high	U.S. computer-aided design and manufacturing advantage
Procurement and Construction	high	U.S firms have extensive experience and software tools to keep track of procurement logistics
Testing and Commissioning	high	Extensive U.S. experience with high technology
Regulatory Framework	high	Unique U.S. experience is strategic advantage
Integrated Resource Planning	high	Extensive U.S. utility experience is strategic advantage
Demand-Side Management Programs	high	Extensive U.S. utility and regulatory experience is strategic advantage

* Funding for pre-feasibility and feasibility studies often comes from bilateral donors such as USAID, where foreign involvement from donor countries is required.

Conclusions

Business Development in ASEAN

Doing business in the ASEAN power sector requires a corporate strategy that is tailored to a company's market niche. However, there are some basic steps that are common to all U.S. companies wishing to enter the market or expand their market share:

- Developing a corporate international strategy.** The strategy should include assessments of the company's overall objectives and those of a particular business unit with respect to the ASEAN region. This step also includes screening and ranking ASEAN markets, and assessing local and international competition, economic and political risks, and the costs associated with developing business in the region (e.g., traveling, hiring local consultants, setting up an office).
- Identifying business opportunities.** The firm will need to research the market in order to identify opportunities and quantify the size of the market for the specific types of equipment or services the company offers. Much information on the ASEAN market is available from a wide variety of sources including the U.S. Department of Commerce, U.S. Agency for International Development, private organizations, and U.S. chambers of commerce within the ASEAN countries.
- Assessing specific leads and business opportunities.** The opportunities identified need to be investigated to determine the likely success or "hit" rate for the firm. This will involve profiling the client or decision maker, such as the utility, to determine past procurement trends, and analyzing target projects in terms of expected sources of financing, anticipated competition, and other factors that will influence the final decision.
- Preparing preliminary bids.** Most power sector projects are competitively bid. The firm will be responding to project solicitations that will include some information on the project. The preliminary bid will often serve to pre-qualify firms for the actual bid. At present, most projects in ASEAN are going to international consortia where projects are bid on a turnkey basis. This will involve affiliating with a consortium, which will often be multinational in character.

Conclusions

- **Bidding for ASEAN projects.** The actual bid comes after a long and thorough evaluation of the project. The actual project bid might come a year or more after the project opportunity was first identified. Since this is the most expensive part of the process, the firm should feel confident that it has a high degree of likelihood of success. It is also a point where bidders, which might have otherwise competed for the job, form alliances.

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