A Walk on the Demand Side: Thailand Launches Its Energy Efficiency Initiatives

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Installed generating capacity in Thailand is expected to triple over the next fifteen years, from 9,600 to more than 30,000 megawatts. The expansion of the power sector will be Thailand's largest infrastructure project and will strain the utilities' technical capabilities and borrowing capacity.

Recognizing the severe impact of such unchecked growth in power demand, the Thai government in late 1991 became the first Asian country to adopt a comprehensive demand side management plan for the power sector. The five-year plan calls for US$183 million of utility spending to save an estimated 225 megawatts at the peak period.

Several months later, the Thai legislature approved a law that will establish what may become the largest government-sponsored fund for investment in energy efficiency and renewable energy in the world. The fund will provide selective grants for a range of energy efficiency and renewable energy projects and related environmental activities. The initial allocation to the fund will be in the range of US$50-60 million, and a tax on petroleum products will generate an additional US$50-60 million annually.

This paper describes the energy-efficient technologies called for in the plan and the type of incentives and delivery mechanisms that will be necessary to get them installed. Many of the DSM technologies are not manufactured locally and will have to be imported, at least until a local production capacity can be established.

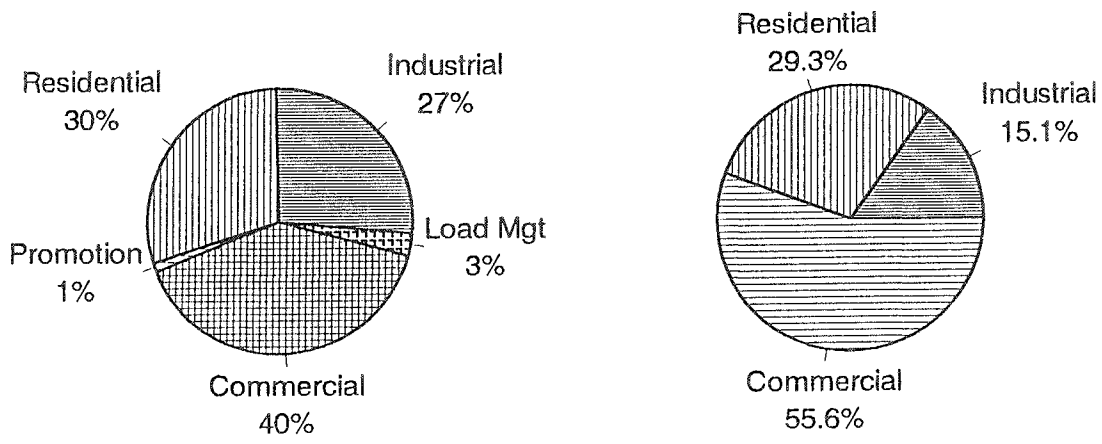
Finally, the paper briefly discusses type of public/private partnerships that may be necessary for the plan to succeed in Thailand.

Thailand's DSM Plan

In November 1991, Thailand became the first Asian country to formally incorporate energy efficiency into its power planning process when it adopted a comprehensive five-year DSM Master Plan. The DSM Master Plan relies on principles and strategies refined during a decade of DSM implementation at the North American utilities. However, all of the technologies and associated costs identified in the Master Plan are based on extensive study of the market situation in Thailand.

The five-year DSM effort will require a budget of US$183 million and save an estimated 225 megawatts (see Figure 1). Although this is a pioneering effort for an Asian utility, the amount represents just a small portion of the US$18 billion that the Electricity Generating Authority of Thailand (EGAT) plans to spend to add 12,000 MW of generating capacity over the next decade. In fact, capital constraints on its power expansion program are one reason that the state-run EGAT stands to benefit from an aggressive DSM program. On average, the DSM options outlined in the five-year Master Plan will provide MW savings at about half the cost of building new capacity.

The 225 MW is only about 4 percent of the projected increase in electric demand over the next five years, and it is just the tip of Thailand's iceberg of efficiency potential. Studies conducted by various Thai agencies and outside consultants of Thailand's electricity end uses have identified an achievable DSM potential of at least 2,000 MW over the next decade (Monenco 1991, Chemiack and du Pont 1991). Including credits for the reserve margin and transmission and distribution losses, this could displace nearly 25 percent of EGAT's planned system expansion at half the cost of new capacity.[1] An aggressive, 10-year DSM effort to save 2,000 MW of peak demand would save EGAT about US$3.9 billion in capital costs for system expansion (Chemiack and du Pont 1991). Table 1 compares the DSM cost savings to other infrastructure expenditures for projects currently undertaken by the Thai government.



Budget = US$ 183 million

Demand Savings = 225 MW
Energy Savings = 1,078 GWh/yr

(Source: Cherniack and du Pont 1991)

Figure 1. Thailand Power Sector: Five-Year DSM Budget and Demand Savings

Table 1. Thailand's Capital Investment Choices. Below are the cost savings accrued by EGAT, government-run utility, for investing in an aggressive 10-year DSM plan. These cost savings are compared to similarly-sized investments that the Thai government is planning for other large infrastructure projects. EGAT plans to add 13,100 MW over the next decade at an approximate cost of US$19.7 billion. The cost of new capacity is US$1,500/kW, while DSM measures for Thailand cost US$800/kW on average.

	10-year achievable DSM potential	= 2,000 MW
	2,000 MW of power plants*	= US$4.5 billion
minus	2,000 MW of DSM	= US$1.6 billion
equals	10-year DSM cost savings	= US$2.9 billion
Other Major Infrastructure Projects		
	2nd Stage Expressway	= US$1.2 billion
	Nationwide sewage treatment	= US$2 billion

*The cost of 2,000 MW of delivered power is calculated based on a 15% reserve margin and 14% power transmission and distribution losses. It is equivalent to 2,817 MW of installed capacity.

Overview of Key Thai Energy Institutions

The agency responsible for setting the direction of Thai energy policy is the National Energy Policy Committee (NEPC), a cabinet-level committee that sets the policies governing fuel and electricity. The operating arm of the NEPC is the National Energy Policy Office (NEPO), which is under the Office of the Prime Minister. The kingdom's three electric utilities are the Electricity Generating Authority of Thailand (EGAT), the Metropolitan Electricity Authority (MEA) and the Provincial Electricity Authority (PEA).

EGAT is a state-owned enterprise that produces virtually all of Thailand's electricity. MEA and PEA distribute electricity provided to them by EGAT. They are state enterprises under the direction of the Ministry of Interior.

The agency charged with taking the lead on energy conservation and renewable energy activities is the Department of Energy Affairs (DEA), which is under the Ministry of Science, Technology and Environment. In summary, NEPC and NEPO develop energy policy and the electric utilities, DEA, and other institutions (e.g. the Petroleum Authority of Thailand) are responsible for implementing those policies.

Establishing the DSM Organization

In November 1991 the NEPC approved a five-year demand side management (DSM) plan submitted jointly by the three Thai utilities. The plan called for the establishment of an inter-utility Demand Side Management Office (DSMO). The DSMO is expected to begin operations before the end of 1992. The operating budget of the DSMO, which includes financial incentives for electric efficiency measures will be an estimated US$183 million over five years. This money will be spent up-front by the utilities and then repaid to them as part of the regular adjustment mechanism for the customer utility rate.

Management and budget authority for the DSMO will come from a DSM Management Committee, which will act as a board of directors and have members from EGAT, MEA, PEA, and DEA and related government agencies. The DSMO will be responsible for carrying out

Table 2. Summary of Proposed DSM Programs

Program	Sites/Units	Target MW	Target GWh/yr	Costs US$10^6	Costs ¢/kWh
New commercial	231	98.0	385.7	36.5	0.8
Commercial lighting					
large buildings	123	12.8	89.5	21.2	3.2
small buildings	153,000	14.2	99.1	14.9	2.0
Industrial motors	130,700	34.2	257.5	48.8	2.2
Residential					
Insulation/AC	12,150	16.4	21.7	12.0	4.9
High-efficiency A/C	17,050	5.4	14.2	4.3	3.6
Refrigerators	545,400	15.8	126.5	13.1	1.2
32-watt lighting	2,053,000	28.7	84.0	19.8	3.1
Other activities				12.0	
Total/Average		225.5	1,078.2	182.6	2.0

the DSM programs. NEPO, acting as staff for the NEPC, will be responsible for overseeing DSM activities and ensuring that they are carried out in a timely and effective manner.

The DSM Office will consist of three major functional areas: Program Design & Delivery, Planning & Evaluation, and Technology Assessment (see Figure 2). Within the Program Design & Delivery Team, there will be a sector manager for the major sectors: industrial, commercial, residential, and agricultural.

The Programs and Technologies

The Thai DSM programs will provide financial incentives for customers to purchase energy-efficient equipment. The utilities will compare the cost of purchasing electricity savings to the cost of building new power plants. Only measures that cost less than the cost of building new generation capacity are included in the programs. The average long-term cost of savings from the DSM program measures is US$0.020/kWh (see Figure 3) (Chemiack and du Pont 1991). When these costs are compared to EGAT's adjusted long-term cost of US$0.062/kWh (see below) to produce new electricity supply, it is clear that the least-cost investment for the utilities is in energy efficiency.

Commercial Sector

Cooling and lighting are the areas of greatest potential for electricity savings in Thai commercial buildings. The savings potential is at least 15 percent for existing buildings and up to 50 percent if energy efficiency measures are designed and incorporated into new construction (Busch 1990). The DSM plan outlines pilot programs for new construction and for retrofit of lighting in existing commercial buildings.

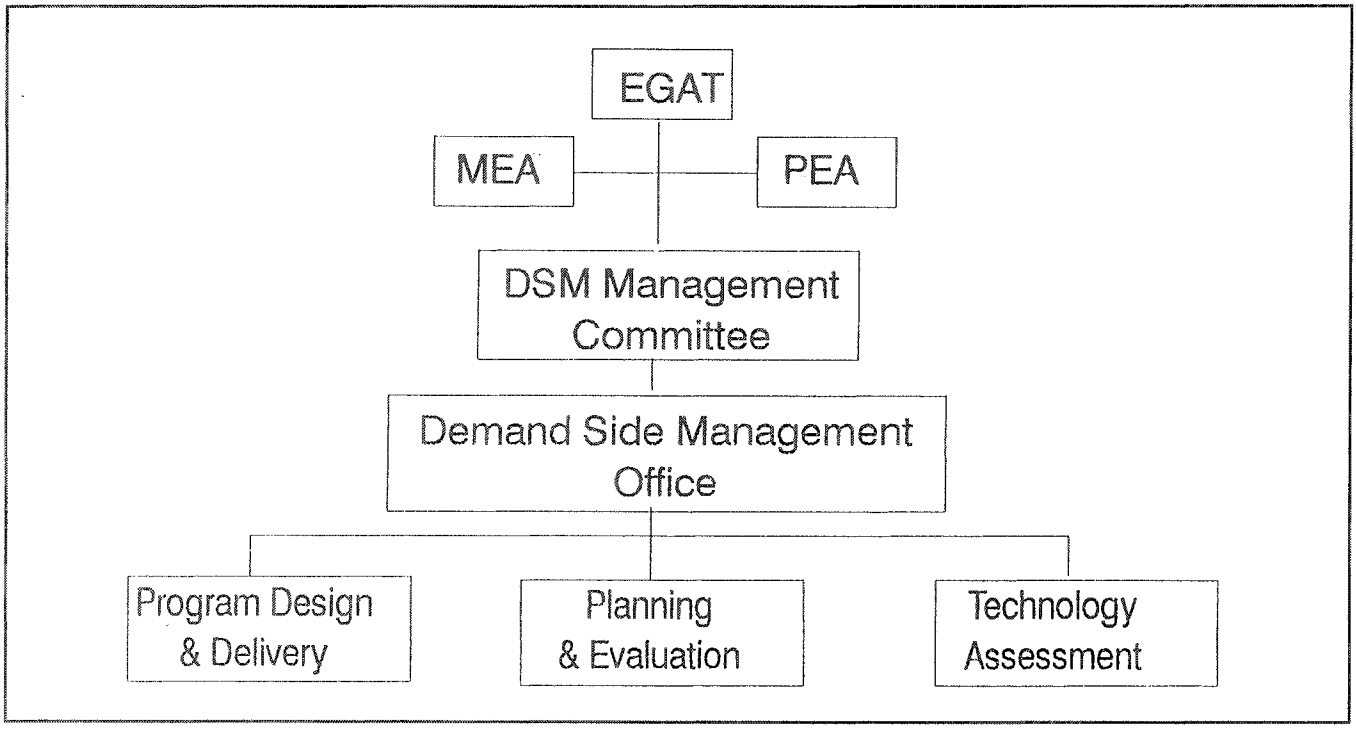


Figure 2. Proposed Structure of Thailand's DSM Office

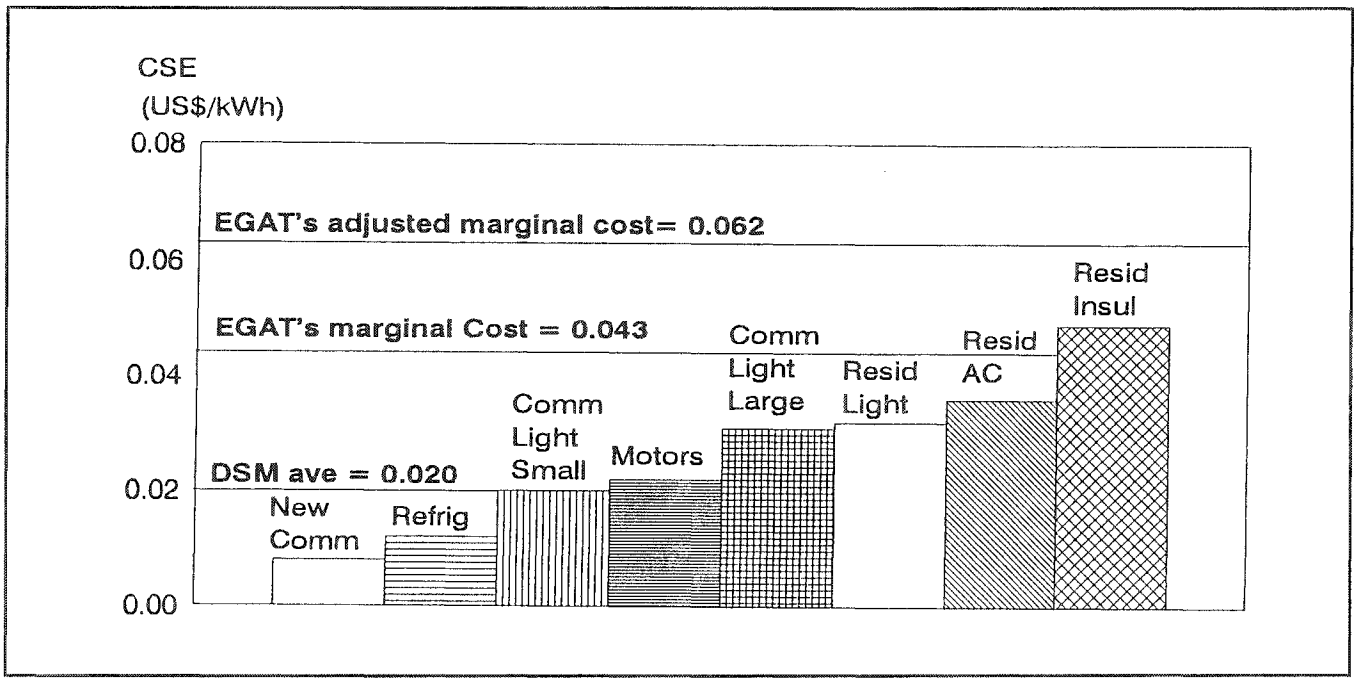


Figure 3. Cost of Saved Energy for Thai DSM Options

The *New Commercial and Institutional Buildings Program* will aim to incorporate the most cost effective DSM measures into the design of new offices, hotels, retail and institutional buildings. The improvements include increased overhangs, improved window glazing, efficient lighting systems, properly sized variable speed drives for fans and pumps, and high-efficiency chillers (see Busch 1990). The DSM Office will pay up to a set fee for design assistance and 50 percent of the cost of energy-efficiency equipment and materials for participating buildings. The five-year program target for this program is 231 buildings and 98 MW. Based on the Busch study (1990), peak demand reductions for prototype commercial buildings range from 237 to 695 kW per building. The size of these prototypes is now considered small by Thai building professionals.

The *Commercial Lighting Retrofit Program* will provide incentives for the owners of large buildings to install electronic ballasts with T-8, 32-Watt fluorescent tubes, efficient lighting fixtures (specular parabolic reflectors), and automatic lighting controls where appropriate. For small, shophouse-type commercial buildings the program will pay for the purchase of 32-watt tubes and efficient T-8 magnetic ballasts. The five-year savings target for small and large buildings is 27 MW.

Industrial Sector

The industrial sector accounts for half of Thailand's electricity demand. Motors use at least 75 percent of the electricity used in factories (ECCT 1991). More complete data need to be collected on the motors market for Thailand, but it is clear that no local manufacturers currently produce "energy-efficient" motors and that imports of efficient motors form a very small percentage of sales. Data from the U.S. motors market indicated that the potential for motors savings is very high -- 2-15 percent for electric induction motors, depending on the motor size (Nadel et al. 1991).

The *High Efficiency Motors Program* will offer financial incentives to factory owners to buy energy-efficient motors when their old motors burn out or need rewinding. The amount of the incentive will depend on the size of the motor and the level of efficiency. The DSM Office will also work to expand the motors program to include adjustable speed drives (ASDs). ASDs can save between 15-50 percent of motor energy and may be used in 40 percent of motor applications. The five-year program target for this program is 130,000 motors and 34.2 peak MW of savings. The savings estimates are conservative and are based on motor change-outs alone; they do not account for

substantial additional savings that can be achieved from other measures such as adjustable speed drives, high-efficiency lubricants and belts, on-off controls, and improved rewinding practices.

The DSM Office will also initiate a program for industrial facility efficiency retrofits. Under this approach, factories will be invited to propose their own DSM projects to the DSM team. The industrial facilities program was not budgeted in the five-year DSM master plan.

Residential Sector

The residential sector accounts for 25 percent of Thailand's overall electricity use. Although the potential for savings in this sector is not as great as in the commercial and industrial sectors, it is still very large. A study commissioned by the International Institute for Energy Conservation estimated that investments in residential DSM measures could avoid the need to build 800 MW of power plants by the year 2001 (Parker 1991). The five-year target for this program is a more modest 66 MW. DSM activities in the residential sector will participate along two related paths: (1) improvements in appliance efficiency and (2) residential rebate programs.

The DSM Office will improve appliance efficiency by setting qualifying efficiency levels for domestic appliances and by offering incentives directly to manufacturers to produce more efficient appliances. The efficiency levels set in for the DSM programs will eventually be translated into mandatory appliance standards by the Department of Energy Affairs. (see section on the Energy Conservation Promotion Act). The DSMO's efforts will be closely coordinated with the standards activities of DEA.

Air conditioning efficiency will be a major focus of the residential programs. More than any end use of electricity, the future increase in air conditioning demand in Thailand's housing will present a special challenge to utility planners. Currently, the saturation of air conditioners is approximately 40 percent for residences in Bangkok and just 3 percent for the rest of the Kingdom, but the fraction of existing households with air conditioning is increasing by 1-2 percent annually (Parker 1991).

The growth of air conditioning in the United States is illustrative. Subsequent to 1950 there was virtually no air conditioning in the U.S. However, by 1990 over 60 percent of U.S. households had air conditioning; the figure was over 90 percent in Florida, which is climatically very similar to Thailand (Parker 1991). Thai utility forecasters can expect that the saturation of air conditioning will continue to expand in all parts of the residential sector, particularly with increasing household income (NEPO 1991A).

The *Insulation and High-Efficiency Air Conditioner Program* will provide rebates to homeowners building new houses with air conditioning. The rebate will cover the incremental cost of purchasing an efficient air conditioner as well as ceiling insulation. (It must be structured so the incentive is paid only for both measures simultaneously.) The insulation will allow the use of a 30-percent smaller air conditioning unit, which will reduce energy use as well. To qualify, the air conditioner must have an energy efficiency ratio (EER) of 10.5 or higher. The five-year target for this program is 12,000 houses.

Rebates will also be available for consumers purchasing air conditioners for existing homes. The DSM Office will pay for the incremental cost of installing an air conditioner with an EER of 10.5 or higher. The five-year target for this program is 17,000 units.

The *High Efficiency Refrigerator Program* will offer incentives directly to manufacturers to produce more efficient units. The incentives will cover the added cost of producing more efficient units. After consultations with IIEC, one Thai refrigerator manufacturer manufactured a prototype refrigerator with 60 mm of cabinet insulation, increased from 35 mm. This prototype is now the most efficient model in its size class in Thailand and uses 25 percent less electricity than the standard model with 35 mm of insulation. The company is retooling its production to begin selling the improved model. The extra insulation should add less than 10 percent to the retail price of the refrigerator (Boonprasert 1992).

The *32-Watt Efficient Lighting Program* will provide a rebate for customers who install high-efficiency 32-watt fluorescent tubes and efficient, low-loss magnetic ballasts for T-8 lamps. The 32-watt lighting system (including tube and low-loss ballast) uses about 30 percent less electricity than a similar 40-watt fluorescent system.

Load Management Activities

The DSM Office will establish a load control project that will assess the potential for peak load control options. By spot metering the major end uses of electricity in up to 70 commercial and institutional buildings in Bangkok, the project will provide the necessary information to assess the potential and techniques for load control. The DSM Office will also conduct building audits in order to

estimate the potential for load management benefits from efficiency improvements in large central air conditioning systems.

In related areas, the DSM Office will: investigate the possibility of using different types of load control technologies such as power line carriers, radio- and telephone-activated controls, and equipment timers; initiate a project to demonstrate thermal energy storage technologies; develop and analyze time-of-day tariffs to support the adoption of thermal energy storage and other load shifting options.

Environmental Benefits of the DSM Master Plan

The tripling of Thailand's generation capacity, from 9,600 MW in 1991 to about more than 30,000 MW in 2006 will impose enormous costs on Thailand's environment in terms of sulfur dioxide, nitrogen oxides, and carbon dioxide (CO_2). Coal and lignite will become much more significant fuel sources in electricity generation: consumption of coal and lignite combined will rise more than ninefold over the next 15 years, accounting for 66 percent of EGAT's generating capacity by 2006 (see Figure 4) (EGAT 1990, EGAT 1992).

Traditionally, the external costs associated with power production have not been accounted for in the tariff structure. These externalities are the result of damage to the environment and human health in Thailand and surrounding regions. The damage is caused by the normal operation of power plants that burn fossil fuels such as gas, coal, and lignite. By not including these externalities in the cost of electricity, power system planners are assigning a value of zero to the environment. Many state and national governments have recognized this fact and begun to add an externality surcharge to the tariff.

In order to properly evaluate the cost-effectiveness of DSM options, the DSM Master Plan has assigned credits for the comparison of DSM measures with supply side power generation options. These credits are 14 percent for transmission & distribution losses, 15 percent for the power reserve margin, and 15 percent for the environmental impact of power generation.

EGAT's long-term avoided cost for new power plants is US$0.043/kWh (NEPO 1991b). After factoring in the credits, EGAT's adjusted avoided cost is US$0.062/kWh. DSM measures will be judged cost effective if they cost less than this number. At present, Thailand has no formal environmental regulations that can influence the choices made by utility planners. One of the stated goals of the DSM Master Plan is to establish an environmental accounting system that will include a method for assessing the environmental benefits of demand side management.

The Thai government has recognized the enormous benefits of DSM savings that displace investments in power plant infrastructure. In its report to the UN Conference on Environment and Development (the "Earth Summit," held in Brazil in June 1992), the government singled out DSM as the single greatest contribution that Thailand can make to reduce the rate of global climate change (TTCGE 1991).

The power sector now accounts for nearly 33 percent of Thailand's total carbon dioxide emissions. It will surpass transportation as the major source of CO_2 emissions in Thailand. In 2001, the power sector will account for 43 percent of Thailand's CO_2 emissions (see Figure 5). By deferring or eliminating the need to build fossil-fuel fired power plants, an aggressive 10-year DSM effort (with a significantly greater commitment of resources than the plan currently being embarked upon by the utilities) has the potential to reduce annual CO_2 emissions from the power sector in the year 2001 by 13 percent.[2] These CO_2 reductions can be achieved at a cost of conserved carbon of about negative US$190/tonne of carbon (du Pont et al. 1992).

Thailand's Energy Conservation Promotion Act

In early 1992, the Thai legislature approved a law that will establish what may become the largest government-sponsored fund for investment in energy efficiency and renewable energy by any nation in the world. The Energy Conservation Promotion Act (the Act) has four main components:

a) Energy conservation in factories. The Act identifies general measures that should be taken by factory owners to reduce energy use. The Act also singles out a category of "controlled factories and buildings." (It is expected that controlled facilities will be defined as having either a peak electric demand exceeding 2,000 kW or annual energy use equivalent to more than 4 million liters of fuel oil (Phandu-fung 1992).) Owners must conduct energy audits of their factories; appoint a full-time energy manager who must be certified by the government (which currently provides training for factory energy managers); keep records on energy production, consumption and conservation; submit said data to the government; set goals and plans for conservation; and submit a conservation plan for review

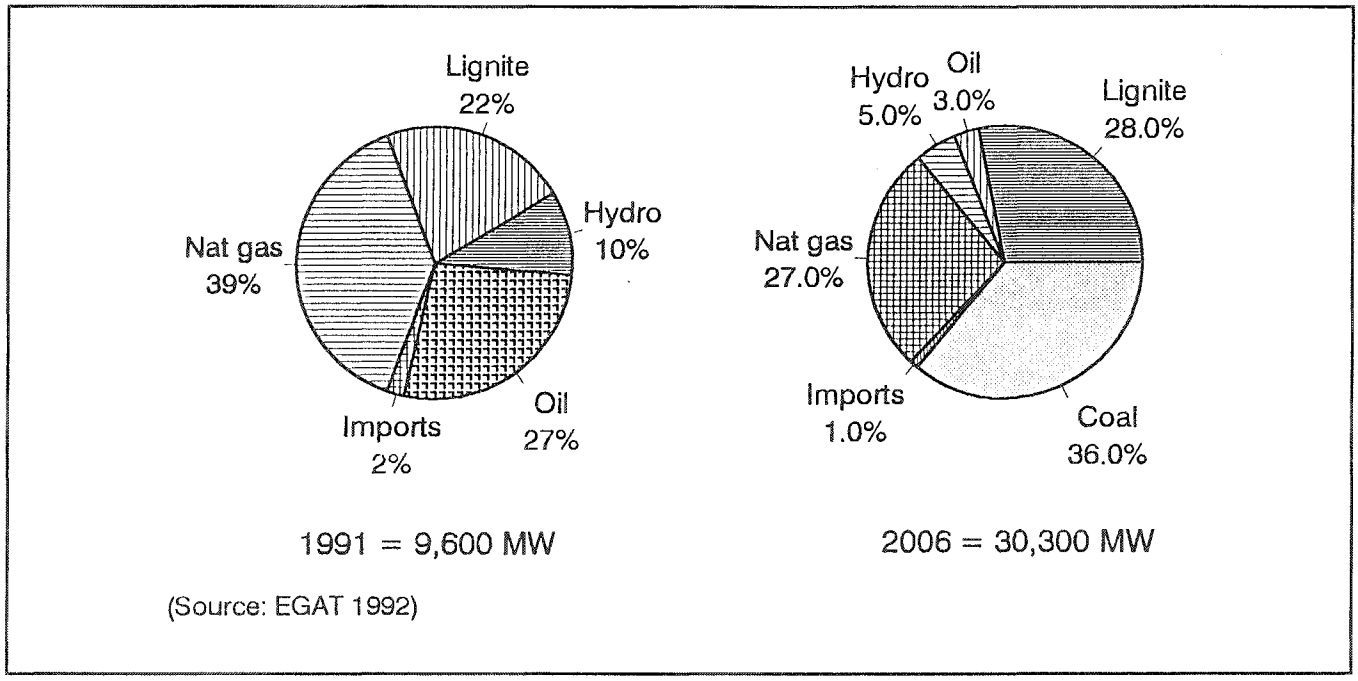


Figure 4. Thailand Electricity Production: Current Output and Forecast by Fuel Type

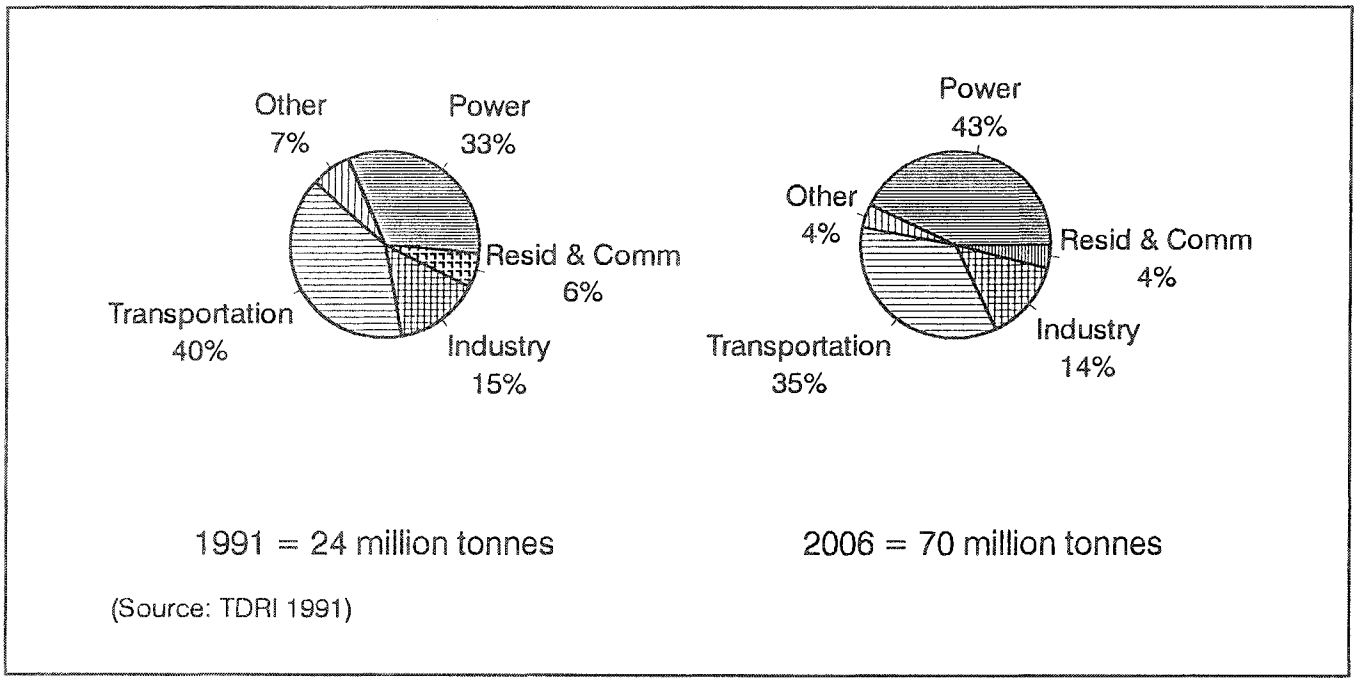


Figure 5. Thailand CO_2 Emissions by Sector: 1991 and 2006

and approval. Factory owners can apply for assistance from the DSM Program and the Energy Conservation Promotion Fund (see below). Three years are given for owners of controlled factories to meet the conservation requirements.

b) **Energy conservation in large buildings.** The Act identifies general measures that should be taken by factory owners to reduce energy use in large commercial and institutional buildings. Owners of controlled buildings must appoint an energy manager who must be certified by the government which also provides training for building energy managers; conduct energy audits of their buildings; keep records on energy consumption and conservation; submit said data to the government; set goals and plans for conservation; and submit a conservation plan to the govemment for review and approval. Building owners can apply for assistance from the DSM program and the Fund. Owners of controlled buildings are given three years to meet the conservation requirements. In addition, the govemment has the authority to issue guidelines on the efficiency of newly constructed buildings. A model energy code has been prepared for new commercial and institutional buildings. The code will be issued on a voluntary compliance basis until institutional capability to certify and enforce code compliance can be developed in the municipal building code inspection agencies. Information materials for building design professionals have been developed, including a software-based compliance checking program.

c) **Efficiency standards for appliances, equipment and materials.** DEA has been authorized to issue regulations governing the minimum efficiency of machinery, equipment, appliances, building materials, control systems and related items. DEA's standard-setting efforts will be closely coordinated with the DSMO's establishment of qualifying efficiency levels for DSM programs. Producers and distributors of high efficiency equipment, appliances and materials can apply for financial and technical assistance from the Energy Conservation Promotion Fund.

d) **Energy Conservation Promotion Fund (the Fund).** The Fund will be set up with money transferred from three sources. The initial allocation for the fund will come from the now-defunct Petroleum Price Stabilization Fund. After the first year, the Fund will be continue to be financed from at least two sources: an annual levy on petroleum and natural gas refinery products, as well as any funds received from the private sector locally, from overseas, and foreign governments or international organizations, including the World Bank and the Asian Development Bank.

Grants will be selectively provided for a range of energy efficiency and renewable energy projects and related environmental activities. Funds may be used for education, promotion, demonstration, monitoring, research and development, policy and planning, and for the administration of the Fund. Funds may be granted to individuals, businesses, non-governmental organizations, government agencies and state enterprises. The initial allocation to the Fund will be in the range of US$50-60 million. Policy makers have discussed a level of 0.07 baht/liter (US$0.011/gallon) for the levy on refinery products. This would result in an annual inflow of capital to the Fund of about US$56 million (Piyasvasti 1992).

Factors Affecting Energy Policy and Implementation

The factors that led to the adoption of the DSM master plan and the Energy Conservation Promotion Act are complex and may not provide clear lessons for other developing countries. It is, however, worth examining the process that led to the adoption of these policies and the institutional relationships between the various Thai energy agencies.

The Thai utilities developed the DSM master plan after being instructed to do so by the National Energy Policy Committee. Perhaps the key factor in the adoption of DSM as a national priority was the strong support of the director of the National Energy Policy Office. Early on, the NEPO director supported the idea of least-cost utility planning. In 1989, the International Institute for Energy Conservation organized a DSM study mission to the U.S. of key Thai utility and energy policy makers. After this mission, the director requested a policy paper on DSM. This eventually led to the director recommending that the NEPC require the Thai utilities to develop a DSM plan.

Perversely, the passage of the Energy Conservation Promotion Act was facilitated by the military-led coup in Thailand in early 1991. The coup leaders appointed an enlightened group of businessmen and technocrats to run the govemment. The new govemment then proceeded to pass policy reforms in many areas related to energy and the environment. The Energy Conservation Act, which had been in draft form for several years, was rewritten, submitted to the legislature, and rushed through committee to ensure its passage before the elections in early 1992.

Under the Act, DEA has the primary responsibility for overseeing the energy conservation activities of controlled buildings and factories, and for issuing an energy code for new buildings and efficiency standards for appliances and equipment. NEPO will form a new division to oversee the

implementation of energy conservation programs, including the Energy Conservation Promotion Fund. In order to avoid overlapping functions, the utilities and the NEPO must develop an institutional mechanism to ensure that the operations of the DSM Office and the Energy Conservation Promotion Fund are closely linked.

Given the huge increase in installed capacity facing EGAT, the five-year DSM plan is just a drop in the bucket. The estimated savings of 225 MW represents just 4 percent of the 5,403 MW that EGAT will build from 1991 to 1996. It also does not approach the scale of savings or effort implied by the 10-year, 2,000 MW savings potential. Although senior management at Thai utilities understands and accepts the principles of DSM, there is typical institutional inertia surrounding the implementation of a project that fundamentally transforms the paradigm of a utility from an energy provider to a provider of energy services. The 225 MW savings target only became a reality after the government minister in charge of energy affairs returned an earlier, 30 MW savings plan complaining that it was not ambitious enough.

Role of the Private Sector

Hundreds of millions of dollars worth of energy-using equipment and related materials are either produced domestically, exported from or imported to Thailand each year. For many appliances and electrical products, the market is growing at a rate of more than 20 percent per year. For example, imports of window and wall air conditioners increased by 163 percent from 1988 to 1990. Imports of lighting fittings increased by 51 percent during the same period. With the establishment of the DSM initiative and the Energy Conservation Promotion Fund, the market share of energy-efficient products is bound to increase. Based on a conservative estimate that efficient products will gain a 10 percent market share by 1994, the estimated market size for energy efficient products will be nearly US$200 million annually (IIEC 1992).

In the lighting industry, which saw sales growth of 25 percent annually from 1988 to 1990, several manufacturers have indicated plans to begin the production of electronic ballasts. Earlier efforts by local distributors to introduce electronic ballasts failed because the market was not ready to accept them. Building owners were not willing to pay 10-15 times more for electronic relative to magnetic ballasts. Two factors now make the economics of producing electronic ballasts more attractive: (1) the DSM program, and perhaps the Energy Conservation Promotion Fund, will provide incentives for the purchase of electronic ballasts; and (2) local manufacture of electronic ballasts could reduce the retail price by more than 50 percent.

Indeed, development of the private sector infrastructure to provide energy-efficiency products and services is perhaps the biggest challenge facing implementers of the DSM plan and the Energy Conservation Promotion Fund. The DSM Master Plan recommends that the utilities rely on private sector firms to market the DSM programs and that, where feasible, the utilities contract with private firms to operate the DSM programs. In addition, the plan stresses the need to establish private-sector advisory groups in each sector to assist the DSM Program Office to provide advice on technologies, incentive levels, manufacturing capabilities, and other aspects of program design.

For some programs, it is expected that the DSM Program Office will purchase energy savings directly from manufacturers, rather than providing rebates to individual consumers at the point of retail sale. In this sense, the DSM Office will closely watch the results of other similar initiatives in Sweden ("innovative procurement") and the U.S. ("Golden Carrot"). The primary candidates for direct purchase of energy savings are the lighting, refrigerator, air-conditioner, and motor manufacturers, because these represent the greatest growth in production and the largest end uses.

In fact, the Golden Carrot (or Golden Mango, as it has been dubbed in the Kingdom) approach can already claim a modest success in Thailand. As described in the earlier section on residential programs, Sanyo (Thailand) has developed, and will soon begin marketing a refrigerator with increased insulation that uses 25 percent less electricity than a comparable standard model (Sanyo 1992). The fact that Sanyo will begin to market the efficient refrigerator without waiting for DSM incentives indicates that there is a large potential to provide incentives for manufacturers to design much more efficient models. For example, IIEC originally suggested to Sanyo that they increase the wall insulation from 35mm to 75mm, rather than just 60mm. This modification would reduce electricity consumption by 48 percent compared to the baseline model (Parker 1991).

The Board of Investment (BoI), a govemment agency that provides investment information and promotional privileges for companies in Thailand's manufacturing and service sectors, can also play a role in the nurture of Thailand's energy-efficiency industry by promoting the domestic manufacture of efficient appliances and electrical

equipment. BoI has granted promotional privileges to 88 firms that manufacture energy-using equipment and related materials. These firms made initial investments of more than US$800 million. The efficiency of most products manufactured and sold in Thailand can easily be increased by 10-20 percent, and in some cases by more than 50 percent (IIEC 1992). Through its various promotional privileges, incentives, and information campaigns the BoI can help to catalyze the development of a strong energy-efficiency industry.

Conclusions

Much of the world's energy community will be closely watching the progress of Thailand's electricity conservation efforts. If the Thai DSM effort is effectively implemented, it could lead to a significant commitment by the other Asian utilities to DSM. (Tenaga Nasional Berhad, the private power utility that serves peninsular Malaysia, is beginning to study the feasibility of implementing DSM schemes.) DSM programs will directly boost the technology sector in Asia and increase economic development in this sector of the economy. This will have a positive multiplier effect throughout the economy.

A major challenge for Thai energy planners and program managers will be to develop the private sector infrastructure necessary to provide the energy-efficiency products and services called for in the DSM plan and the Energy Conservation Promotion Act. Thai industry is healthy and has plenty of investment capital, as witnessed by three successive years of double-digit economic growth from 1989-1991. Public/private partnerships will be an essential strategy if this capital is to be successfully mobilized to develop and strengthen the emerging energy efficiency industry.

Endnotes

1. After accounting for a 15 percent reserve margin and 14 percent transmission and distribution losses, 12,000 MW of power plants translates into 8,520 MW of delivered power. Thus, 2,000 MW of efficiency is about 23.5 percent of the delivered peak power.

2. This is a crude estimate made by assuming that the 10-year achievable DSM potential of 2,000 MW is realized as a cancellation or deferral of power plants spread evenly across all fuel types in EGAT's 10-year power development plan.

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