Compendium:
Asian Energy Efficiency Success Stories

by Peter Rumsey and Ted Flanigan

This Publication was made possible through support provided by the John Merck Fund and the Office of Energy, Environment, and Technology; Center for Environment; Bureau for Global Programs, Field Support and Research; U.S. Agency for International Development (under the terms of Cooperative Agreement No. PCE-5743-A-00-2057-00). The opinions expressed herein are those of the authors and do not necessarily reflect the views of the John Merck Fund or the U.S. Agency for International Development.

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1. Executive Summary

Energy efficiency is a topic of great interest within and of vital importance to Asia. The largest of the continents, Asia is home to half the world’s population. Urbanization, the rise of manufacturing, and the emergence of a new middle class are driving increased energy consumption in many parts of the region. Consider the following:

- Asian energy demand, with an average annual growth rate of 3.5 percent, is increasing at a rate almost twice as fast as the rest of the world.
- Much of the region is dependent on imported fossil fuel, leading many countries to seek to develop “alternative” power sources.
- Growth in Asian electricity demand is especially high, with annual rates of increase ranging from 7 to 15 percent. As electrification progresses in the less developed countries of the region, demand will rise further still.

The need to meet the growing demand for energy in Asia presents a window of opportunity to incorporate efficiency in new appliances, facilities, and energy systems. Energy efficiency can provide numerous benefits to Asian countries, including reduced expenditures for imported fuels, avoided costs of power plant construction, improved air quality, heightened competitiveness of local industry, and increased social equity.

This compendium highlights several of the most notable of Asian energy efficiency “success stories.” Too often, energy efficiency programs from North America and Western Europe are presented to Asian countries as examples of the potential in Asian countries for similar efforts. While these programs are often worthy of examination, our intent in presenting these success stories is to disseminate the lessons learned from these early Asian examples and to catalyze similar efforts throughout the region. This report focuses on six primary types of programs for Asian countries to consider as they advance their plans to promote energy efficiency:

- **Energy conservation centers.** Centers in China, India, Indonesia, Japan, Pakistan, South Korea, and Thailand are profiled. Energy conservation centers are the most common type of energy program in Asia, excluding government information campaigns. The centers examined performed numerous functions, including public education, conducting energy audits, and professional training;
- **Technical assistance/audit programs.** The Philippines Technology Transfer for Energy Management program is examined, which provided technical assistance and financing for energy efficiency investments by industrial and commercial firms;
- **Standards and labeling.** Programs in the Philippines and South Korea are profiled. The South Korean program established efficiency levels and labeling requirements for a variety of appliances and equipment, including electric refrigerators, air conditioners, lighting equipment, and passenger cars. The Philippine program focuses on residential air conditioners;
- **Commercial building codes.** The development and implementation of commercial building codes in the ASEAN countries is examined. The ASEAN codes regulate the energy performance of the building shell, lighting systems, and cooling systems;
- **Industrial energy-use regulations.** The Chinese government program of energy consumption quotas, production standards, investment funds, and technical assistance is assessed. Chinese industrial regulations are among Asia’s most effective energy efficiency programs. However, many elements of the program, developed in the 1980s, need to be redesigned to meet the...
needs of China’s emerging market economy.

- **Utility-driven market transformation.** The Fluorescent Lamp Campaign mounted by the national Electric Generating Authority of Thailand is analyzed. This campaign has successfully encouraged all domestic manufacturers of fluorescent tubes to switch from 40-watt to 36-watt tubes, while also encouraging consumer acceptance through public education and technology demonstrations.

The programs described above demonstrate that innovative and successful energy efficiency initiatives can be found through the Asian continent. Analysis of these success stories yields several conclusions:

- Asian energy policymakers are eager for knowledge on what their neighbors are doing but have had trouble getting up-to-date information.
- Government initiatives are more common than utility initiatives. Government programs can be successful, but tend to be slow and under-funded, and improve baseline conditions rather than pushing the markets at the upper margins of efficiency.
- Many Asian countries have implemented codes, but without a specific and rigorous enforcement mechanism, the programs can be less than effective.
- In theory, energy efficiency standards and codes can be ratcheted upwards, but in practice, such revisions are difficult if not impossible to execute.
- Support from key policymakers or top utility management is critical to program success and sustainability.
- Very competent staff and professionals reside in Asia and are ready and willing to implement efficiency measures.
- The most successful programs are internally funded.
- The challenge for effective foreign assistance is to strategically provide aid to create strong local energy efficiency capabilities.

It is imperative that Asia embrace energy efficiency as soon as possible. Most of Asia is just now erecting many of the buildings and factories that will be used well into the next century. These buildings will represent a huge lost opportunity for energy efficiency if they do not incorporate energy-efficient designs when built. The cost of going back to improve them later, as has been done in the U.S. and Europe, will be several-fold more expensive and difficult to implement.

In the coming years, Asia will develop and refine its own interpretation of how best to promote energy efficiency. This interpretation will be based in part on sharing experiences with neighbors and on solid evaluations of past experiences. The lessons learned from this review lead to a simple set of recommendations for Asian countries:

- Learn from others’ experiences in Asia and elsewhere.
- Get full support from key decision-makers for any programs that are initiated.
- Ensure that the private sector is closely involved.

There is no doubt that energy efficiency represents a huge resource for Asia. The key challenge to tapping this cheap and economically beneficial opportunity is in developing efficiency promotion programs that work, are simple to administer, and are relatively low-cost. If past successes are any indication of future promises, Asia may be well on the path to harvesting the multiple advantages of energy efficiency.
2. Introduction

2.1 Purpose and scope of report

This compendium of Asian success stories is intended to highlight some of the most exemplary energy efficiency case studies from Asia, to acknowledge their import as early examples of what can be done in the region, to celebrate their successes and lessons learned, and to catalyze similar efforts throughout Asia.

Too often energy efficiency programs from North America and Europe are presented to Asian countries as examples of the potential in Asian countries for similar efforts. While these programs are often valid and worthy of examination, Asians rightfully note that Asia is different, that programs cannot simply be transferred from developed countries in the West to developing countries in the East. By focusing on Asia, this report bridges the current information gap and serves a useful tool in planning a viable and least-cost energy future for Asia.

What has worked in Asia? Why have the programs reported on in this review been successful? How could they become more successful? What can other Asian nations take from these case studies to provide direct guidance to their own countries? What models are there in the region that can be easily transferred from one country to another? These are the questions which this report attempts to answer.

The audience for this report need not be restricted to Asia; this report can provide insights to policy makers and energy efficiency enthusiasts worldwide. Just as lessons learned in North America and Europe can support efforts in Asia, Asian models for efficiency can provide valuable insights for North American and European analysts, policy makers, and program planners. The report has also been developed to serve as a guide for multilateral development banks and other funders who are actively supporting or considering supporting energy efficiency initiatives in Asia. By examining the range of programs presented in this report, funders and others may be able to enhance their understanding of the issues surrounding energy efficiency in Asia and how to best address Asian countries’ needs for a sustainable energy future and for the overall well-being of these growing economies.

2.2 Programs for Asian countries to consider

This report serves as an overview of several types of energy efficiency programs that other countries might consider for the residential, commercial, and industrial sectors. (Transportation initiatives are not covered in this report.) The programs presented have been implemented primarily by government agencies. One utility-run demand-side management program is included to highlight a model that has not yet been widely exploited in Asia.

This report focuses on six primary types of programs for Asian countries to consider as they advance their plans to promote energy efficiency: energy conservation centers; technical assistance/audit; standards and labeling; commercial building codes; industrial energy use regulations; and utility-driven market transformation. While not a complete roster of program types, these generic program types serve as a starting point for subsequent initiatives.

- Energy conservation centers

Energy conservation centers are a popular Asian strategy for promoting efficiency. Centers are attractive to funders as they are usually tangible, multi-purpose facilities that hold tremendous potential for training, the dissemination of information to the public, and technology demonstrations; energy efficiency centers can also provide administrative support for services ranging from audits to technical assistance, to product specification, financing for efficiency upgrades, contractor certification, and even turn-key energy services. It is difficult, however, to quantify the positive impacts of energy conservation centers, a situation that can threaten their long-term funding.

- Technical assistance/audit programs

One of the primary barriers to energy efficiency in all sectors is a lack of information about where and how to capture the benefits of energy efficiency. In the highly energy-intensive commercial and industrial sectors, an attractive option to boost efficiency is to provide technical assistance by supporting audits to help large customers identify energy conservation measures and to analyze their efficacy and financial implications. These audits can be used to identify both equipment and process changes, often providing means to decrease the energy intensity of manufacturing which in turn can lead to lowered costs of production, greater profitability, and better competitive positions.

The technical assistance can range from audits to end-use metering to modeling to the performance of post-installation inspections to ensure that upgrades are completed properly and will result in the anticipated returns on investments. Often technical assistance programs focus on projects that can serve as demonstrations for further initiatives, thereby leveraging program dollars and the effect of such investments.
Standards and labeling

A simple and effective strategy for providing guidance to residential consumers in their purchase of household appliances is standards and labeling. (These programs can also be used in the commercial and industrial sectors, for instance for packaged air conditioning and motors.) Standards set a minimum efficiency level that appliance manufacturers must meet in order to sell their wares. Meanwhile, labeling stimulates consumer awareness and encourages manufacturers to exceed the standards. Labeling also encourages manufacturers to use efficiency as a feature of their sales campaigns. In the United States, standards and labeling have been most effectively used for appliances, but also have been used for cars with marked success. Labeling schemes are now being introduced for homes as well.

Commercial building codes

Governments have the opportunity to establish building codes that serve much the same role as standards. They can be used in the residential and commercial sectors to establish baseline efficiency levels. Codes are commonly employed for new construction — to avoid the “lost opportunities” associated with “doing it wrong” the first time, when the cost of efficiency measures is relatively small. However, existing facilities can also be required to comply with the minimum efficiency levels established by building codes. Another program option is to require building owners to meet baseline efficiency levels through building codes at the time of major remodels or when tenants change.

One drawback of codes is that they are difficult to enforce. Without enforcement, a code may be ineffective. Other important issues for policy makers to address in the design of building codes are at what levels to set the codes, whether to make them prescriptive or performance-based, and how to weigh different efficiency opportunities. For instance, codes can set overall efficiency standards, based on energy consumption per square meter of interior floor space; alternatively, codes can assign specific values for window glazings, HVAC systems, lighting systems, and other building components.

Industrial energy-use regulations

There are several options that can be employed to promote or require industrial energy efficiency. Industries can be required to conduct energy audits; they can be required to develop energy-efficiency campaigns and plans; they can be required to cut their energy intensity by a certain quota; and/or they can be required to reduce specific end-use energy consumption during peak periods. Since industrial production is generally energy-intensive, energy regulations can boost industrial productivity and profitability. While the upfront costs of efficiency improvements must be overcome, generally payback periods for industrial energy efficiency investments are short and the long-term benefits of such investments can be profound.

Utility-driven market transformation

Utilities (and government agencies) can use their tremendous purchasing powers to transform markets in a number of ways. Utilities can arrange for the bulk purchase of energy-efficient products, creating an immediate market for those products and thereby encouraging manufacturers to produce them; they can support the development of energy service companies in their service territories; and they can transform markets by educating their customers. Given their size, financial strength, and ability to borrow money and/or recoup costs through their retail electricity rates (not to mention their avoided costs), utilities can employ “market push” and “market pull” strategies. They can push markets by working directly with manufacturers, while pulling the market by working with end-users to create demand for energy-efficient products and services.

Noticeably absent from the roster of case studies presented in this report are the wide range of utility-driven incentive programs that characterize “conventional DSM” from North America. The reason for this is that to date Asian utilities have almost universally not been involved with promoting energy efficiency through “conventional” incentive mechanisms such as consumer rebates. Instead, energy efficiency has been driven largely by government initiatives. As integrated resource planning practices are institutionalized, however, Asian utilities are likely recognize that it is in their financial interest to invest in their customers’ energy efficiency. In fact, the Electricity Generating Authority of Thailand (EGAT), the national generation and transmission utility, has plans for a wide range of DSM programs ranging from collaboratives with manufacturers and government agencies to direct financial incentives, to loans provided to customers through the two major Thai distribution companies.

EGAT’s planned activities represent an exciting potential for Asian utilities. Utilities in North America — facing greater competition — are significantly revising their DSM programs to minimize rate impacts and are ushering in a new wave of what analysts call “third generation” DSM programs. Meanwhile, EGAT seems to be quickly adapting by
using the very best and most current models from North America, tapping a wealth of a decade’s worth of DSM in the United States and Canada.

Other Asian utilities will have the opportunity to follow suit. They can jump-start their DSM efforts by learning from the vast body of North American experience, avoiding the areas that are problematic in an era marked by an ever more competitive power industry.

2.3 **A starting point for efficiency initiatives**

The case studies in this report are presented as a series of examples from which Asian countries (and other developing countries) and their utilities may be able to fashion efficiency initiatives. They represent starting points for analysis and consideration, while the contacts and selected references at the end of the report provide conduits for further research and development. It is the authors’ hope that the compendium provides for optimism and direction that energy efficiency can indeed be tapped and expanded in Asia so that Asian economies can grow in ways that are sustainable from an energy standpoint.

Before getting into the case studies, however, it is important to assess the context in which the programs have been implemented. The following section provides information on selected Asian countries’ economic growth, energy demand growth, and electricity demand growth. The data presented highlight key trends and issues that Asian countries must address — such as a dependence on imported oil and rapidly growing electricity demand, thus underscoring the importance of energy efficiency and the tremendous opportunity it holds to mitigate problems that could occur in its absence.
3. The Asian Energy Context

Given the sheer size of Asia, it is no wonder that its countries are extremely varied in their cultures, economies, and political infrastructures. There is, however, a common denominator among many Asian nations: they are growing rapidly. Asian nations are experiencing growth on many fronts including their economies, population, and urban communities. All of these factors contribute to increased energy consumption, a situation that challenges their ability to provide electric power in a reliable and environmentally acceptable manner.

The data presented herein necessarily focus on a selected subset of Asian nations whose energy efficiency programs are featured in this report. The majority of the Asian countries whose programs are presented are part of the Association of Southeast Asian Nations (ASEAN), including the Philippines, Thailand, Indonesia, Malaysia, and Singapore. Other countries included in the report are Japan, China, South Korea, and Pakistan.

The largest of the continents, Asia is home to half the world’s population. Throughout the region, industrialization, urbanization, and the emergence of a new middle class are driving increased energy consumption.

Asia is the largest continent on Earth, encompassing over half of the world’s population, and composing several distinct regions. By virtue of its enormous population, Asia already consumes a significant share of the world’s energy resources. As these countries continue to modernize their economies, furthering the region’s industrialization and urbanization, Asian energy consumption will continue to grow.

Economic growth and industrialization is also leading to the emergence of a new Asian middle class, which is further stimulating energy consumption. Seeking to emulate their counterparts in the developed world, this segment of the region’s population is seeking and acquiring modern, energy-intensive comforts and conveniences, such as air conditioning and television. Meanwhile, the major cities are rapidly building new office towers and stores, fully furnished with modern equipment, to service this population’s needs.

The new lifestyle in the region’s homes and workplaces is contributing to high demand growth for energy, challenging capital and indigenous energy resources.

Rapid economic growth characterizes the region. Some Asian countries, notably China, use relatively large amounts of energy per unit of GDP, indicating a high level of energy inefficiency, for instance in outdated industrial facilities.

Many Asian countries are developing rapidly. Thailand, Indonesia, and Malaysia, for example, have experienced seven to eight percent annual economic growth from 1980 to 1991. These countries and others have experienced a significant rise in energy use due to increased industrial and commercial

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[1] = GNP/capita * population (for population data see Social Indicators Table)

### SOCIAL INDICATORS

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Energy use per unit of Gross National Product (GNP) provides an important indicator of a country’s economic strength and the effectiveness with which it uses its energy resources. Low energy use per GNP signifies that the energy costs for manufacturing are relatively small, a sign of a rather energy-efficient economy. Such efficiency can increase price competitiveness and can free capital for investment in research and development, quality improvement, and business development. High energy use per GNP can signify that a country’s industry is relatively inefficient, for instance marked by out-of-date factories employing energy-inefficient technologies. Chinese industry, for example, in some cases uses double the amount of energy for each unit of production when compared to identical production in other countries.

**Asian energy demand is increasing at a rate almost twice as fast as the rest of the world. Much of the region is dependent on imported fossil fuel, leading many countries to seek to develop “alternative” power sources.**

Energy demand growth in Asia has averaged approximately 3.5 percent per year for the past seventeen years. In certain areas of Asia the energy growth rate is even higher. For instance, over the past decade (1980-1991) the overall annual energy growth rate was over five percent for China, Malaysia, Pakistan, Singapore, South Korea, and Thailand. World energy demand, in contrast, is rising by only approximately two percent annually. In 1990, 22 percent of world commercial energy production was consumed in the Asia-Pacific region, but if current energy demand growth remains constant, Asia’s share of global energy demand will grow.

Finding sufficient energy resources to meet this growth has been and will continue to be a major challenge for Asian nations. Much of Asia’s continued energy growth will likely be based on fossil fuels. Asia already commands a significant portion of the world’s coal market, accounting for 29 percent of total coal production and 36 percent of consumption. In China and India, coal is the dominant source of energy, providing, in the case of China, roughly 76 percent of the country’s total fuel supply. In the region as a whole, coal-based electricity generation rose from a 7.8 percent share in 1980 to a 24.8 percent share in 1990, as Indonesia, South Korea, the Philippines, China, and Thailand significantly increased their use of coal.

Although the oil shocks of the 1970s encouraged many Asian countries to attempt to diversify their energy sources, much of the region still remains highly dependent on imported oil. Singapore, an island nation with few energy resources, relies entirely on imported oil. Thailand, South Korea, and the Philippines rely on oil imports to meet more than half of their en-
nergy demand. Dependence on imported oil will keep these countries in vulnerable economic positions as they remain exposed to unreliable oil supply and potential price volatility.

While the generation of electricity from domestically-mined coal does not carry the economic risks associated with reliance on oil imports, both sources of power carry potentially serious environmental risks. Fossil fuel-fired power plants jeopardize urban air quality, exacerbate land and water pollution, and will likely increase the effect of global climate change. In the global battle against climate change, energy and environmental analysts predict that changing the fuel mix of Asian energy consumption away from fossil fuels likely will be pivotal to mitigation efforts related to global climate change.

Given the economic and environmental risks associated with oil and coal, many Asian countries have sought to develop “alternative” power sources. The Philippines have developed one of the world’s most impressive geothermal capabilities. South Korea utilizes nuclear energy as a primary energy source, deriving 15 percent of its total energy consumption from this source in 1990. Now Thailand is considering its first nuclear plant. Malaysia has begun to tap its estimated 20,000 MW hydroelectric potential, and the development of hydro resources continues to be a core strategy for countries such as Indonesia and Japan as well. Natural gas is also playing an important role in Asia. Natural gas consumption as a fraction of total energy consumption in Indonesia has increased from 3 percent to 30 percent; Malaysia saw an increase from 12.5 percent to 29 percent. Moreover, as in North America and Europe, inexpensive natural gas is driving a movement toward independent power production in Asia.

**Growth in Asian electricity demand is especially high, with annual rates of increase ranging from 7 to 15 percent. As electrification progresses in the less developed countries of the region, demand will rise further still.**

While Asia is experiencing dramatic overall energy growth, demand for electricity is even more pronounced. For example, Indonesia’s energy consumption growth rate from 1980 to 1991 was 4.8 percent, while its electricity use growth rate, at 15.5 percent, was three times as fast. In Thailand, electricity demand is growing by 10 percent annually. With the exception of the Philippines, all countries in the region had electricity growth rates of over seven percent during the 1980s. These high growth rates can be attributed to increased investments in power generation, transmission, and distribution; rising average income levels; and improved access to electricity, as many of these countries focus on rural electrification initiatives.

Access to electricity in Asia varies widely. Industrialized countries such as Japan, Singapore, and South Korea are virtually 100 percent electrified. Other countries are far from achieving universal access. Indonesia, for example, has only a 28 percent electrification rate. In the Philippines, about 60 percent of the population has access to electricity. As these and other countries in the region aggressively pursue complete electrification, the region’s electricity demand will certainly rise.

### ENERGY USE STATISTICS

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The need to meet the growing demand for energy in Asia presents a window of opportunity to incorporate efficiency in new appliances, facilities, and energy systems.

As Asian countries continue to experience strong economic development, the demand for energy will climb. Reliable and efficient energy systems are vital to meeting this new demand for energy. Such systems will allow countries to fulfill their social and economic agenda by optimizing the countries’ resources while minimizing foreign dependency and environmental degradation. These are fundamental challenges for Asian economies, and together they create an imperative for these countries to invest in energy efficiency as a means of furthering their development and prosperity.

Asian countries also have the opportunity to learn from the mistakes of the Western industrialized countries with regard to fossil fuel dependency, artificially low energy prices, and a retroactive search for energy efficiency programs and strategies. Asia has a window of opportunity to do it right the first time, to marry economic growth with energy efficiency. Asia can create new strategies for long-term energy reliability and efficiency.

Energy efficiency can provide numerous benefits to Asian countries, including reduced expenditures for imported fuels, avoided costs of power plant construction, improved air quality, heightened competitiveness of local industry, and increased social equity.

Energy efficiency can bring a host of benefits to Asian countries. Efficiency not only results in direct economic benefits, such as reduced expenditures for imported fuels and avoided power plant construction, but also engenders important indirect benefits. For instance, reducing end-users’ energy bills can serve to improve the profitability of local businesses and industries, which in turn can bolster employment, creating “economic multipliers.” Energy efficiency, if strategically deployed, can also enhance electric system reliability, a significant factor in encouraging business development and sustaining economic growth.

Energy efficiency is also key to environmental reforms. Countries around the world must reduce their pollution to mitigate the threat of global climate change and acid deposition, while concurrently addressing local and regional air quality issues that in many areas, including Asia, have become acute. In addition to air quality, energy efficiency can address a range of land and water quality issues. Fortunately, efficiency is an environmental strategy that pays for itself over time. Energy-efficient technologies and process improvements can result in highly favorable returns on investments, making efficiency a business investment that can support the bottom line while providing environmental benefits.

Efficiency also has a social dimension. Low-income groups often spend a disproportionate share of their income on energy. By reducing the quantity of energy that these groups consume, efficiency programs can support social equity and the welfare of these citizens. Not only can utility bills be reduced, but housing can become more affordable, jobs more plentiful, and indigenous resources used more judiciously. Taken together, these constitute a path to an economically and socially sustainable society.
4. Exemplary Efficiency Programs

4.1 Tech. Transfer for Energy Management

While industrial energy audits and training sessions form the core of current Department of Energy (DOE) industrial initiatives in the Philippines, there is no question that a pinnacle of industrial energy assistance came towards the end of the past decade, when DOE administered the highly successful Technology Transfer for Energy Management (TTEM) program. TTEM not only provided information and technical assistance for Filipino, foreign, and multinational industrial and commercial establishments in the Philippines, but backed these services with financing at below-market interest rates.

TTEM’s primary purpose was to promote and accelerate the adoption of energy-efficient technologies and operational practices by industrial consumers. Industrial interests are often heavily dependent on fossil fuels and electricity. Curtailing their energy consumption would serve to reduce the flow of dollars spent on imported oil. The program was also intended to enhance the financial sector’s capability to evaluate the technical and economic viability of energy efficiency investments and to develop local expertise on energy-conserving technologies.

The Context

The liability associated with the Philippines dependence on imported oil became pronounced during the global oil crises of the 1970s. The surge in world oil prices caused the country’s oil import costs to grow from $187 million in 1972 to $2.5 billion in 1980, despite a decrease in the volume of imports. (Please note that “$” indicates U.S. dollars throughout this report.) These supply disruptions caused the Philippines to consider how to lessen dependency on imported oil. In order to enhance energy supply reliability, the country sought to broaden its mix of fuels. The Philippines began to focus on domestic oil and coal, hydroelectric, geothermal, bagasse, and agriwastes (including coconut shells, rice husk, woodwastes) resources, as well as “non-conventional” energy sources such as black liquor, biogas, producer gas, solar, and wind.

While these new sources produced nearly 40 percent of the nation’s energy by 1990, economic growth caused oil imports to continue to increase. This occurred in part because of the pronounced fall in oil prices in the last half of the 1980s. This new price signal posed a challenge to the drive toward energy conservation and alternative fuels. It was within this context that the Office of Energy Affairs (OEA), which subsequently became the Department of Energy, began its focus on energy conservation and the TTEM program in particular. During the implementation of the TTEM program, an acute supply-side crisis, resulting in massive power failures and routine six- to twelve-hour blackouts in the nation’s capital, underscored the need for such energy conservation programs.

In May of 1985, TTEM was approved for $4.6 million in funding by the U.S. Agency for International Development (USAID). Half of this money was used to provide information and technical assistance services, the other half for an innovative loan program. The program was coordinated and supported by in-kind assistance from the Bureau of Energy Utilization within OEA, and received substantial input from a Steering Committee composed of representatives from the OEA, the Philippine Central Bank, Department of Budget and Management, Department of Finance, National Economic and Development Administration, and Board of Investments. The private sector was represented by the Philippine Chamber of Commerce and Industry, the Energy Management Association of the Philippines, and the Bankers Association of the Philippines. The program was carried out by a project staff composed of a director, staff engineers, information officers, and an administrative complement. The project also benefited from technical assistance provided by a U.S. firm, Resource Management Associates, which assigned a full-time, on-site project coordinator to oversee and
guide the program. In addition, specialists were brought in as needed from abroad to assist with technical details related to select projects.

Although the Project Agreement with USAID was signed in 1985, the political revolution in the Philippines in 1986 and subsequent government reorganization delayed TTEM’s launch. In February 1987, the first resident consultant for the program arrived from the United States and full project implementation began. The first step was for the Steering Committee to approve a project selection criteria and interest-rate-setting policy for the loan aspect of the program.

**Program Design**

The centerpiece of the four-year TTEM program was the Demonstration Loan Fund, which was established with $2.4 million to finance energy efficiency at below-market interest rates. The fund was intended to demonstrate efficiency technologies and practices not widely used in the Philippines. While all types of industrial and commercial establishments were eligible for the program, recipients of loans had to agree to share their experiences with other industries and to allow for tours of their facilities, thereby allowing their projects to serve as catalysts for similar efforts. By so doing, the demonstration projects addressed two major constraints to implementation of energy efficiency in the Philippines: the lack of reliable information on energy-efficient technologies and the reluctance on the part of management and financiers to provide funding for efficiency upgrades.

The Demonstration Loan Fund began in 1988 and within two and a half years had committed over 95 percent of its resources. Eligible projects could receive a maximum of $200,000 as long as the loan did not exceed 75 percent of the total project cost. Most recipients were large companies.

USAID provided the initial seed money for the program to the Central Bank of the Philippines, which in turn provided the money on an as-needed basis to nine regional banks that were accredited for the program. This arrangement relieved the Central Bank of all collection responsibilities. Moreover, by using its institutionalized credit/debit relationships with the accredited banks, the Central Bank was assured of collecting 100 percent of the funds that it provided.

From the borrower perspective, the program was attractive because projects approved by DOE were eligible for TTEM funding at a maximum interest rate of 14 percent, while market rates were on the order of 18 percent. Moreover, there was a provision that if market rates fell, the Demonstration Loan Fund rates would fall proportionately. Accredited banks lent money for efficiency upgrades to approved customers using loans with five-year terms. These banks were allowed to collect fees for services such as a loan origination, gross receipts tax, and a collateral-short guarantee that could be as high as 3 percent. Thus overall, loans were made with interest rates as high as 24 percent depending on the credit of the loan recipient.

By the end of 1995, all 16 of the program’s outstanding loans will have been repaid. To date, the program has experienced no defaults and all the money has been paid back with interest to government’s Bureau of Treasury, where it was earmarked for subsequent projects.

**Impact Data in Brief**

One of the most important features of the program was its focus on building institutional capabilities for energy efficiency within both the public and private sectors. Within the OEA, staff received technical training domestically and abroad, and a library was created to provide means to track new and appropriate technologies. To support TTEM, a pool of experts from the U.S. and the OEA was developed. Instruments necessary to accurately measure and monitor projects were also purchased, many of which now are being used for other programs. Nearly 1,100 participants attended 25 seminars that were conducted nationwide to familiarize energy users and the financial sector with energy efficiency opportunities. Ten trainees traveled to the United States for intensive training programs. In addition, three brochures were produced on TTEM as well as an audio-visual presentation. Finally, a quarterly newsletter was established.

The TTEM program provided free technical assistance to over 120 companies, including 25 audits, 8 feasibility studies, 16 technical research efforts, and 40 consultancy services. From these activities, TTEM was able to identify about 100 potential projects; thirty demonstrations were carried out, with 16 of these funded using the program’s financial assistance component. Many of the remaining projects identified were financed internally by the companies involved, an example of how the program was able to leverage greater savings.

The Demonstration Loan Fund was a pronounced success, providing capital to 16 projects with an average payback of 2.5 years and an average internal rate of return of 40.7 percent. On an aggregate basis, the 16 projects funded resulted in annual energy savings equivalent to 78,000 barrels of fuel oil worth $2.5 million annually. Though all savings were all converted to barrels of oil equivalent, actual savings were: wood and bagasse — 24,000 megatonnes; coal — 3,750 megatonnes; diesel — 427,300 liters; grade C bunker oil —
1,872,000 liters; LPG — 310,250 kg; and electricity — 10,055 MWh. Electricity demand was also reduced by 2.0 MW and 1.3 MW of cogeneration capacity was created.

Summary/Lessons Learned

TTEM provides a powerful model for subsequent initiatives in both the Philippines and abroad. Several lessons learned may be useful for further initiatives:

• **Move high percentage of program funds into the field.**
  
  Roughly half the money provided by USAID to TTEM was spent on technical assistance, information, and administration (twenty-five staff members were involved in the project). The other half of the money went directly to customers for energy efficiency retrofits. DOE officials suggest that while this ratio may have been appropriate for TTEM as a pilot program, by building on the success of the initial demonstrations, future initiatives may well be able to get an even higher fraction of the capital into the field.

• **Interest rates need only be slightly concessionary.**
  
  Another success of TTEM was the interest rate selected. Generally, financing programs with low interest rates attract the greatest participation. TTEM, however, was designed with only slightly concessionary interest rates. TTEM program designers did not favor low-interest-rate loans for fear that such loans would distort the market and limit the future ability of commercial lenders to make efficiency loans at market rates. Most end-users in the program were pleased with the financing and took the cash at the terms provided. Other projects identified through the program found their own avenues for financing the improvements. DOE officials suggest that the program’s interest rate was not a liability, but instead an asset. Moreover, program staff suggest that the technical assistance aspect of the program, not the financing, was the key to the program’s success.

The success of the pilot program coupled with the fact that the money originally lent has been repaid and is dedicated to future initiatives has encouraged DOE to establish and institutionalize a similar program. To date, however, the program remains unfunded. DOE has had difficulty accessing money from the government, making repeated requests to the Department of Budget Management to appropriate funds for the program. This has underscored an important difficulty with revolving loan mechanisms.

Although the loan aspect of the program pays for itself, the Philippines government hesitates to establish revolving funds. In part, they are leery of the complexity that may arise from the creation of multiple budgets for agencies. This institutional barrier has slowed the program’s progress but has not halted DOE from seeking a mechanism. If DOE prevails, however, it will have to relieve Central Bank of its role administering the revolving fund, a situation that DOE hopes will not diminish the program’s effectiveness.

While funding is no longer available for TTEM, many of its projects continue to serve as models for a range of industrial applications. Projects funded included combustion monitoring and controls, flue gas heat recovery, power factor corrections, insulation for industrial applications, steam system improvements, chiller optimization and controls, cogeneration installations, and process improvements. These projects continue to save money and energy and to serve as valuable demonstrations of the efficacy of energy efficiency to the industrial, technical, and financial communities. Thus they leverage TTEM’s success in the absence of a formal and ongoing program. This form of market transformation was one of the most important goals of the TTEM program and is a clear measure of the program’s success.

4.2 South Korea: Energy Efficiency Management System

For several years, South Korea has run one of Asia’s most aggressive energy conservation programs. In fact, since the mid-1970s, there have been over one hundred separate conservation initiatives across all energy end-use sectors in the country.

The “Energy Efficiency Management System in South Korea - Standards and Labeling” program was started in 1992. The program dictates minimum efficiency standards for a range of energy-consuming technologies including air conditioners, refrigerators, and lighting equipment. (Target efficiency levels were established for passenger vehicles.) The labeling component of the program also covers commercial and industrial equipment such as boilers. Key to the program has been its focus on manufacturers, retailers, and consumers to ensure that energy-efficient equipment is available and properly labeled.

The Standards and Labeling program has achieved remarkable results in a short period of time. Over the past three years, the energy efficiency of common appliances in South Korea has dramatically increased. For example, refrigerators’ energy efficiency have increased by 11 percent, while air conditioners’ efficiency levels have increased by an average of 24 percent. These gains point to the success of the
program in transforming markets of common household appliances to high efficiency equipment.

The Context

South Korea, one of the four “Asian Dragons,” has experienced dramatic economic growth in the past few decades, accompanied by rapid growth of commercial energy consumption. While the rest of the world has increased its annual energy consumption by 2.5 percent, South Korea’s energy consumption has grown by as much as 7.9 percent annually. This growth has been important to the country’s economic development and international trade, but it has damaged South Korea’s environment. South Korea considers the health-threatening pollutant concentrations to be a direct outgrowth of intensive fossil energy consumption. South Korea has identified many policies for addressing these problems, but promoting energy conservation is one of the few that is not only economically attractive but which has also been effective.

Energy conservation has a long history in South Korea. As early as the 1970s, the government implemented energy conservation programs to reduce dependency on imported oil. Financial and tax credits were provided to homeowners and businesses to promote the installation of energy-efficient equipment in the industrial, commercial, and residential sectors. Particular emphasis was placed on identifying new ways to improve energy efficiency. At the time there were no national standards for energy efficiency, nor were there any energy efficiency product labels.

In the 1980s and the early 1990s, the global trend towards developing specific measures to achieve environmentally sound, sustainable growth inspired South Korea to establish a scientific system to monitor and promote energy efficiency throughout the country. In September 1992, the government of South Korea initiated a comprehensive program called, “Energy Efficiency Management System in Korea - Standards and Labeling.” The Ministry of Trade, Industry, and Energy, as authorized by the Rationalization of Energy Utilization Act, sets rules for energy efficiency standards and labels. The South Korea Energy Management Corporation (KEMCO), a public agency, supervises their implementation and enforces these rules. The testing associated with the standards and product compliance is carried out by designated testing laboratories.

Program Design

The energy efficiency regulations implemented by KEMCO can be grouped into three components: Efficiency Standards, the Commercial Efficiency Labeling program, and the Efficiency Rating Labeling program for consumer goods. Together, the elements create both a “market push” and a “market pull.” The standards generate a push, requiring manufacturers to make and sell products that adhere to certain minimum efficiency levels. The labeling generates a pull, educating consumers on the economic benefits of efficient equipment so that they will demand these products from manufacturers.

1. Efficiency Standards Program

The Efficiency Standards Program establishes efficiency levels for electric refrigerators, air conditioners, lighting equipment (incandescent and fluorescent lamps, and ballasts), and passenger cars. The government introduced these levels in two phases. A “minimum efficiency level” was required of manufacturers by the end of 1993. (The minimum level for ballasts was extended to June 1995.) This standard improved the existing efficiency of program products by up to 7 percent. The program’s “target efficiency level” are required to be in place by the end of 1995 (June 30, 1997 for ballasts). This level was established to reduce energy consumption by 10 to 30 percent.

2. Commercial Efficiency Labeling Program

This component requires that labels indicating energy efficiency be placed on many kinds of commercial equipment.
including steel boilers, cast iron boilers, oil heaters, hot water boilers (coal-, oil-, LPG-, and LNG-fired), instantaneous water heaters, lighting equipment, and passenger cars. Importers of foreign products and domestic manufacturers are required to submit designated products for testing by authorized agencies. The test results must be clearly indicated on the product label. Although the labels do not provide information on the relative energy efficiency of a particular product compared to others in its class, the information does allow consumers to compare products.

A product’s energy efficiency also must be explicitly stated in almost all product advertising. This step helps to raise public awareness of energy efficiency in general and makes efficiency an important feature and selling point for all products. Furthermore, labeling encourages manufacturers to increase the efficiency of their products in order to maintain a competitive edge.

3. Efficiency Rating Labeling Program

The final component of South Korea’s energy efficiency standards and labeling program involves labeling consumer goods, specifically refrigerators, air conditioners, lighting equipment, and passenger cars. Under this scheme, all product models are given an efficiency rating on a scale from one to five, with the most efficient products receiving a rating of “one.” Similar to the commercial program component, all products’ energy efficiency ratings must be mentioned in any and all product advertising.

KEMCO manages the energy efficiency rating and labeling. Eight different laboratories and research institutes provide testing services. Domestic manufacturers and importers of foreign products request that a cooperating laboratory test their products. Upon testing the product, the testing laboratory provides the manufacturer or importer with an official efficiency level, which the manufacturer or importer then reports to KEMCO.

KEMCO conducts regular monitoring of efficiency claims. The agency is required to undertake random inspections of factory or marketplace samples up to three times a year. KEMCO verifies that all products covered by the law are labeled and that the labels accurately reflect the product’s energy usage.

Impact Data in Brief

The Standards and Labeling program has achieved impressive results. Studies by KEMCO show that the energy efficiency for products covered has increased, while the overall energy consumption for these products has decreased. KEMCO also found that, as a result of the program, sales of energy-efficient equipment rose in proportion to sales of standard equipment. In part, this reflects the success of the program in raising consumer awareness. As consumers have developed a preference for energy-efficient products, manufacturers have increased the efficiency of their products to capitalize on consumers’ demand for efficient products. The table below shows energy efficiency improvements of selected products resulting from the standards and labeling efforts.

This twin manufacturer/consumer effect — higher-efficiency products available from manufacturers coupled with greater levels of purchases of energy-efficient equipment by consumers — is the key reason standards and labels are such powerful tools for promoting energy efficiency.

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<td>0.2%</td>
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<td>69.4</td>
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</tr>
<tr>
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<td>14.0</td>
<td>0.9%</td>
<td>0.6%</td>
</tr>
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Summary/Lessons Learned

Although the South Korean standards and labeling program is very successful, KEMCO has identified a few areas in which the current standards and labeling effort could be improved. KEMCO staff have recommended that the government conduct cost-benefit analyses of the program’s elements to identify which program features to emphasize. Moreover, staff found that the large number of regulations and the agencies involved in the project makes management rather complicated. Furthermore, staff believes that there are too few testing laboratories, causing delays. Finally, KEMCO found that the current labeling scheme needs some modifications to fully reflect functional differences between products.

4.3 Energy Conservation Centers

Many Asian countries established energy conservation centers (ECCs) in response to growing concerns over energy use, and thus increased interest in energy efficiency, in the 1970s and 1980s. The most notable of these centers is the Energy Conservation Center of Japan. Developing counties in Asia, with the assistance of foreign donors, have aimed to emulate the success of the Japanese center. Among the countries undertaking such efforts are China, India, Indonesia, Pakistan, South Korea, and Thailand. While none of the centers can be regarded as a universal success, each center has elements that have been highly successful. The collective experience warrants a discussion of energy centers as potentially viable energy efficiency strategies. This program summary reviews ECCs in China, Indonesia, Japan, Pakistan, and Thailand.

The ECC is the most common type of energy program in Asia, excluding government information campaigns. The primary reason for this is the relative ease and low cost of establishing such centers. An energy conservation center can be established as a semi-autonomous body overseeing several types of energy conservation activities. ECCs typically carry out several basic functions: educating the public about the benefits of energy conservation; conducting energy audits or feasibility studies for large businesses; and training professionals, such as engineers and plant managers whose work has a direct impact on energy use. As a single unit, ECC activities are easy to track and assess. This arrangement also provides convenient one-stop shopping for energy efficiency services for businesses and the general public. ECCs are also convenient recipients of foreign donor support.

The Context

Reliable and reasonably priced energy is a key component to successful economic development. The countries with the most rapid growth in the region have also been among the most successful in keeping energy supply and prices steady. Energy conservation centers were seen by most of these countries as effective and efficient means to address these twin goals.

The Energy Conservation Center, Japan (ECCJ), the first energy conservation center in Asia, was established in 1978. As a result of ECCJ’s success, donor organizations recognized the potential benefits of these centers. During the 1980s, the Japanese, the World Bank, the U.S. Agency for International Development (USAID), and various European donors provided funding for ECCs in Indonesia, Pakistan, and Thailand. The Beijing Energy Efficiency Center (BECon) was established in 1993 and was funded by the U.S. Department of Energy, the U.S. Environmental Protection Agency, and the World Wildlife Fund. All of these centers were established as either completely autonomous or semi-autonomous from the government. This autonomy has given them significant flexibility, ensuring that their activities would not be hindered by other reforms in the energy sector. This independent framework has also enabled some centers to charge fees for their services, contributing to their financial sustainability.

PROGRAM SUMMARY

| Countries: China, Indonesia, Thailand, Pakistan, and Japan |
| Program: Energy Conservation Centers |
| Mechanism: ECCs formed in the 1970s and 1980s; established by private organizations, multinational cooperatives, governmental agencies; providing promotion of conservation, education & training, business development, technical research, audits, tune-ups, publications; funded by government agencies, non-government organizations, and membership fees |
| Data in Brief: Little quantitative impact data; numerous audits, exhibits, publications, training courses, and "tune-ups" accomplished |
4.3.1 The Beijing Energy Efficiency Center (BECon)

The Beijing Energy Efficiency Center (BECon) was established in 1993 as a non-profit, non-governmental institution whose purpose is “to promote energy-efficiency policies and programs at the national level.” BECon was founded through a cooperative agreement between the Energy Research Institute of the Chinese State Planning Commission, the U.S. Pacific Northwest Laboratory, and the Lawrence Berkeley Laboratory of the U.S. Department of Energy.

BECon has four primary activity areas: 1) policy research; 2) business development; 3) training; and 4) information dissemination. The policy research program addresses large energy policy issues such as integrated resource planning for electric utilities. Most recently, BECon developed an integrated resource plan for Shenzhen City. BECon’s policy program also addresses transportation policy and has conducted extensive research on the Beijing area. The second activity area, business development, is BECon’s most innovative and unique element. It includes market research for private companies (most of which are foreign), consulting services, technology demonstrations, and project financing. These are intended to be income-generating activities for the Center, which in turn are an important part of BECon’s goals for financial sustainability. The Center’s training program targets key areas, the most recent of which is energy efficiency standards. Information dissemination activities of the Center address opportunities for energy efficiency in large industries. Information is provided on efficient boilers, furnaces, fans, and electric motors as well as opportunities for cogeneration.

A relatively new organization, BECon has a small staff of eight professionals. The Center cooperates closely with other Chinese and foreign organizations. For instance, an American expert in energy efficiency recently spent about one year assisting BECon with its start-up activities. The Center has received funding from the U.S. Department of Energy, the U.S. Environmental Protection Agency, and the World Wildlife Fund. In addition, BECon has received income from consulting contracts with foreign companies and organizations. BECon also receives logistical assistance from the Chinese government’s Energy Research Institute.

4.3.2 P.T. Konservasi Energi Abadi (KONEBA)

P.T. Konservasi Energi Abadi (the Indonesian Industrial Energy Conservation Corporation or KONEBA) was established as a quasi-private industrial energy conservation corporation in 1984. Unlike other energy conservation centers, the establishment of KONEBA was initiated by Indonesia’s largest government-owned fertilizer company, PURSI, and was intended to be a profit-making venture.

In 1984, PURSI negotiated a World Bank loan for expansion of its fertilizer business. PURSI added $4.5 million onto the loan request to fund the KONEBA concept. To leverage this loan, PURSI created a five-person board with representatives from four other fertilizer companies. These companies jointly matched the World Bank loan amount, increasing the initial capitalization of KONEBA to $9 million. Once established, PURSI supplied 23 of the initial 25 KONEBA staff members. In retrospect, the capability of the original staff has been questioned. Some analysts believe the staff’s lack of knowledge about energy efficiency was partially responsible for the Center’s difficulty in fulfilling its original mission.

KONEBA was established as an income-generating center that would raise funding to pay back the World Bank loan. With this in mind, KONEBA focused on income-generating services at the expense of more traditional energy center roles such as education, promotion, policy analysis, and training activities. KONEBA instead acted more like a for-profit energy service company, concentrating most of its efforts on large industrial customers with the ability to make energy conservation investments. Typical services offered by KONEBA included energy audits of facilities, detailed engineering designs, and in rare cases, financing complete with shared-savings arrangements.

The original mission came to an abrupt end in 1991. At that time, the Center was far from generating sufficient income to cover its loan repayment installments. As a result, one year before the end of the loan period, the Indonesian government assumed control of KONEBA and its debt obligations.

Failing its original mission, KONEBA was radically transformed and internalized within the Indonesian government. KONEBA is now a department of the national Ministry of Mines and Energy and primarily focuses on serving facilities owned and operated by the Ministry. Recent projects include power plant efficiency improvements, analyses of efficiency potentials of state-owned refineries, and retrofits of the district offices of Indonesia’s generation utility with electronic ballasts. While KONEBA’s original capital budget was $9 million, today the Center requires approximately $500,000 per year to cover its operating costs and to provide institutional energy efficiency services to the Indonesian government.

4.3.3 Energy Conservation Center, Japan (ECCJ)

The Energy Conservation Center, Japan (ECCJ) was established in 1978 with the authorization of the Ministry of International Trade and Industry (MITI). It is one of the oldest
A Compendium of Asian Energy Efficiency Success Stories

and most respected energy centers in Asia. The institutionalization of energy conservation in Japan, however, far predates the Center. Shortly after the Second World War, a series of “Heat Management Regulations” were enacted in Japan in an effort to encourage industry to reduce manufacturing costs. Energy efficiency came to the electric power sector in 1963 when the National Coordination Committee for the Rational Use of Electricity was established. Within this energy-conscious environment, ECCJ enforces and supports Japan’s energy conservation regulations. ECCJ enacts key areas of the regulations, including energy manager certification, public information dissemination, and training.

Services Offered

ECCJ has eight regional offices, with headquarters located in Tokyo. The organization is divided into eight functional departments:

1. **Public relations**: coordinates advertising and special events to raise the public awareness of energy conservation;
2. **Research**: gathers data on emerging efficient technologies and energy-use patterns;
3. **Education and Training**: trains industrial energy managers;
4. **Technical**: provides consulting services on the effective use of waste heat;
5. **International Cooperation**: provides technical assistance to developing country projects through in-country offices and brings foreign nationals to Japan for intensive training sessions;
6. **Publications**: publishes books and magazines in Japanese and English;
7. **Examinations**: conducts examination for qualified industrial energy managers; and
8. **Administration**: handles day-to-day coordination of all Center activities.

Current Situation

ECCJ employs over 80 people and is an integral and respected part of Japan’s energy conservation effort. The Center offers a comprehensive package of energy conservation services, with the exception of financing assistance. Fortunately, financing is available through various government-controlled loan facilities established as part of the national energy conservation policy.

ECCJ’s finances are very stable. In fiscal year 1994, the Center’s budget was 3.0 billion yen (roughly $30 million). Only 18 percent of ECCJ’s budget came from subsidies or government funds. Seven percent was earned from membership fees, while the vast majority, 73 percent, was derived from services provided to customers.

### 4.3.4 Energy Conservation Center of Pakistan

The National Energy Conservation Center of Pakistan (ENERCON) was established as an independent office under the Ministry of Water and Power in 1986. Funding for the Center came from a $9.1 million start-up grant from USAID (without which ENERCON would not have been set up). The USAID grant enabled a large team of experts from the U.S. to work hand-in-hand with ENERCON staff over a four-and-a-half-year period from 1986 to 1990. In 1990, when the Government of Pakistan took over funding for ENERCON, the Center had twelve professional staff. At least half of the budget was used for foreign energy experts who spent a great deal of time in training activities and project implementation.

Services Offered

During the height of the USAID project, ENERCON offered a full set of energy conservation services including: industrial energy audits; boiler and furnace tune-ups; commercial building energy analysis, computer modeling, and retrofit assistance; detailed weather data for the three primary cities in Pakistan; agricultural well efficiency measurements, audits, and retrofits; tractor efficiency measurements and recommendations; auto tune-up demonstrations; and an outreach and information campaign. In addition to these services, ENERCON provided critical support to the development of commercial building energy codes in Pakistan. These codes were based on the OTTV method, a type of building code discussed in greater detail in the ASEAN Building Codes section of this report.

A 1993 evaluation of the program uncovered an interesting fact. Industries were most likely to undertake comprehensive energy efficiency measures if the first measures they undertook were low-cost and had fast paybacks. Boiler and furnace tune-ups, for example, were very popular. These initial successes often resulted in further investments in measures with longer payback periods. To conduct audits, ENERCON successfully used several private Pakistani consulting firms. This helped build private sector support for and experience with energy conservation. The project also developed an innovative technique for large-scale energy audit programs: the “targeted services approach.”

Current Situation

During the height of USAID assistance, ENERCON employed over 120 staff in the Center. Today ENERCON op-
erates with a staff of about 100 employees who continue to carry out projects such as boiler tune-ups and energy audits. These activities, however, are not yet financially self-sustaining. ENERCON continues to be dependent on donor funding to sustain its activities. As of August 1995, the World Bank was considering a $50 million loan to ENERCON for power plant and transmission efficiency improvements as well as energy efficiency work with Pakistan's largest industries.

4.3.5 Energy Conservation Center of Thailand

The Energy Conservation Center of Thailand (ECCT) was approved by the Thai cabinet in 1985 and was established in 1988. Many aspects of ECCT were modeled after the Energy Conservation Center, Japan. ECCT was jointly founded by the Thai government and the Federation of Thai Industries (FTI). The latter group envisioned ECCT as a joint private/public project to promote and implement energy conservation. These groups envisioned that, after five years, the Center would be financially self-sustaining.

Initially, funding for the original $3.2 million budget was to be split between the government and FTI. Although FTI proved unable to provide its share of the funding, ECCT has enjoyed success with government-only funding. During its first five years, the center operated at a loss of about $80,000 per year (20 percent of operating expenses), but this situation has improved every year. By 1993, well ahead of target, EECT had achieved financial self-sufficiency. For fiscal year 1995, the center is expecting to show a operating profit of roughly $100,000.

ECCT, because it initially received government funding, is required to follow government regulations and procedures. According to program experts, there have been two difficulties with this arrangement. First, it precludes ECCT from engaging in some business opportunities and joint ventures on energy services and products. Second, ECCT is required to follow government-mandated pay scales, which are several-fold lower than private sector salaries. This has caused ECCT to lose several of its best employees to private industry, and forced the Center to consider creating a foundation or new organizational structure to address this institutional barrier. Several structural hurdles, however, have been overcome. ECCT is allowed to keep its own bank accounts and is able to receive payments for its technical services.

Services Offered

All of ECCT’s services are income-generating. They fall into four categories:

1. Assistance to the Department of Energy Development and Promotion (DEDP): DEDP, a government department, contracts with ECCT each year for services in energy audit training, industrial efficiency feasibility studies, and industrial energy audits.
2. Services to industry and commercial buildings: ECCT offers services in boiler tuning, load management, and air compressor maintenance. In addition, industries can hire ECCT to prepare detailed feasibility study of efficiency improvements. Often these studies are focused on cogeneration systems.
3. Contacts with foreign organizations: Each year ECCT carries out contract work for foreign organizations such as the United Nations, GTZ (German Technical Aid), and the World Bank. ECCT is also asked to prepare market studies or conduct training of local energy managers or decision makers.
4. Independently organized training courses: ECCT organizes and hosts twelve training courses each year for which participants pay a fee to ECCT.

Current Situation

ECCT was established with a $1.6 million investment from the Government of Thailand. The money was dispersed in equal amounts over a five-year period. By the end of the five years, ECCT had $1.2 million in the bank, thanks to income generated by its activities. Today ECCT has an annual budget of $480,000 and most this expense is covered by the income sources mentioned above.

The Center’s recent work has included acting as a consultant to the World Bank and other donors in the establishment of similar energy conservation centers in Nepal and Laos. ECCT’s forty-person staff (which includes 20 professionals) is looking towards future areas of growth. A key thrust will be to find ways to overcome the regulations placed on it as a government-associated organization. ECCT is also hoping to play a role in the implementation of Thailand’s demand-side management programs and the energy conservation promotion project.

Impact Data in Brief

There are few data on the energy savings achieved by energy conservation centers. Existing studies tend to measure centers’ impacts in terms of projects completed, tracking the number of audits completed and the number persons trained. Little information exists on the number of kilowatt-hours or tonnes of oil equivalent saved as a result of energy center projects. This is true for energy centers in the United States and Europe as well. Energy centers are inherently short on quantifiable savings while strong on qualitative
impacts. Nevertheless, a summary of the impacts and accomplishments is presented below.

A summary of the Energy Conservation Center, Japan’s activities for fiscal year 1994 provide an indication of the program’s impacts. In that year alone:

- 300,000 pieces of informational/awareness materials were published;
- 78,000 people visited the annual energy conservation exhibition (ENEX);
- 3,000 energy managers attended ECCJ training courses;
- 200 energy audits were conducted;
- 4,400 people took the energy management examination;
- 50 overseas trainees were received;
- 50 Japanese experts were dispatched; and
- numerous publications were completed.

China’s BECon Center was founded in 1993 and thus its energy savings impacts have yet to be realized. (As discussed earlier, its strength so far has been expressed in terms of regional planning initiatives.) Since its inception, BECon has held a workshop for over 100 appliance standards experts, conducted several market research and energy policy studies, and produced a report on energy-saving technologies.

Data for Indonesia’s KONEBA Center are even more sparse. The only information available at the time of the writing of this report is that 35 industrial energy audits were completed during the period from 1984 to 1989.

In Pakistan, the impacts of the USAID-sponsored component of the ENERCON program are well documented. Not only is there information on the number of audits, retrofits, and training, but efforts were made to quantify the impact on consumer energy bills. Little impact information is available after USAID pulled out of the program. During the USAID sponsorship, the Center’s accomplishments included:

- reducing customer energy bills by $5.45 million/year;
- 248 energy audits, including one-sixth of all industrial plants in the country;
- retrofitting 115 tubewell in the agricultural sector, creating average savings of 15 percent;
- tuning up 3,000 cars, resulting in fuel savings of 10 percent (while cutting hydrocarbon and carbon monoxide emissions by 40 percent);
- 600 boiler and furnace tune-ups;
- training 3,500 engineers in workshops;
- training 4,000 women in half-day seminars; and
- training three private firms.

Since its inception in 1988, ECCT has kept track of its accomplishments. Over the life of the organization, it has completed 400 industrial audits and 100 commercial building audits. It has tuned 200 boilers, and 15 factories have taken advantage of an ongoing annual service for electrical load management and compressor maintenance. ECCT has also conducted 12 trainings per year and helped establish an Energy Managers Club. Nevertheless, like the other Centers there are few data on the actual amount of energy saved from ECCT’s activities.

Summary/Lessons Learned

Energy centers appear to be Asia’s preferred type of energy conservation promotion activity. This popularity is due to both local initiative as well as the attraction that they hold for foreign donors. Donors seem to like funding energy centers because they are physical, tangible facilities capable of coordinating a range of related activities. The success of these centers, however, has been mixed and difficult to measure. That said, there are elements of each of the centers that have been highly successful and warrant careful examination and possible replication.

- **Energy conservation centers facilitate an integrated approach to energy efficiency programs.**

Each of the centers profiled in this summary simultaneously implemented several activities and approaches to encourage energy conservation. Examples of activities included energy audits, technical advisory services, vehicle tune-ups, agricultural pump improvements, extensive training for professionals and energy managers, commercial building design assistance, and policy formulation. Essentially, energy centers serve as clearinghouses for a range of energy conservation activities and information resources.

- **Training and energy audits are the two most common and most successful elements of energy centers.**

Each of the energy conservation centers presented in this compendium undertook these two activities. Discussions with staff of the centers revealed that even after several years, training programs are still popular and successful. While energy audits were still being carried out by most of the centers, there is some question as to their effectiveness.

- **Energy conservation centers shy away from offering financing for energy efficiency projects.**

Project financing often is seen as one of the major barriers to implementing energy efficiency. Nevertheless, none of the centers offered such assistance to their constituents, despite the apparent logic of providing “one-stop shopping” to encourage energy consumers to undertake efficiency measures. There is no clear reason for this omission other than...
possible constraints pertaining to the legal status of the energy centers. It is likely that future energy center initiatives could increase their effectiveness by providing financing. Offering project financing along with energy audits could prove to be popular with industrial and commercial customers in particular.

- **Financial self-sustainability of energy conservation centers is an elusive goal, but one that can be achieved.**

Most of the energy centers aimed to achieve financial self-sustainability after initial funds were exhausted. With the exception of Japan and Thailand, however, this was not possible. Japan still receives a small amount of funding from the government, but the bulk of its income comes from membership fees, consulting services, and training tuition. In Thailand, much of ECCT’s income comes from contracts with the Thai government, but it also generates income from industrial services.

- **The independent status of energy conservation centers can be a help and a hindrance.**

Independence from the government is critical for energy centers that seek financial self-sufficiency and a well-qualified staff. The experience of the Asian energy centers reveals that receiving income for services is difficult if not impossible if the organization is part of the government. An additional factor reinforcing the need for independence is the low salaries of government employees relative to private sector employees. In several countries, highly skilled staff members of energy conservation center have found that they could easily work in the private sector at much higher wages.

Independence may have its pitfalls. It can mean an end to government funding. Moreover, independent centers could have a diminished influence in larger policy issues and other important non-income generating activities. Finally, while a degree of autonomy is attractive, each of the centers reviewed was highly dependent on an initial government and/or donor subsidy.

The establishment and funding of energy conservation centers is a key parameter for subsequent program design that needs to be carefully evaluated in light of the center’s goal and objectives. While a degree of autonomy and financial independence is attractive, completely private energy centers may lose some of their effectiveness. Importantly, for-profit private enterprises are generally not able to carry out activities whose primary objectives are the improvement of a public or societal good such as the environment.

### 4.4 ASEAN Commercial Building Codes

The six Association of Southeast Asian (ASEAN) countries of Brunei, Indonesia, Malaysia, the Philippines, Thailand, and Singapore are home to over 320 million people and comprise one of the fastest growing economic regions in the world. Expansion in these economies has gone hand-in-hand with rapid increase in energy use. Concurrent with this rapid economic expansion has been the growth of the commercial or service sector. Today, throughout the ASEAN region, there is a boom in office, hotel, and shopping center construction. This has translated into explosive growth in energy consumption in buildings. In 1970, commercial buildings in the six countries consumed 4.3 billion kWh. By 1987, that number had increased to 23 billion kWh, an annual rate of increase above 10 percent for the 17-year period.

Energy codes for commercial buildings are one way to avoid missing the opportunity of making buildings efficient from the start. Efficiency in new buildings, if ignored, is often referred to as a “lost opportunity.” While it is possible to retrofit existing buildings, it is always substantially more expensive than designing efficiency into new buildings.

#### PROGRAM SUMMARY

| Countries: | Singapore, Philippines, Malyasia, Thailand, and Indonesia |
| Program:   | ASEAN Building Energy Codes |
| Mechanism: | Program began in 1982, assisted in examining and developing codes on envelope, cooling, and lighting; developing regional consistent codes; compliance based on minimum energy rating, prescriptive, and performance codes; voluntary codes have proven ineffective in Indonesia and Malaysia |
| Data in Brief: | Savings have not been established; estimated energy savings of 19% to 24% due to code change |

#### The Context

In 1979, Singapore instituted South East Asia’s first building energy codes, a set of regulations requiring commercial building owners to achieve specific levels of energy efficiency. To support and expand Singapore’s pioneering ef-
fort, the ASEAN-USAID Building Energy Conservation Project was initiated in 1982. Through this project, the U.S. Agency for International Development (USAID) assisted Singapore in examining their existing codes and assisted four other countries in developing similar codes.

USAID implemented its assistance to the ASEAN countries in two phases. The first phase was a collaboration between the Singapore government and the U.S. Department of Energy’s Lawrence Berkeley Laboratory (LBL). LBL already had extensive experience in designing the U.S. building energy codes. The primary goals of the phase were to improve Singapore’s existing code, transfer analysis capability to Singaporean energy policy makers, and establish a process for expanding the codes to the other ASEAN countries. The first phase was concluded with a conference in Singapore in May 1984. The proceedings of the conference included analyses of various components of the codes as well as descriptions of energy conservation activities within ASEAN countries.

The second phase of the project was initiated in 1985. It aimed to expand the program to the other ASEAN countries. All ASEAN countries except Brunei participated in this phase of the project. The project funded 22 research sub-projects that could assist the development of commercial building energy codes for the region. Government energy department staff and academics were among the participants in this phase. The participating countries developed codes that, like Singapore’s, were based on the Overall Thermal Transmittance Value (OTTV) system. Having developed the codes, the project sought to convince ASEAN governments and building professionals that the codes should be made mandatory. While the ASEAN-USAID project was completed in 1992, there continues to be substantial activity in developing and implementing the codes.

The codes focus on improving the efficiency of building shells (exterior), cooling equipment, and lighting systems. In each country, a slightly different set of codes was developed based on local climatic conditions and the judgment of local energy planners. Furthermore, each country has implemented and enforced the codes with different degrees of rigor. In Singapore, the code is strictly enforced. (As will be described below, this has led virtually all commercial buildings in Singapore to meet the minimum energy efficiency code.) In the Philippines the code has recently become mandatory, but until then the code had been a voluntary guideline. Thailand intends to follow the Philippines lead, i.e. to introduce the codes as voluntary guidelines and later to make them mandatory. In Malaysia and Indonesia, the code is voluntary, providing a guideline that building designers are encouraged to use.

Because the codes were established through a multilateral organization, ASEAN, regionally consistent standards have been developed, and the participating countries together have gained a wealth of experience in the process of designing building energy codes. Most important, the long-term energy savings from the adoption of the codes will be substantial. The ASEAN-USAID project found that energy savings of 20 percent could be realized in commercial buildings if the codes were implemented.

Although Singapore is the only participant to have fully implemented and enforced the code (which experts contend needs to be improved), the region has begun to institute a system whereby architects and engineers make it a matter of habit to design energy-efficient buildings. Furthermore, once institutionalized, the code can be revised, strengthening the standards for efficiency and encouraging more widespread use of energy-efficient equipment and design practices.

**Program Design**

The ASEAN commercial building energy codes regulate the building “envelope” (also known as the shell or exterior), the lighting system, and the cooling equipment. Primary focus is on the envelope because compliance with the code is based on the Overall Thermal Transmittance Value (OTTV) of the building envelope. The OTTV is an estimation of the energy that will be transferred through a wall for a given set of conditions. The OTTV method takes account of both conductive heat transfer and radiative heat transfer through windows. To determine the OTTV, the building designer must calculate (1) a thermal transmittance value for each exterior surface (including windows and roofs) and (2) a weighted average for the whole building’s shell. While each ASEAN country has a slightly different code, most of the assumptions and methods are similar. All require that the OTTV for a whole building not exceed 40 to 50 watts per square meter.

It should be noted that different formulae used to determine the OTTV can lead to very different results. The U.S. version of the OTTV, for example, developed by the American Society of Heating, Refrigeration and Air-conditioning Engineers (ASHRAE) requires that the OTTV not exceed 90 watts per square meter. Though it would appear that the ASEAN code is more stringent than the American standard, the difference is due largely to different assumptions and constants used in the two OTTV’s. Despite the different OTTV values, the two codes are equally stringent. The ASHRAE standard may even be more stringent since it covers efficiency levels of lighting systems and HVAC equipment that are not covered by the ASEAN code.
Although OTTV is an important parameter of building efficiency, analysts suggest that it should not be the only parameter. There are other means of establishing standards for building energy use that should be examined by those considering adopting building codes. These methods fall into two basic categories: prescriptive and performance. Prescriptive standards require that buildings use certain materials such as double-pane glass, prescribed levels of fiberglass insulation, and specific lighting components. While these standards are easier to implement and understand than either the OTTV or performance-based standards, they offer little flexibility to designers.

Performance-based codes afford a greater degree of flexibility to building designers than the OTTV method but also are more complex. Such codes require that computerized simulations of energy use, based on the interaction between the building’s envelope, its lighting system, and its cooling system, be performed prior to construction. These simulations allow tradeoffs between various building components and systems to be considered freely. An inefficient envelope, for example, could be compensated by using a more efficient cooling or lighting system that would keep overall building efficiency within the designated limits.

Standards based on OTTV are commonly seen as a compromise between prescriptive and performance-based methods. The OTTV allows the designer to make tradeoffs between different elements of the building envelope, without the opportunity to make changes to lighting and cooling systems to compensate for thermal transmittance values. The ASEAN codes, however, do have provisions for non-OTTV components; in fact, the code contains requirements for lighting systems, cooling equipment, and electrical power and distribution equipment such as transformers and electric motors. The most common non-shell requirements are for lighting power density not to exceed a given number of watts per square meter and for cooling equipment efficiencies to be greater than a given minimum. As an example, most ASEAN codes require that lighting power density in an office not exceed 16-20 watts per square meter and that water-cooled chillers that consume less than 0.7 to 0.8 kW per ton of refrigeration. Both requirements are easy to meet with standard equipment normally used in ASEAN countries.

### 4.4.1 Singapore

Singapore first implemented its code in 1979. The code applies to both new and existing buildings. New buildings are required to comply with the energy code prior to the issuance of a building permit. Existing buildings were given two years to be upgraded as necessary to reach compliance.

In order to ensure rapid implementation of the code, Singapore has used a “carrot and stick” approach, offering an incentive for complying with the code and penalizing non-compliant buildings. The Singaporean government used building permits as an effective stick for dealing with new construction. New buildings that failed to meet the code did not receive permits, providing ample incentive to developers to comply. Forcing compliance of existing building was more difficult.

As an incentive to owners of existing buildings, the Singapore government allows 40 percent of the total cost of retrofitting an existing building to be claimed as an income tax or property tax deduction. An additional scheme was implemented in 1983 that allows companies to use an “accelerated depreciation allowance” for energy-saving equipment, permitting companies to depreciate the equipment over a three-year period and gain associated tax benefits.

To penalize the owners of existing buildings that failed to meet the code, the government of Singapore assessed (after a two-year grace period) a 20 percent surcharge on the building’s electricity bill. As hoped, most buildings were upgraded by 1981, two years after the code’s enactment. The surcharge was imposed on 52 buildings, and by January 1984 all but nine had met the requirement. At that time, the surcharge was raised to 50 percent. This was sufficient encouragement. All buildings were upgraded by 1987.

An objective of the ASEAN-USAID project was the development of an improved code for Singapore as some weaknesses were discovered in the original code. The two primary recommendations were to increase the solar factor (or solar component) used in the OTTV equation, and to use OTTV constants that reflect the load on the chillers instead of the instantaneous heat transfer of the building shell. By the beginning of 1995, however, the revisions had yet to be implemented. While code revision under normal circumstances is a slow process, in Singapore’s case the process was exacerbated by lengthy debates surrounding complex technical issues related to building performance.

### 4.4.2 Indonesia

Indonesia introduced a building energy code as guidelines (essentially voluntary codes) in 1990. In 1992, several government ministries held a conference to discuss improvements to the code. One year later, an updated code was published. Today, compliance with the code remains voluntary and there are no definite plans to make it mandatory. It is believed that the code is relatively unknown in the private-sector building-design community and that no privately owned buildings have purposely been built to meet the code.
Even government buildings do not meet the code, though the Public Works Department has attempted to design its buildings to meet the code when possible. The cost of education and enforcement is a major reason for the government’s hesitation to implement a mandatory code.

### 4.4.3 Malaysia

Malaysia launched a “guideline” (i.e., voluntary) building energy code in 1989. In an effort to improve upon the 1979 Singapore regulations, the Malaysian OTTV incorporates chiller load into the formula. As of this writing, the Malaysian Standards Institution is developing mandatory Building Energy Standards based on the guidelines, which are expected to be implemented sometime after 1997. Nevertheless, some engineers and government departments are reportedly already using the code, and it is believed that the code has helped eliminate some of the most inefficient building energy use in Malaysia.

### 4.4.4 The Philippines

The first mandatory commercial building code in the Philippines came into effect in late 1994, but by the mid-1995 the code had yet to be fully implemented. Education of building code inspectors and building design professionals did not begin until late 1994. Most people believe that implementation of the code will not begin until 1996. The code’s success will depend on how well government inspectors have been educated and on the rigor with which penalties are imposed on building owners who refuse to comply. As of August 1995, penalties have not been specified in the code literature.

### 4.4.5 Thailand

Thailand has finalized its building energy code and plans to submit it for ministerial approval in mid-1995. The code is part of a larger energy conservation act passed in 1992. The act includes a provision for energy conservation in industrial and commercial facilities and also calls for the creation of an energy conservation fund to be used to help finance energy conservation projects.

The Thai Department of Energy Development and Promotion, under the Ministry of Science Technology and the Environment, introduced the code on a voluntary basis as a guideline in 1994, well before it was mandatory. The “introduction” included press coverage and seminars for building professionals. Unlike the Philippines’ code, which became mandatory before it was well known, Thailand has educated and prepared the public for the new codes.

The commercial building code will apply to both new and existing buildings with an actual or expected peak electricity demand greater than 1,000 kilowatts. Existing buildings (including those under construction or applying for construction permits before the law is enacted) will be required to upgrade to a level of 55 watts per square meter. All buildings applying for construction permits after the law is enacted will be required to have a shell performance of 45 watts per square meter or less. The code also includes provisions for lighting and cooling systems. Beginning after 1999, non-compliance will be penalized by a surcharge on electricity bills.

### COUNTRY CODE STATUS

<table>
<thead>
<tr>
<th>Country</th>
<th>Status/year</th>
<th>Applicability</th>
<th>Provisions Included</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indonesia</td>
<td>Voluntary</td>
<td>New buildings with air-conditioning</td>
<td>Building shell, lighting, A/C equipment</td>
</tr>
<tr>
<td>Malaysia</td>
<td>Voluntary/1989</td>
<td>New buildings</td>
<td>Building shell, lighting, A/C equipment</td>
</tr>
<tr>
<td>Philippines</td>
<td>Mandatory/19944</td>
<td>New buildings with energy use greater than 10 w/square meters</td>
<td>Building shell, lighting, A/C equipment, boilers and hot water systems</td>
</tr>
<tr>
<td>Singapore</td>
<td>Mandatory/1980</td>
<td>New and existing buildings A/C greater than 30 kW</td>
<td>Building shell, lighting, controls and ventilation</td>
</tr>
<tr>
<td>Thailand</td>
<td>Mandatory/mid1995</td>
<td>New and existing buildings with consumption greater than 1000 kW</td>
<td>Building shell, lighting, A/C (sizing, ventilation, efficiency)</td>
</tr>
</tbody>
</table>
Impact Data in Brief

Since Indonesia, Malaysia, the Philippines, and Thailand have yet to enact or have only recently enacted their codes, few energy savings have been realized in these four countries. Meanwhile, no analysis of the energy savings engendered by Singapore’s code has been conducted. The original ASEAN-USAID estimate contends that the codes would lower energy consumption by 19 to 24 percent over typical ASEAN buildings. The report also stated that tighter codes, designed to encourage all cost-effective conservation measures, could result in savings of as much as 50 percent.

Summary/Lessons Learned

The importance of building codes cannot be overstated. Building energy codes have been written in 10 Asian countries and 38 countries worldwide. Within ASEAN countries, the codes could save over 20 percent of the energy used in commercial buildings. The high degree of success with building codes in North America and Europe hints that such savings could be only a beginning. With this in mind, the initial efforts with building energy codes in Asia should be carefully scrutinized to determine how to achieve the most effective implementation.

- Provide for the education of building construction professionals prior to the enforcement of the code.

Singapore provides the most successful and encouraging example of building codes in ASEAN. It is believed that all medium and large commercial buildings in Singapore comply with the code, and the educational component (which is as important as development and enforcement of the code) is well underway. Architects, engineers, and building inspectors are all becoming familiar with designing with the code in mind. In contrast, the Philippines is only beginning the several-year process of educating professionals on how to design buildings that meet the code.

- Enact a strong penalty-reward system.

Singapore’s penalty-reward system has helped foster code compliance. Lessons from Singapore suggest that a clear and consistent message needs to be sent to the building community regarding the penalties and rewards of the codes and the timing of their mandatory execution.

- Political barriers are sometimes greater than technical barriers.

The largest barrier to success seems to be encouraging the government to enact a mandatory code with which all buildings must comply. The ASEAN countries developed draft codes around 1989 or earlier. With the exception of Singapore, which implemented its code in 1979, most ASEAN countries are only now making their code mandatory.

- Voluntary codes have little impact.

The ASEAN experience demonstrates that voluntary codes or guidelines have little if any impact on building practices. Without an penalty-reward system, building designers — who are paid set fees and who are generally on tight budgets and schedules — have little incentive to go through the extra hassle of meeting the code.

4.5 EGAT Fluorescent Lamp Campaign

The Electricity Generating Authority of Thailand (EGAT) is a nationally owned corporation responsible for providing power to the entire country. It produces and transmits power, which is then distributed by two companies — Metropolitan Electricity Authority, which serves metropolitan Bangkok, the nation’s major population center, and Provincial Electricity Authority, which serves the rest of the country.

Rapid growth in electricity demand in the country has given demand-side management (DSM) a new sense of urgency and importance in Thailand. EGAT leads this charge and has programs or planned activities for a range of technologies including fluorescent lamps, ballasts, air conditioners, refrigerators, thermal energy storage, and industrial motors.

EGAT’s “pilot” DSM program started in 1993 and will last for five years. The utility has dedicated $188 million to DSM, a large budget that may be the largest among Asian nations.

The funds for EGAT’s ambitious DSM initiatives will be derived both internally and externally. EGAT will raise $140 million through a fuel cost adjustment mechanism incorporated into its electricity tariffs. Of the remaining funds, $25 million will come in the form of a grant from the World Bank’s Global Environmental Facility (GEF) and $25 million will come in the form of a soft loan from Japan’s Export/Import Bank.

The Thai DSM program differs from other DSM programs receiving World Bank support in that it was initiated locally. Only after the program had been approved by the Thai government did the World Bank and GEF get involved. The GEF funds will be used to secure a technical advisor from Canada, to undertake capacity-building activities such as training, and to hire foreign consultants for specific tasks such as evaluations. The program is also unusual in that evaluations will account for almost 10 percent of the bud-
The philosophy behind EGAT’s DSM initiatives is markedly different from that of North American DSM programs. The EGAT philosophy has three key objectives:

- to encourage the purchase of energy-efficient products by the Thai people;
- to promote "an attitude change" within the country’s residents; and
- given the extremely hot climate in Thailand, to increase the efficacy of building envelopes throughout the country.

It is from this orientation that EGAT has proceeded with DSM. The utility is cognizant of the opportunity it has and the challenge it faces in ensuring that energy efficiency provides relief to the country’s electrical load growth.

EGAT’s first focus has been fluorescent lamps, 36-watt four-foot tubes in particular. The 36-watt lamps produce as much light output as their 40-watt counterparts by using a thinner-diameter tube. These T8s (eight-eighths of an inch in diameter) can replace the T12s (twelve-eighths of an inch) without changing the ballast. Furthermore, they cost the same or less than their T12 counterparts, as their smaller size requires less materials during production.

EGAT strategically focused its first DSM campaign on the 36-watt lamp for a number of reasons. First, lighting is responsible for 25 percent of national electricity use, and fluorescent lamps dominate the lighting market in Thailand. Targeting motors or packaged chillers would only have applied to specific sectors, and EGAT wanted its first campaign to be highly visible and to impact as many of the country’s citizens as possible. Second, the more efficient T8 lamps were no more expensive than their less efficient T12 counterparts, an unusual opportunity that EGAT felt it could exploit. Third, fluorescent lamps are produced by a number of domestic manufacturers, and EGAT wanted to choose a technology that was produced in Thailand. As is the case in most developing countries, domestic products are substantially cheaper and thus are available to more income groups. Fourth, since there are a limited number of domestic manufacturers of fluorescent lamps in Thailand, EGAT had an opportunity to transform the market at low cost, effectively setting the stage for subsequent initiatives.

The Context

Driven by a thriving national economy, demand for electricity in Thailand is growing 10 percent annually, causing capacity demand in this country of nearly 60 million people is rising by 1,000 MW each year. DSM officials at EGAT explain that it took 110 years for Thailand as a whole to grow to its current national power demand of 11,000 MW. Now that capacity demand is projected to double in ten years. Furthermore, while the first 11,000 MW were relatively easy to tap using domestic hydroelectricity and thermal generation based on domestic lignite reserves, the next 11,000 MW will be very difficult to procure.

Thailand is already faced with several difficult and sometimes controversial resource choices. The country is torn between construction of nuclear plants, importing coal from Australia, and developing hydroelectric dams in neighboring Laos. Each of these options has significant drawbacks, and power generation has become a common front-page item in local newspapers. For this reason, efficiency is a highly attractive political and economic option, and one that EGAT is seeking to maximize.

Program Design

In 1993, EGAT began its Fluorescent Lamp Campaign to promote the use of 36-watt, T8 lamps. At that time, Philips lighting already had switched all of its local production to the 36-watt lamps. EGAT officials explain that the well-known and trusted international lighting company had demonstrated that the technology worked, easily saving four watts per lamp with a minimal negative impact on ballast losses.
What Philips was up against, however, was a public perception that the lamps did not produce the same amount of light, that they would likely fail prematurely, and that they might not work in existing fixtures. This perception caused Philips to lose some of its 35 percent market share in Thailand despite its strong reputation for making a quality product.

In reality, the 36-watt lamp is not fraught with the problems that Thais perceived. It can be used in existing fixtures, and the lamps do provide an equivalent lumen output while lasting just as long as their 40-watt predecessors. Thus EGAT’s challenge was to convince all five domestic manufacturers of fluorescent tubes to participate in the program and to completely switch their production of 40-watt lamps to 36-watt lamps. For its part, EGAT would work to change the public perception of the technology, using its financial resources and corporate strength to transform market demand for fluorescent lamps.

After a series of negotiations, on September 20, 1993, a Memorandum of Understanding was signed between EGAT management, Thai government officials, and fluorescent lamp manufacturers. The Thai Prime Minister, the Chairman of EGAT, and presidents of each of the five manufacturing firms were signatories to the compact. The manufacturers agreed to completely change over their production within two years. EGAT, in turn, agreed to undertake a 220 million baht ($8.8 million) advertising and awareness building campaign over a two-year period beginning in January 1994. By September 1995, only 36-watt lamps will be manufactured in Thailand and 40-watt tubes will be a thing of the past. (Manufacturers, of course, will be welcome to produce even more efficient lamps such as the 32-watt tristimulus phosphor lamps promoted in many DSM programs in the United States.)

To promote the 36-watt lamp technology, EGAT has engaged in a massive promotional campaign. Posters have been distributed featuring the energy-saving lamps. Six “spots” are aired on television every day — and will be for the duration of the campaign — on major networks in the country, using celebrities as well the former Prime Minister to promote the lamps. Radio and newspaper ads are also run regularly, highlighting the opportunity for customers to save ten percent of the energy used for lighting while serving the nation’s interest by minimizing the need for expanding power generation capacity.

EGAT has supplemented this broad-based effort with demonstrations and campaigns in each of the country’s 26 provinces. Around the country, sixteen city halls and 45 schools have been retrofitted with the lamps. Lectures and seminars on the new lamps have reinforced the value of these demonstrations, while marches with schoolchildren have raised awareness of the program and its national importance. Through this campaign, EGAT is setting the stage for subsequent energy efficiency initiatives, building on its early success.

Impact Data in Brief

The Fluorescent Lamp Campaign is in mid-stream, but its success in accelerating the adoption of more efficient fluorescent tubes is already apparent. While Philips (with a 35 percent market share for four-foot lamps) already had retooled to produce the lamps, Toshiba (which also commands a 35 percent market share) terminated production of 40-watt lamps ten months in advance of the program’s cut-off date of September 1995. EGAT officials believe that Toshiba made the transition earlier than planned because of the market acceptance that the program had created. As of this writing, the three other domestic manufacturers (Asia Lamp, Saffi, and Daichi), with a combined market share of 20 percent, are producing both 40- and 36-watt lamps, with current production split between the two varieties. The remaining ten percent of the market is held by imports, and Osram, the primary player, exclusively imports 36-watt lamps. In approximately eighteen months, the market share for the T8 lamps has increased from about 30 percent to nearly 90 percent.

A national survey commissioned by EGAT was very encouraging. Ninety-seven percent of the 3,000 people surveyed were aware of the “thin tube” technology, and 90 percent said they would purchase the lamps the next time they needed a four-foot lamp. Only five percent were hesitant, commenting that they would purchase the T8 lamp depending on its price. Of course, the T8 lamps are no more expensive than the T12 lamps. Another indicator of the program’s success is that manufacturers are using the energy efficiency aspect of their products as a marketing tool. In their advertisements, Philips, Toshiba, and Osram all claim their lamps to be energy-efficient, a testament to the program’s success in raising awareness of the value of energy-saving lamps.

While the transition from 40-watt to 36-watt lamps has been accomplished in very short order, it will take some time for the 36-watt lamps to fully saturate the Thai market. The T12 lamps currently in use as well as those in distributors’ and private inventories will likely be used before ultimately being replaced. When all lamps in Thai society are replaced, however, the program’s effect will be huge. Since lighting accounts for roughly 25 percent of electricity use in Thailand, and most lighting is fluorescent, the program has the potential to save roughly two percent of national electricity use. EGAT officials suggest that when national power demand grows from the current 11,000 MW to 15,000 MW in
the next four years, 300 MW will be saved through the program at a fraction of the cost of additional capacity.

Summary/Lessons Learned

- **Energy efficiency can be strategically deployed by Asian utilities for maximum effect.**

By focusing on a common technology used by all sectors of the economy and by all strata of society, EGAT developed a solid platform for subsequent initiatives. Through a short, intense, and broad-based campaign, using the media and demonstrations across the country, EGAT has made it clear to the Thai population that it is taking energy efficiency seriously.

- **Both private and public sector support are crucial.**

It is important to begin DSM initiatives in close consultation with private sector manufacturers. Moreover, by selecting a product produced by a limited number of manufacturers, EGAT was able to establish a powerful collaboration that can serve as a model for future initiatives. The utility also showed that DSM projects can be very low cost. EGAT has been able to administer the program with ten staff (out of its 80-person DSM group) and with less than $10 million for promotion and advertising.

The public sector also has been important to EGAT’s success. As a nationally-owned utility, EGAT has the support of the Prime Minister, and even the King of Thailand is reportedly well aware of the Fluorescent Lamp Campaign. This assistance from the highest levels of government has boosted the program’s visibility and credibility. Internal management support at EGAT has also been essential. The Chairman of EGAT has championed the program and participated in the Memorandum of Understanding signed with the presidents of the manufacturers, effectively clearing any bureaucratic hurdles internal to EGAT that might have slowed the campaign.

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The Fluorescent Lamp Campaign sets the stage for a range of future initiatives. Already EGAT is working on a program to promote low-loss ballasts specifically designed for the 36-watt lamps, and has begun discussions with the twenty ballast manufacturers in the country. EGAT hopes to establish a national standard for ballasts of 6 watts per lamp. A refrigerator labeling program was introduced in January 1995, and air conditioner labeling is slated to begin in January 1996. (Since the marginal cost of efficient refrigerators is only $20, EGAT does not plan to offer incentives. For air conditioners, however, where the marginal cost is as high as 10,000 baht ($400), EGAT may provide loans through the Thailand’s two distribution utilities.)

EGAT is also planning a motors program to provide technical assistance to help customers assess the cost-effectiveness and life-cycle savings of efficient motors. The program will likely provide financial incentives to encourage the purchase of high-efficiency motors. EGAT is also working to develop financing for commercial and industrial customers to promote energy efficiency. For large customers with backup generators (a capacity that could be as large as 1,000 MW nationally), EGAT is working out the details for a program in which customers could receive five-year, no-interest loans for efficiency upgrades, in exchange for agreeing to provide the capacity of their emergency generators when needed by EGAT. Through these programs, on which EGAT plans to spend $188 million, the utility hopes to offset the need for as much as 7,000 MW of new capacity over the next 15 years. These savings are equivalent to 30 percent of projected load growth.

In each of these programs (and more slated for delivery), EGAT seeks to change public attitudes about efficiency. The utility recognizes that in so doing, it can create a foundation that will provide for continued energy efficiency improvements.

### 4.6 Chinese Industrial Efficiency Regulations

Asia’s most populous nation, China, is also the continent’s largest energy user. The country uses more energy per unit of gross domestic product than any other Asian nation. In an attempt to reduce this inordinate demand for energy, during the 1980s China developed a comprehensive set of policy directives, procedures, regulations, technical assistance programs, and project financing initiatives to promote energy efficiency. In addition, a extensive network of energy conservation offices was established throughout the country.

While elements of China’s comprehensive efficiency program have succeeded, there are certainly aspects of the program that would be difficult, if not impossible, to reproduce in a market-oriented economy. In particular, the electricity quota aspect of China’s energy conservation program would be impractical in other countries. Nevertheless, the quota system (in which electricity use beyond a user’s prescribed allotment is priced substantially higher) could be transformed to market-based energy pricing systems such as time-of-use tariffs. Regardless of the transferrability of the components of China’s conservation efforts, China’s programs have been by far Asia’s most successful in achieving actual energy savings, both in gross amount and in percentage savings.
The Context

China’s astonishing economic growth has been coupled with considerable growth in energy consumption. The reason for this is two-fold. First, China has made a conscious decision to base its economy on industrial production and not agriculture. Moreover, the industrial sector has tended to emphasize the production of basic goods that require more energy to produce than higher-value-added goods. Second, Chinese industry employs relatively old, inefficient equipment. In some cases, Chinese industry uses twice as much energy per unit of production compared to identical production in other countries.

Despite growth in energy consumption, the energy intensity of China’s economy (energy consumed per unit of GDP) dropped by more than 30 percent between 1980 and 1990. This was due to structural changes in the economy as well as to efficiency improvements. According to a World Bank report, structural factors accounted for 55 to 65 percent of the decline in energy intensity while technical factors accounted for the remaining 35 to 45 percent.

The most impressive technical efficiency improvements occurred in the steel industry, where unit energy consumption fell by over 20 percent during the 1980s. Government-sponsored energy efficiency programs have played an important role in achieving these gains. China hopes to continue this trend and is planning for a further 20 percent improvement in energy efficiency during the 1990s. Despite these gains, China still lags behind international norms of energy efficiency. If efficiency levels in China were improved to levels comparable to those in developed countries, broad estimates indicate the country could reduce current consumption by 30 percent.

Program Design

The Chinese government’s energy conservation program focuses on improving industrial energy efficiency. The program includes major policy directives, procedures, regulations, technical assistance programs, and project financing initiatives. When compared to other efforts undertaken by other developing countries in Asia, China’s program is notable for its comprehensive network of energy conservation centers, its monitoring and tracking of energy use, and its promotion of energy awareness.

Policies for the energy conservation program are developed and overseen primarily by the State Planning Commission (SPC) with the assistance of the State Economic Commission and the State Economic and Trade Office. The Ministry of Energy also plays an important policy role through its Department of Energy Conservation. Each of these organizations has a relatively small staff devoted to energy conservation, ranging in size from 15-25 professionals. The primary responsibility for the implementation of the program lies with local government institutions. Provincial governments oversee energy conservation efforts with a network of energy conservation offices at the prefecture and county level. A total of 200 energy conservation service centers are reported to be operating nationwide.

The Chinese government develops detailed targets, guidelines, and standards on industrial energy consumption and energy conservation. Individual industrial enterprises are also required to report back to the government on their energy use and efficiency improvements. Several aspects of this program, in particular, are worth studying.

Energy Consumption Quotas

Each enterprise is given an energy use quota. In order to encourage enterprises to remain within their quota, prices for energy use above the given quota are substantially higher than prices up to the quota. In some cases, the cost of “out-of-plan” energy can be double that of “in-plan” energy. This system is China’s favored method for pushing enterprises to aggressively pursue energy savings. In addition to penalizing above quota energy use, the Chinese government also provides a reward to enterprises which successfully under-

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**PROGRAM SUMMARY**

**Country:** China  
**Program:** Industrial Energy Efficiency Regulations  
**Mechanism:** Comprehensive energy conservation program initiated in the 1980’s to serve the public with policy direction, procedures, regulations, technical assistance, and energy conservation offices; mechanisms include energy quotas, industrial standards, equipment standards, investment funding, and performance awards  
**Data in Brief:** Little concrete data exists; as much as 35-45% of China’s recent economic growth attributed to energy efficiency
take energy efficiency measures. Energy conservation efforts are a key criterion selecting winners of enterprise performance awards.

**Production/Equipment Standards**

Standards for energy consumption per unit of production have been established in several industries. Local government energy offices monitor compliance through a detailed reporting system and occasional field tests. Some enterprises set standards for individual machines or production lines and then base worker bonuses on their ability to achieve the standards.

Energy efficiency standards have been developed for several electricity-using appliances. While most of the standards are mandatory, some are used as guidelines. Compliance is strengthened by the publication of lists of banned as well as energy-saving appliances. The standards cover residential appliances as well as machine tools and other industrial equipment. Power transformers are also covered by the regulations.

**Investment Funding Facilities**

Investment funds for energy efficiency improvements have been established both by the national government and by local governments. The funds are provided to enterprises as loans at subsidized interest rates. The primary criterion in reviewing loan applications is the investment cost per unit of energy savings. In some states, regulations require that a minimum of 20 percent of depreciation funds should be invested in energy conservation projects. Funds also are available through commercial banks and from the enterprises themselves. The total investment in energy conservation between 1980 and 1991 was about 27 billion yuan, approximately $5.7 billion.

**Technical Assistance Facilities**

An extensive network of energy conservation service centers has been established throughout the country to help enterprises in their energy conservation efforts. The network includes seven comprehensive training and technical assistance facilities. In addition, every province has local centers as well as local testing and measurement stations.

**Impact Data in Brief**

There are few internationally available data on the impacts of the program. The World Bank reports that the Chinese economy experienced a 20 percent reduction in energy intensity from 1980 to 1990. This translates into a savings of roughly 300 million tons of coal equivalent. Since 35 to 45 percent of the reduction is attributable to technical improvements, efficiency measures saved between 100 and 140 million tons of coal equivalent. As a point of reference, the total national energy consumption in China in 1989 was roughly 1,000 million tons of coal equivalent. Thus, energy efficiency resulted in saving of between 10 and 14 percent of national energy consumption. In addition, the program has catalyzed energy conservation investments totaling 27 billion yuan or $5.7 billion.

**Summary/Lessons Learned**

China’s industrial regulations are among Asia’s most effective energy efficiency programs. Chinese energy efficiency successes include the establishment of over 200 hundred energy centers; encouraging industries to regularly review the potential for energy efficiency; reducing energy consumption by 10 percent; and encouraging nearly $6 billion of investment in energy efficiency. Despite these successes, many aspects of the program need to be redesigned to meet the needs of China’s emerging market economy. Moreover, the programs would need to be restructured to be effective in the established market economies in the rest of Asia. There is little doubt that this can be done and that intensive industrial efficiency programs could be successful throughout Asia.

- **The program’s comprehensive approach helped make it successful.**

This program has offered a full range of assistance including technical advice and training for industry, monitoring of energy use, information dissemination, energy quotas and pricing, as well as financing assistance. By providing the means as well as an appropriate incentive (disincentive) structure, the Chinese program successfully engaged a large portion of the nation’s industrial enterprises.

- **Energy quotas, while not applicable in market economies, have worked well.**

The penalty of higher-priced energy beyond an enterprise’s quota was a strong incentive to save energy. Unfortunately, in addition to there being several problems associated with determining a company’s quota, quotas are not well suited for market economies. In a market system, quotas will need to be replaced with market-based pricing incentives. Some of the pricing mechanisms that are commonly used in market economies include time-of-day rates and demand charges. Another option for market economies is voluntary load curtailment programs.
The close connection between energy planning offices and program implementation ensures the program’s continued success and strong government support.

Often energy conservation programs lose the support of the government and have difficulty making progress. In this case, the government-run energy planning offices considered energy conservation a vital component to meet growing energy needs. As such, the government lent its full support to the program.

While China’s program worked extremely well during the 1980s, in the 1990s China is slowly moving toward a market-based economy. Within this new economic framework, China will need to update its energy conservation program. The World Bank’s study on energy conservation in China set forth recommendations on how to improve the existing program in order to conform to the emerging market based economy.

- Reform energy prices to reflect the long-run marginal cost of supplying energy;
- Drop electricity quotas in favor of pricing mechanisms such as time-of-day rates and demand charges for electricity;
- Drop mandatory unit energy consumption standards due to the inaccuracy of unit energy consumption comparisons;
- Strengthen standards for new equipment;
- Change financing criteria from cost per unit of energy to project rate of return;
- Strengthen the technical assistance and training activities; and
- Drop the rule that 20 percent of depreciation funds need to be spent on energy efficiency.

4.7 The Philippines “AirCon” Program

One of the greatest accomplishments of the Philippine Department of Energy (DOE) with energy efficiency is the Residential Air Conditioner (AirCon) Standards and Labeling program. After years of coordination with manufacturers and the Department of Trade and Industry’s Bureau of Product Standards, DOE launched the model program in early 1994. The program has the potential to become a powerful platform for subsequent energy efficiency efforts not only in the Philippines but also in other Asian countries.

The Philippines AirCon program is similar to appliance standards and labeling programs in the United States and other countries. The standards establish minimum levels of efficiency that all units must meet in order to receive government certification to be sold in the country. These standards can also be ratcheted upwards over time to continually remove the least efficient products from the market. Meanwhile, the labeling component educates consumers on the benefits of energy-efficient appliances. As consumers become energy-conscious, manufacturers are provided with an incentive to use efficiency as a marketing tool and to outstrip their competition in the production of cost-effective, energy-efficient products. By coupling standards and labeling, the Philippines have been able to promote more efficient units and have begun an important and ongoing transformation of the market for air conditioner units in the country.

The Context

Two factors are driving energy efficiency in the Philippines: a pronounced dependence on imported oil and electrical system reliability. The liability of the Philippines’ dependence on imported oil became evident during the global oil crises of the 1970s. Prices for oil surged dramatically, causing the Philippines oil import costs to grow from $187 million in 1972 to $2.5 billion in 1980, while the overall volume decreased. This supply disruption caused the Philippines to attempt to lessen its dependency on imported oil by broadening its mix of fuels and promoting energy conservation. The Philippines began to focus on domestic oil and coal, hydroelectricity, geothermal resources, bagasse, agriwastes,
woodwastes, and “non-conventional” energy sources such as black liquor, biogas, producer gas, solar, and wind. While these sources accounted for nearly 40 percent of national energy production by 1990, economic growth and falling oil prices caused oil imports to continue to increase. This challenges the drive to conserve energy and promote alternative fuels.

Meanwhile, by the early 1990s there were serious problems with the reliability of the Philippines electrical system. The reasons for the electricity shortages that occurred in 1992 and 1993 were numerous, including: the cancellation of the 620 MW Morong nuclear power plant; delayed construction of other baseload plants; prolonged droughts that limited hydroelectric output; breakdowns at poorly maintained power plants; and the inability of the national utility to raise rates to enable it to maintain plants and finance new investments. As a result, Metro Manila, the nation’s largest population center, suffered blackouts often lasting six to eight hours. This unreliability of the power system had a crippling effect on the country’s economic growth.

**Program Design**

In 1980, the Philippine government passed a law promoting energy conservation, and the Ministry of Energy began to assess means to use energy more efficiently in all sectors of the economy. The government was especially interested in curbing oil imports, but it also began to investigate how to stem the growth in electricity demand, and specifically cited increasing the efficiency of refrigerators, lamp ballasts, and air conditioners as a means of doing so. Air conditioners were given a high priority because, while only penetrating a small fraction of households, they represented one of the most dramatic areas of increased demand for electricity in the residential sector.

From that time, it took over ten years to implement the Residential AirCon program. This was a function of the major government changes in the mid-1980s, the ensuing economic slowdown, and the painstaking (though ultimately rewarding) process of bringing the private sector into the negotiations in order to develop reasonable standards that could be improved over time.

The Philippines AirCon program is administered by two government agencies, the Department of Energy and the Department of Trade and Industry. DOE administers the program and runs the Fuels and Appliances Testing Laboratory (FATL). FATL is a key component of the program, serving as an independent testing laboratory to verify manufacturers’ assertions of the efficiency of their units. The Department of Trade and Industry’s Bureau of Product Standards is responsible for enforcing the standard. Initially covering only domestically produced units, the program was modified recently to cover imported air conditioners as well.

The Energy Efficiency Ratio (EER), a measure of the efficiency of an air conditioner based on output cooling capacity and energy consumption, is a critical feature of the program. The minimum standards established through the program set a floor EER for all aircon systems. The EER also serves a key labeling function. Prominently displayed on a certified yellow card on every residential air conditioner sold, the EER can be a means for manufacturers to promote their high efficiency units. In the competitive Philippine aircon market, the EER can be a powerful advertising tool.

**Impact Data in Brief**

As of August 1995, there are over 95,000 window and split-type air conditioners sold annually in the Philippines. All of these units must comply with the standards and labeling program. FATL analysts suggest that prior to the initiation of the program, only half of the annual sales volume for small-sized, window-type air conditioners met the standard, while none of the larger units did. By forcing these units off the market, the program had an immediate and pronounced effect in the overall efficiency of air conditioners sold in the Philippines. When the standards are made more stringent in 1996, the least efficient units will once again be eliminated.

The program can also promote efficiency improvements among units already complying with the minimum standard. As the program’s labeling component increases consumer awareness — and a recent campaign has played an important role in raising the awareness of both consumers and distributors — manufacturers will have an additional incentive to market efficient units. Energy-conscious consumers will, in effect, drive manufacturers to produce the equipment with the highest levels of energy efficiency that can be cost-effectively achieved. FATL analysis indicates that, due to the “push” of standards and the “pull” of labeling, the Philippines aircon program has resulted in efficiency gains across all aircon units on the order of 25 percent.

Preliminary estimates suggest that the program resulted in first-year capacity savings of roughly 6 MW of capacity and energy savings of roughly 17 GWh. The impact of the program will increase with time because the number of air conditioners in the country is rising dramatically. Manufacturers conservatively estimate that the market will grow by 20 percent annually for the foreseeable future. In 1994, demand for window-type units increased by nearly 40 percent.
Based on this demand growth program analysts believe that by the year 2012 the program will have saved over 400 MW of peak capacity and will have resulted in cumulative energy savings of 780 GWh. The standards and labeling program will offset hundreds of millions of dollars of generating capacity additions. Furthermore, as the Philippines economy appears poised to enter a period of sustained and dramatic economic growth, it is likely that even greater demands will be placed on the country’s generating capacity, underscoring the importance of the standards and labeling program.

Program designers and implementers see the AirCon program as an excellent first step, and one that can be replicated in subsequent efforts. FATL plans similar programs for other end-uses such as refrigerators, lamp ballasts, fans, rice cookers, washing machines, and other household appliances. The success of the AirCon program has been critical to program planning, and the program serves as a powerful and positive template for further initiatives.

Summary/Lessons Learned

• **Private sector participation is essential.**

The Residential AirCon Program has been a marked success because it has been a carefully crafted effort between the public and private sector. Rather than forcing a tough set of standards down the throats of the manufacturers, the Philippines government established a Technical Committee to develop the program — headed up by the president of the trade association of home appliance manufacturers — and worked diligently to reach consensus on the most appropriate course of action.

• **The combination of incentives and penalties is extremely effective.**

While manufacturers have had to retool their factories and invest in designing more efficient units, they have benefited from using the labels as market tools. For its part, the government has played an important role in promoting the labels, raising awareness of the value of energy-efficient products and creating a means of product differentiation. As a result of this collaboration, manufacturers have recognized that they can develop high quality products that will give them sustained and increasing revenues through sales in the Philippines and potentially through export to other countries in the region.

• **Establishing test procedures that are agreeable to government and industry is critical.**

The testing and certification aspect of the program has been the most contentious aspect of the program and represents a fertile area for lessons learned. How can manufacturers be assured that a government-operated laboratory with restricted funding will be accurate? Can the government accredit independent laboratories to do this work, akin to Energy Technology Laboratories in the United States? What test procedure are to be used? These have been among the key issues faced by program planners in the Philippines. They represent only the tip of the iceberg of lessons learned that can be used to maximize the effectiveness of subsequent standards and labeling programs both in the Philippines and in other countries.

The Residential AirCon Standards and Labeling program represents a highly successful model of how government, in the absence of utility involvement, can accelerate the transformation of the market for efficient household appliances at low cost by working in collaboration with manufacturers. As the electricity markets around the world become more competitive due to industry restructuring, standards and labeling programs may well become important tools with which to promote efficiency and, in the long run, support national economies.

A more complete description of this program can be found in a companion report — *Standards and Labeling: The Philippines’ Residential Air Conditioner Program.*
5. Conclusions

• There is a rich but largely unknown experience of energy efficiency in Asia.

With Asian energy efficiency programs, the old adage “the further you look the more you find” describes the situation well. Initially, newcomers to the region might believe that there is a lack of experience in energy efficiency. This is far from the truth. Innovative and successful programs can be found throughout the continent. This compendium summarizes only some of those experiences, and unfortunately it was difficult to uncover information about these programs. Often little has been written about past experiences and successes, a situation made worse by difficulty in international communication and a lack of institutional memory regarding the programs themselves.

As this report shows, the Asian experience with energy efficiency has been largely successful. It is hoped that the programs presented can serve as models to use, replicate, and build upon in the future. Promoting these case studies is the fundamental purpose of this report and was a source for enthusiasm with which the designers and implementers of each of the programs and projects shared their experiences and data.

• Asian energy policymakers are eager for knowledge on what their neighbors are doing but have had trouble getting up-to-date information.

Due to the economic successes in Asia over the last decade, Asian policy makers are more and more turning to their neighbors for “Asian solutions to Asian problems.” One common theme uncovered by this research is that there has been surprisingly little sharing of the best programs among the Asian countries themselves, not to mention with countries around the world. This has not been a function of unwillingness, but instead of staff and resources of energy efficiency programs throughout the region being insufficient to provide the levels of outreach necessary to catalyze further initiatives. Language is also a barrier, as are cultural differences and unique country circumstances. Nevertheless, as energy demand continues to grow in Asia, the importance of sharing information on energy efficiency programs will also grow.

• Government initiatives are more common than utility initiatives.

Another theme uncovered by this research, and corroborated by the International Institute for Energy Conservation’s Bangkok office, is that unlike the North American experience with energy efficiency, most Asian success stories have been driven by government initiatives and regulations rather than by utility demand-side management programs. Of the case studies presented in this text, only one program is specifically utility-driven. Clearly the North American DSM model, while itself undergoing a dramatic evolution, has not been widely employed in Asia. This is interesting given the high prices for electricity in the region, most Asian countries’ high level of dependence on imported fuels, the dramatic load growth specifically related to electrification, and these countries’ needs to address and mitigate air pollution.

• Government programs can be successful, but tend to be slow and under-funded, and improve baseline conditions rather than pushing the markets at the upper margins of efficiency.

Many government-driven efficiency programs in Asia, while both successful and similar to their North American counterparts, have been bogged down in bureaucracy and plagued by insufficient funding. Unlike private utilities, which can fund, design, and implement customer energy efficiency programs in a few years, government programs tend to be the products of lengthy legislative processes that necessarily work towards consensus. Government programs also often require yearly appropriations of funds, making multi-year efforts difficult. While noble and necessary, government initiatives tend to gradually improve the bottom of the market, cutting out the least efficient products and establishing a conservative baseline for efficiency, rather than promoting the best technologies — that do indeed bear high marginal costs — and thus focusing on the upper end of the market.

Building codes, for example, only require that a minimum efficiency level be attained, rather than providing incentives for reaching incrementally higher levels of efficiency. Appliance standards have the same affect, shoring up the bottom end of the market but not touching the top end. (Labeling programs, however, effectively complement standards by providing an incentive for manufacturers to continually strive to produce the most efficient, cost-effective product possible.)

While standards have inherent limitations, the establishment of energy efficiency floors is essential. Countries that fail to establish such floors could suffer “product dumping”, as manufacturers of inefficient products flood their market. Though carrying low up-front costs, these products would be more expensive to operate than their energy-efficient counterparts, penalizing the consumer and the national economy. This situation could also occur if imports are not
subject to the same standards of domestically-produced products (this was briefly a problem in the Philippines).

- **In theory, standards and codes can be ratcheted upwards, but in practice, such revisions are difficult if not impossible to execute.**

Singapore’s commercial building code has many merits, including the “teeth” that it has for non-complying developers and building owners. The code, however, has not been improved since it was established in 1979. Although a study in the early 1980s found the code’s requirements to be sub-optimal, proposals to improve the code have not yet been adopted.

In the Philippines, air conditioner standards were expected to be raised rather rapidly, pushing manufacturers to continue to develop and market more energy-efficient products. The need to build consensus and to collaborate closely with manufacturers, however, has caused the standards improvements to be delayed, lessening the impact of the program.

Conversely, Thailand’s Fluorescent Lamp Campaign (carried out by the national utility with the support of top echelons of the government) has shown that manufacturers are willing and capable of improving product efficiency quickly when they see a clear benefit in program participation. EGAT, by spending nearly $10 million promoting the program, strongly stimulated the market. This encouraged manufacturers to accelerate their program commitments, rather than dragging the process on and begrudgingly participating.

- **Many Asian countries have implemented codes, but without a specific and rigorous enforcement mechanism, the programs can be less than effective.**

Another key issue to be addressed when implementing codes is their enforcement. Who will enforce the codes and how? Without clear means for enforcement, codes become worthless, and a disappointing indicator of a country’s lack of commitment to efficiency. Building codes in the Philippines, for example, have neither been widely publicized nor enforced, diminishing the import and significance of these efforts.

- **Support from key policymakers or top utility management is critical to program success and sustainability.**

The most successful efforts in Asia have had support from key decision-makers. Those that have been less successful, such as the implementation of building codes in ASEAN countries, lacked such support. One source of such a deficiency is hastily initiated foreign assistance projects. In order to minimize this downfall, bilateral and multilateral assistance programs should devote considerable time and attention to building working relationships with policy makers and utility management in designing programs that meet their objectives.

- **Very competent staff and professionals reside in Asia and are ready and willing to implement efficiency measures.**

Thanks to support from international organizations as well as a wealth of training on energy efficiency, demand-side management, and integrated resource planning for utilities, the key barrier to promoting energy efficiency in Asia is not education. Highly competent staff know the “ins and outs” of efficiency; many have been trained both domestically and abroad.

This does not mean that new initiatives do not need to address education. Some of the best programs have contained elements of “institution building” for current and future project staff, professional and trade associations, vendors, distributors, manufacturers, and end-users of energy. This is an important focus, fostering the long-term growth of efficiency projects.

- **The most successful programs are internally funded.**

While foreign investments in energy efficiency in Asia have supported many efforts, it appears that domestic financial commitments to energy efficiency will be key to sustaining energy efficiency in the long-term. TTEM serves as a case in point. The program was generously funded as a pilot program in the late 1980s. An exemplary program, it died when foreign funds ran out. Today, the Philippine Department of Energy is attempting to revitalize the program, but is having difficulty convincing the government to fund the program.

On the other hand, the Thai DSM program, which is 85 percent internally funded, is highly successful, stable, and potentially long-lasting despite a rather slow start. Singapore’s building codes have been internally funded, except for technical assistance from the ASEAN-USAID program, and are still in full force and being improved.

- **Little attention has been paid to rigorous evaluations of past programs.**

Of all of the programs examined for this compendium, only a few had been evaluated. Impact data, such as savings and costs, are nearly non-existent, as are comprehensive evaluations of the process and impact efficacy of the programs. The few evaluations that do exist were undertaken by for-
foreign donors interested in the results of their funding. The only locally-sponsored rigorous evaluation will be of the Thai DSM program. Techniques used in that review as well as the extensive experience in efficiency program evaluation from developed countries should be spread throughout Asia.

Feedback is vital in developing effective future initiatives as well as communicating experiences to other energy policy makers domestically and throughout the region. Often when a program is discontinued without undergoing an evaluation, the lessons and experiences of that program are lost. Foreign donors could very effectively leverage their funds through support of evaluations of existing efficiency initiatives.

- **The challenge for effective foreign assistance is to strategically provide aid to create strong local energy efficiency capabilities.**

A key challenge for outside funders is how to best promote energy efficiency, to leverage change, and to build capabilities in Asian countries without directing policies and plans in ways that are not sensitive to local conditions. This report has found that foreign initiatives, while well-intentioned and apparently well-designed, often are not as appropriate to the local situation as they could be. Analysts in both the Philippines and Thailand expressed these concerns during our interviews with them.

While appreciative of outside assistance, in-country experts feel that such assistance has often fallen short of the mark. Rather than supporting locally initiated programs, donors have too often imposed programs from afar. While aid recipients are not likely to turn down such assistance, the lack of local support has meant that programs are not as effective as they might have otherwise been.

Some analysts in Asia suggest that the best way to support energy efficiency is to (a) support local initiatives and (b) build capabilities within the private sector. The Thai DSM and Singapore building code programs mentioned above both had local roots as well as donor support. Instead of initiating these programs, donor funds were used to strengthen existing ones. In addition, donors could increase their effectiveness by institutionalizing energy efficiency in the private sector. While assistance to governments and utilities is helpful and needed, it might be more effective to work with the private sector, supporting public/private initiatives and the development of an energy efficiency industry in Asian countries. Such an undertaking will not be easy, but it could substantially increase the impact of foreign aid in advancing energy efficiency in Asia.

This paper has highlighted some of the more exciting energy efficiency initiatives in Asia. While these programs have been quite effective, the huge Asian opportunity for energy efficiency has not yet been tapped. Most of these efforts, with exception of the Chinese industrial program, have been limited by either scope, budget, or time. Given the extraordinary demands being placed on the region for electricity and energy development, staff who are not only capable but well-trained, and the successes that stand out and serve as models for what can be done in the future, the Asian market is ripe for further efficiency improvements.

It is imperative that Asia embrace energy efficiency as soon as possible. Most of Asia is just now erecting many of the buildings and factories that will be used well into the next century. These buildings will represent a huge lost opportunity for energy efficiency if they do not incorporate energy-efficient designs when built. The cost of going back to improve them later, as has been done in the U.S. and Europe, will be several-fold more expensive and difficult to implement.

In the coming years, Asia will develop and refine its own interpretation of how best to promote energy efficiency. This interpretation will be based in part on sharing experiences with neighbors and on solid evaluations of past experiences. The lessons learned from this review lead to a simple set of recommendations for Asian countries:

- Learn from others’ experiences in Asia and elsewhere.
- Get full support from key decision-makers for any programs that are initiated.
- Ensure that the private sector is closely involved.
- Ensure that all efforts are initiated locally and are well adapted to the local situation.
- Prepare an adequate budget and ensure that the budget is largely locally funded.
- Undertake detailed evaluations of implemented programs in order to improve future work and learn from past mistakes.

There is no doubt that energy efficiency represents a huge resource for Asia. The key challenge to tapping this cheap and economically beneficial opportunity is in developing efficiency promotion programs that work, are simple to administer, and are relatively low-cost. If past successes are any indication of future promises, Asia may be well on the path to harvesting the multiple advantages of energy efficiency.
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CHINESE INDUSTRIAL ENERGY EFFICIENCY REGULATIONS

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THE PHILIPPINES RESIDENTIAL “AIRCON” STANDARDS AND LABELING PROGRAM REFERENCES

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Acknowledgements

This Profile was co-authored by the International Institute for Energy Conservation (IIEC) and IRT/The Results Center. IIEC's participation was funded by the Global Energy Efficiency Initiative under United States Agency for International Development's Cooperative Agreement No. PCE-5743-A-00-2057-00. The Results Center's participation was funded through the John Merck Fund.

Without the diligence and support of Karen Holmes and Bob Price at the IIEC Washington, DC office, this Profile would not have been possible. Thanks also to our most gracious research contacts and hosts throughout the region.
About the Global Energy Efficiency Initiative...

Funded by the U.S. Agency for International Development, The Global Energy Efficiency Initiative (GEEI) is a coalition of more than 100 governmental, private, and non-governmental organizations working to promote international sustainable energy. It was launched in 1990 to promote the adoption of energy efficiency as a least-cost development strategy in developing countries and Eastern and Central Europe. IIEC serves as the Secretariat for the GEEI Working Group, which is working in two principal areas: enhancing innovation and coordination among member projects; and influencing international energy efficiency policies.

Program Highlights

• GEEI recently published the Sustainable Energy Guide, profiling more than 100 sources of information, training, technical assistance and financing available from the public, private and multilateral sectors. The Guide is intended to build the capacity of developing country project managers to access assistance in creating, funding and implementing projects in energy efficiency and renewable energy.

• GEEI secretariat staff, along with several GEEI member organizations, are participating in the InterAction Working Group on International Sustainable Energy. This group fosters partnerships between sustainable energy experts and development practitioners to increase awareness and understanding of the use of alternative energy sources in overseas projects.

• GEEI is carrying out numerous activities to help advance informed discussion and debate of international sustainable energy policies. One such activity is an analysis of U.S. federal policy concerning international energy efficiency, slated for release in the winter of 1995.

• GEEI also sponsors periodic briefings on emerging policy issues. Recent briefings have addressed such issues as: development assistance for renewable electricity; the energy-related aspects of the U.S. government’s Environmental Technology Initiative; and the role of energy service companies (ESCOs) in implementing energy efficiency in developing countries.
The International Institute for Energy Conservation

Catalyzing Energy Efficiency Around the Globe

The International Institute for Energy Conservation is a non-profit organization founded in 1984 to accelerate the global adoption of energy-efficiency policies, technologies, and practices in order to enable economically and ecologically sustainable development. By conserving energy, countries can meet rising demand for energy services at a much lower cost, allowing them to focus on economic and social development.

IIEC acts as a facilitator between institutions with experience implementing energy efficiency and those institutions in developing countries with the need for such expertise. We help build capacity within developing countries to implement their own energy-efficiency programs by working through our regional offices in Europe, Latin America, and Asia. In addition, IIEC’s main office, located in Washington, D.C., carries out activities in the following program areas: private sector, transportation, model countries, multilateral development banks, and information & training. IIEC also publishes a newsletter, E-notes, and many other publications.

IIEC works at three different levels: development of energy policy; design and implementation of efficiency programs; and capacity-building through training and education. Examples of IIEC’s recent work include:

- Drafting of a master plan for demand side management adopted by the government of Thailand in 1991.

- Assisting a Chilean mining conglomerate to establish an energy-efficiency unit as a profit center within its organization.

- Developing a project with the Mexican utilities and government, funded by the Global Environmental Facility, to distribute energy-efficient lamps to 1.5 million Mexican homes.

- Assisting the European Bank for Reconstruction and Development in the identification of bankable energy-efficiency projects in Central and Eastern Europe.