PART III – BUILDING ENERGY EFFICIENCY POLICIES IN ASIA

China

Summary

- China has been transformed from an energy exporter as recently as the early 1990s to the world's third-largest net importer of oil in 2006. The growth rate of its energy consumption through 2030 is predicted to be the highest in the world.
- Nearly half of the world's new building construction now is in China—this will also be the case for the next 10 years. Energy consumption of buildings rose from 10 percent of the total in the late 1970s to more than 25 percent in 2006, and is expected to soar to 35 percent soon.
- There has been a distinct shift in China's national energy policy from a previous focus solely on energy development to emphasis on both development and efficiency; building and transport sectors are accorded the same importance in the energy conservation policy as the industry sector.
- Although China's building energy-efficiency program remains focused on the enforcement of building energy codes, recent efforts go beyond that through demonstration buildings, building performance ratings, and green building rating systems. These initiatives remain exploratory, but public concern about the environment, energy waste, and climate change has grown rapidly in

recent years, and may lead to major changes in China's booming construction industry.

- Cities across China enforce building energy standards to varying degrees. Enforcement infrastructure is, to a certain degree, established in major cities, e.g., Shanghai, Beijing, Guangzhou, Shenzhen, Tianjin and Wuhan, with rising compliance rates. But enforcement is still spotty in the smaller cities and towns.

Data Profile

China was largely self-sufficient in energy before the 1980s. The first two oil shocks in the 1970s had little impact on the Chinese economy and energy sector. Indeed, China exported crude oil to several of its Asian neighbors during this period.

Since the early 1980s, with the nation's industrialization and urbanization drive, domestic energy production has failed to keep pace with China's growing energy demand. In 1993, China became a net importer of oil and in 2006 it became the world's third-largest net importer of oil, behind the U.S. and Japan.

The large gap between stagnant energy production and fast-growing consumption is projected to expand further in the next two decades. According to the Energy Information Administration (EIA), China's oil and natural gas consumption is projected to rise 3.8 percent and 6.8 percent annually, respectively, through 2030. Both are the highest in the world. With such a growth rate, China's energy demand is likely to more than double in two decades from the current level.

Such rapid growth in energy consumption is attributed to a rapid rise in demand in China's energy-intensive industries, as well as its building and transport sectors. The building sector, which accounted for 10 percent of total national energy consumption in the late 1970s, consumed more than 25 percent of the total over recent years and is forecast to soar to 35 percent within the coming 10 years.[75] Approximately 2 billion square meters of floor area are being constructed

annually, which accounts for almost half of the annual constructed floor area worldwide.[76] Existing buildings in China amount to some 40 billion square meters,[77] and this number is expected to double by 2020. According to experts, 95 percent of China's buildings are "highly inefficient," with envelope thermal conditions that are two to three times less efficient than those in developed countries.[78]

Undoubtedly, the energy performance of so much new construction, as well as that of the huge stock of existing buildings, will have significant repercussions on global energy consumption and greenhouse gas emissions.

National Energy Policy

Alarmed by China's rapid growth in energy consumption, government officials have started to worry that energy shortages and increasing imports would become a bottleneck hindering economic growth, threatening both the environment and national security. In 2004, the State Council's Development Research Center published a report exploring options for a national energy strategy: China National Energy Strategy and Policy 2020 (NESP). According to the report, China spends 13 percent of its GDP on energy, almost double the level in the U.S. The report also said that China could decrease its use of energy from predicted levels by 25 percent by 2020, if it were to take effective energy-saving measures. The Chinese government has begun to recognize that the country has great potential to improve efficiency and alleviate the impact of shortages in energy supply.

This backdrop has induced a significant shift in China's energy policy in recent years. Although the Chinese government has been pushing energy efficiency and conservation since the late 1980s and has achieved significant accomplishment, energy development was seen as the main strategy for securing long-term economic development and national security. In recent years, however, improving energy efficiency has been assigned a high priority, with equal importance as energy development.

In 2004, the State Council approved an energy development program for 2004-2020. It is China's first long-term energy policy in almost half a century. The program lists energy conservation as its first concern, along with other principles such as optimization of the energy consumption mix, promotion of environmental protection, and protection of energy security. This stated new philosophy represents a shift from a previous sole focus on energy exploitation. Central leaders have reached consensus that it will not be sustainable to rely on heavy energy consumption to drive the economy.

In the latest national development plan, the 11th Five-Year Plan (2006-2010), it is stressed that China will develop a resource-efficient development mode with Chinese characteristics by giving priority to resources and energy savings, and promoting a recycling economy to gradually create savings-oriented industrial and consumption structures.

Energy-Efficiency Policies

There has also been a notable change in China's energy-efficiency policy. Energy efficiency in the industrial sector, which was the single biggest energy consumer in China in the past decades, had been the sole priority. In recent years, with the significant increase of energy consumption in building and transport, these two sectors have been accorded the same importance as the industry sector.

In November 2004, the National Development and Reform Commission (NDRC) unveiled the China Medium and Long Term Energy Conservation Plan (Conservation Plan), which stresses that energy conservation is a long-term strategic guideline in China's economic and social development and an extremely urgent matter at present. The plan established two main principles: 1) China should adopt neo-industrialization, in which energy-savings play an important role,[79] and 2) the market is expected to play the leading role in allocating resources.[80]

According to the Conservation Plan, over the medium term period China is focusing energy savings in four equally important areas: the industrial sector, transportation, construction, and commercial and civil power use.

Building Energy-Efficiency Policies and Initiatives

Building Energy-Savings Targets

China began to pay attention to building energy-efficiency issues in the mid-1980s when large-scale urban construction (mainly residential buildings) began. Since early 2004, building energy efficiency has been emphasized to an unprecedented degree, with ambitious energy-saving targets being set in the Conservation Plan:

> *By the end of 2010, all Chinese cities will be expected to reduce their buildings' energy use by 50 percent; by 2020, that figure will be 65 percent. Furthermore, by 2010, 25 percent of existing residential and public buildings in the country's large cities will be retrofitted to be greener; that number will be 15 percent in medium-sized cities and 10 percent in small cities. Over 80 million square meters of building space will be powered using solar and other renewable energies.*[81]

For the Eleventh Five-Year Plan (2006-2010), ten programs have been planned for improving energy efficiency. Building energy efficiency is one of them and there are two others related to buildings (the Environmentally-Friendly Lighting Program and the Program of Energy Conservation in Governmental Departments). The building sector is expected to contribute 40 percent of the total energy-saving target for the Eleventh Five-Year Plan period. The main strategies for achieving the target include strictly enforcing the standards of energy-efficiency design for construction industries and improved appliance/equipment efficiency for commercial and civil energy conservation.[82]

Building Energy-Efficiency Standards

Evolution

At present, there are two sets of national building energy standards in China, one for public, or non-residential, buildings and another for residential buildings. These national standards are model energy standards, roughly analogous to the International Energy Code (IEC) or ASHRAE 90.1 in the United States, with their actual enforcement relegated to the local governments or construction commissions. In a number of instances, individual cities and provinces have developed their own standards, either before the national standard became available, or if the local standard was more stringent.[83] However, by and large the recent efforts in developing national building energy standards have made most of the local standards outdated and unnecessary.

China's Ministry of Construction (MOC) issued the first energy design standard for residential buildings in the Heating Zone in north China in 1986, and revised it in 1995. The energy-saving target of this standard was a 30 percent reduction in heating energy use, compared with pre-existing buildings, by 1986, and a 50 percent reduction by 1995. In 2001, a standard for residential buildings in the Hot-Summer Cold-Winter Region in central China was issued, followed by a standard for the Hot-Summer Warm-Winter Region in south China in 2003. The energy-saving target was set at a 50 percent reduction in total heating and cooling energy use. A revised national energy design standard for residential buildings that combines the three previous regional standards has been under development since 2005, and is expected to be completed in 2007. Preceding these national or regional standards, there have also been local standards in major cities, such as Beijing, Tianjin, Shanghai, and Chongqing.

For non-residential buildings, the first energy standard was the standard for tourist hotels adopted in 1993, targeting 30 percent energy savings compared to pre-existing buildings. In 2004, a national energy-efficient design standard for public buildings (similar to commercial

buildings) was adopted. This is China's first such national standard, although Shanghai had produced a local standard for commercial buildings in 2003. This standard set a target of 50 percent energy savings in heating, cooling and lighting energy use compared to pre-existing buildings, achieved through improvements to the building envelope, HVAC, and the lighting system.[84] The savings from envelope and equipment measures varies by climate, with envelope savings ranging from 13-25 percent, HVAC, 16-20 percent, and lighting, 7-18 percent.

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One characteristic shared by all of China's building energy standards is their narrow scope. The residential standards are largely envelope standards; the public building standard also addresses HVAC system efficiency, but not that of the lighting, electric power, or hot water systems. One reason for this is that the MOC has separate energy standards for lighting (Building Lighting Design Standard GB 50034-2004), room air conditioners, and commercial HVAC equipment, to which the building standards refer. Another reason is that in residential buildings, air conditioning is installed by the apartment owner, making any requirements in the building standard difficult to enforce and thus largely advisory.

The residential standard contains prescriptive requirements for the roof, floor, wall, and windows that vary by climate and the number of floors of the building. The window requirements vary by the window-to-wall ratio, with more stringent thermal requirements (in the heating-dominant climates) or shading coefficient (in the cooling-dominant climates) requirements for larger window areas. Compared to the residential standard, the prescriptive envelope requirements in the public building energy standard have similar to somewhat lower thermal requirements for both opaque surfaces and fenestration, but noticeably more stringent shading coefficient requirements in recognition of the higher cooling loads in public buildings.

In addition to these prescriptive requirements, both the new residential and public building standards contain performance options whereby a building is deemed to meet the standard so long as its calculated building energy use is below that of a reference building. This "custom budget" approach is similar to that used in U.S. standards such as ASHRAE 90.1, and differs from the "fixed budget" approach found in several other Asian countries.

Both standards have a chapter on the requirements for equipment.[85] In addition, the public building energy standard also has a chapter on monitoring and controls, mostly with recommendations on how to control the building HVAC system for energy efficiency, and enabling the possibility of energy monitoring. The standard does not cover lighting systems, a very important aspect of energy efficiency in large buildings, which is covered in a separate lighting energy standard that was developed by the MOC in 2003.

Jurisdiction

From an institutional point of view, China has the benefit of a centralized ministry (MOC) responsible for regulating a building industry that over the past decade has built roughly half of the new construction of the entire world. Under the MOC, there is a network of construction commissions in the major cities and provinces to oversee building construction, including the granting of building permits and enforcement of building codes, as well as a parallel network of building research institutes to provide technical expertise and support to the MOC and the building industry. Within the MOC, building energy standards fall under the jurisdiction of the Department of Standards and Norms. However, the technical development of building energy standards is the responsibility of the Department of Science and Technology, in collaboration with building research institutes, universities, and industry representatives. For example, for the current residential and public

building standards, compilation committees were organized under the leadership of the China Academy of Building Research.

Implementation

As in many other countries, the point of control in enforcing building energy standards is during design and construction, with non-compliance resulting in the building permits not being issued. Although the MOC has made both standards mandatory, enforcement remains a problem, especially in small and medium-sized cities. A survey conducted by the MOC in 2005 of code enforcement in northern China identified another problem: while over 87.5 percent of the buildings complied with the energy standard on paper, less than 49 percent were found to be compliant upon actual inspection. Barriers to effective enforcement include the lack of supporting information, training, resources and political will in supporting the enforcement of the code.

Appliance/Equipment Labeling and Standards

Since 1989, China has developed one of the most comprehensive appliance standards and labeling programs in the developing world.[86] The program includes mandatory minimum energy-efficiency standards, voluntary endorsement labeling, and mandatory energy-information labeling: [87]

- The minimum energy-efficiency standards are mandatory and have been issued for 23 types of appliances and equipment.
- The voluntary endorsement label has been issued for 36 types of appliances, lighting, and industrial products.
- The information label is currently under development.

In fact, in terms of the coverage of the labeling and standards program, China is the leader whose program covers the most types of appliance/equipment among the 11 Asian economies reviewed in this study. However, the program lacks effective implementation and

enforcement due to the lack of transparency in the standards-making process, a lack of monitoring and penalty measures, etc.[88]

Other Initiatives

Although the MOC continues to regard the enforcement of building energy standards as the linchpin in improving building energy efficiency, there have also been a number of pilot efforts or discussions about voluntary market-based programs.

Green Building Movement

To encourage buildings to go beyond the minimum energy-efficiency requirement, the MOC recently unveiled the "Evaluation Standard for Green Building" (GB/T 50378-2006), which took effect June 1, 2006. The standard is similar to that of LEED. MOC will collect building energy consumption data, assess energy performance based on the standard, and issue the three-star Green Building certification to qualified buildings. The local government will be in charge of the issuing of lower level one-star and two-star certifications.[89]

In support for a Green Olympics for the 2008 Games, the Beijing Science and Technology Commission sponsored the development of another green building rating system, Green Olympic Building Assessment System (GOBAS), led by Tsinghua University. The system is modeled primarily on Japan's Comprehensive Assessment System for Building Environmental Efficiency (CASBEE) and, to a lesser extent, on LEED.

Since these two national green building rating systems came into being just recently and are still in the early stages of development, high-performance building projects sponsored by both government and business are seeking recognition for their energy performance with international green building systems like LEED. Up to the end of 2006, 5 projects from China were certified under LEED (see Part II for the first LEED-certified commercial project in China, the TaiGe Service Apartments).

Building Inspection Program

In 2005, the central government began a nationwide building inspection program to monitor the implementation of energy-efficiency regulations. Design institutions, developers, and construction companies that do not comply with regulations can lose their license or certification. A CNY500,000 (around US$66,000) fine was recently introduced for new buildings that are found not to have met the standards. Retrofit of the building will be required after the fine.

Demonstration Cities and Projects

To promote the implementation of national policy at the local level, seven cities (Shanghai, Beijing, Shenzhen, Chongqing, Fuzhou, Xiamen and Tianjin) have been chosen as pilot cities by the central government to develop local building energy-management systems, with the help of international organizations like the Chinese Sustainable Energy Program (CSEP), to showcase energy-efficient technologies and practices.[90] Initiatives include establishing the design examination system of energy efficiency in buildings, formulating local building codes, instituting an energy-efficient building rating and certification system, training architects and engineers, and promoting the development of an energy-efficient materials and products market.

Meanwhile, there have also been numerous demonstration buildings showcasing energy-efficient technologies and practices in Beijing (e.g. the new headquarters building of the Ministry of Science and Technology in China 2004, Tsinghua Sino-Italian Ecological and Energy-efficient Building 2005, Low-energy Demo Building 2005), Shanghai (Shanghai Research Institute of Building Sciences Eco office 2006), and other cities.

Planned Energy Consumption Data Collection

China is planning to establish energy consumption data collection and energy audit and information disclosure mechanisms for government

office buildings in the 11th Five-Year Plan period (2006-2010). These measures are expected to enable consumers to make informed decisions, and promote the taking up of energy-efficiency measures by developers.

Planned Financial Incentives

Until now, China has offered no financial incentives through its national policies to promote energy-efficient buildings. However, MOC has conducted extensive studies on the introduction of an incentive mechanism and produced a first draft, which will soon be submitted to the State Council for examination and approval. Meanwhile, the Regional Finance Research Division of the Research Institute for Fiscal Science (under the Ministry of Finance) and the China National Institute of Standardization are designing tax and fiscal policies to encourage commercialization of efficient appliances and equipment. They are expected to develop policy recommendations and an implementation plan. At the local level, certain progressive cities such as Shenzhen are beginning to offer financial incentives to developers who use energy-efficient building technologies.[91]

Hong Kong

Summary

- The building sector accounts for more than 50 percent of total final energy consumption in Hong Kong; and this amount is rising as energy consumption in the building sector grows faster than in other sectors.
- Public awareness of environmental protection is developing in Hong Kong as people suffer from severe air pollution. Government and the public view energy efficiency as one of the key measures to address this problem.
- The Hong Kong government is taking a voluntary and lead-by-example approach to improving building energy efficiency. A variety of building energy-efficiency measures and programs are available on voluntary basis, while substantial efficiency improvements are being undertaken in government buildings in order to provide a role model and showcase energy-efficiency technologies and practices for the private sector.
- Hong Kong is one of only two economies among those reviewed in this study that have non-government building energy-efficiency programs. The Building Environmental Assessment Method (BEAM), a voluntary green building rating and certification system, is the most widely used green building scheme in Asia, and has been adopted in over 100 premises.

Data Profile[92]

Hong Kong derives its energy supplies entirely from external sources. Between 1995 and 2005, the final energy consumption in Hong Kong increased by 14.0 percent, with an average annual growth rate of 1.3

percent, while GDP grew at an average annual rate of 3.9 percent in real terms over the same period.

Unlike other Asian countries where the industrial sector accounts for 30 to 50 percent of total energy consumption, Hong Kong, as a service-based economy, has a shrinking industrial sector. Its proportion of total final energy consumption decreased from 20 percent in 1994 to 10 percent in 2004. The building sector is Hong Kong's biggest energy consumer, with total final energy consumption rising from 44 percent in 1994 to 54 percent in 2004. As the second largest consumer of energy, the transport sector accounted for 35 to 38 percent during the same period.

The building sector is also the largest user of electricity and gas, taking up around 90 percent and 97 percent of the total local consumption of electricity and gas, respectively.

Air conditioning accounts for more than 30 percent of the total electricity consumption in Hong Kong. Non-domestic buildings consume 72 percent of air conditioning. Hong Kong's total electricity consumption grew by 52 percent from 1990 to 2000, while the electricity consumption by air conditioning grew about 55 percent during the same period. The use of air conditioning is expected to grow further due to Hong Kong's increasing population and economic activity.

Energy Policy

Hong Kong has no indigenous energy resources, and relies totally on imports for its primary energy demand. To support Hong Kong's economic development, energy policy in Hong Kong aims to:

- Ensure that the energy needs of the community are met safely, efficiently and at reasonable prices;
- Minimize the environmental impact of energy production and use; and
- Promote the efficient use and conservation of energy.

The Hong Kong government has a fundamental philosophy of minimum government intervention in the business sector, which means

the government intervenes only when public interest is involved. In keeping with such a free-market economic philosophy, the government considers the private sector best suited to supply energy requirements in response to market demands, and intervenes only to safeguard the interests of consumers, where necessary, to ensure public safety and to protect the environment. The energy sector consists of investor-owned electricity and gas utility companies.

Energy-Efficiency Policies

The Hong Kong government has been working on energy efficiency for more than 10 years and has reduced the emission of greenhouse gases by 17 percent from its historical high in the 1990s, according to government data.[93] Because Hong Kong's industrial sector has contracted, energy-efficiency programs in Hong Kong focus on the building sector and transportation sector, which accounted for 54 percent and 36 percent of total energy consumption in 2004 respectively.

To promote energy efficiency and conservation, an Energy Efficiency Office (EEO) was established under the Electrical and Mechanical Services Department (EMSD) in 1994 to provide the technical expertise and drive for energy-efficiency and conservation programs. The office issues codes of practice, such as building energy codes, establishes guidelines, and is actively involved in working groups and related committees in the efficient use and conservation of electricity. Additional initiatives range from energy management and database management, benchmarking, the exploration of advanced energy-efficiency technologies, and energy-efficiency labeling schemes to promoting wider use of new and renewable energy.[94]

Building Energy-Efficiency Policies and Initiatives

Building Energy-Efficiency Standards

Hong Kong's efforts to develop building energy standards started with the commissioning in 1990 of a consultant report on building energy

regulations. This report recommended that Hong Kong adopt an overall thermal transfer value (OTTV) standard for the building envelope. Such a building energy-efficiency regulation was introduced in July 1995 with "suitable" OTTV for the walls and roofs of commercial buildings[95] and hotels. In practice, the code has been applied to any air-conditioned building.

In addition to the OTTV standard, which affects only the construction of the building envelope, the Hong Kong government also developed separate standards for lighting, air conditioning, and electrical equipment (all in 1998), and for elevators (2000). Thus, by 2000, these five standards together contained the same scope as more comprehensive standards such as ASHRAE 90.1 in the U.S. In 2005, Hong Kong revised all five of these standards, adding a performance-based option to the building envelope standard to encourage innovations in building designs.

The Hong Kong OTTV standard is a mandatory standard, while other codes for lighting, air conditioning, electrical equipment and elevators are voluntary.

Among the positive features of the Hong Kong policy, the standards are freely available on the Web, and each standard contains the standardized forms that users can fill out to demonstrate compliance.

A study of the design and estimated annual energy use in a representative sample of air-conditioned buildings revealed that mandatory implementation of EMSD's energy-efficiency codes for all such buildings could lead to a savings in annual electricity consumption in Hong Kong of about 8 percent.[96] Many buildings commissioned in recent years have not even met the requirements of the codes.

Appliance/Equipment Labeling and Standards

The Energy Efficiency Office has operated a voluntary energy-efficiency labeling scheme for appliances, home and office equipment, and vehicles since 1995. The scheme now covers 17 types of household

appliances and office equipment.[97] The scheme has been well-received by the trade and consumers in Hong Kong, and has helped phase out less energy-efficient products from the market. According to the EEO, about half of the energy savings it has achieved has come from the scheme.

Hong Kong is the only economy among the 11 Asian economies reviewed in this study that does not have energy-efficiency standards for appliances/equipment.

EEO is now monitoring the labeling program, and will decide whether the labels should become mandatory, and whether minimum energy-performance standards should be implemented.

Other Initiatives

In addition to the building energy standard and appliance/equipment labeling program, a variety of supportive non-regulatory programs are available in Hong Kong.

Building Energy Consumption Indicators and Benchmarks

Benchmarks have been established for offices, commercial outlets, hotels and boarding houses, universities, post-secondary colleges and schools, hospitals and clinics, private cars, light-goods vehicles, medium-goods vehicles, heavy-goods vehicles, private light buses, and non-franchised buses. The web site for this program contains plots of the energy use of the buildings in a database, and also an on-line benchmarking tool that allows users to enter their energy consumption.[98]

Energy Efficiency Registration Scheme for Buildings

To promote adoption of the voluntary standards, EMSD established an Energy Efficiency Registration Scheme for Buildings in 1998. Designers, developers, property management companies, etc., can submit details of their building for assessment. If the EEO determines that the building is in compliance with the standards, a registration certificate will be issued,

and the building can use the scheme's energy-efficient building logo on their documents to publicize their achievement in energy efficiency. As of December 2006, 1,722 registration certificates have been issued for 713 building venues, mainly government buildings.

Energy-Efficiency Awards

To draw public and professional attention and to encourage wider acceptance of the building energy codes, the Hong Kong Awards for Energy Efficiency and Conservation in Government were launched in 2003. The awards scheme was then adapted and launched in 2004 for the private sector under the name of Hong Kong Energy Efficiency Awards.

Energy Audit Program

Begun in 1994, the energy audits conducted by EEO cover all major government buildings and information on measures implemented to achieve energy savings in these buildings was disseminated to the private sector. A set of energy audit guidelines was published, and then augmented in 2004, for the benefit of property owners and property management companies.

Pilot Scheme for Wider Use of Water-Cooled Air Conditioning System

Launched by the government in 2000, the scheme allows non-residential buildings to use cooling towers in their air conditioning systems (which could produce electricity savings of 20 to 30 percent). At the end of October 2004, 118 applications had been received under the scheme.

Demand-Side Management (DSM) Program

The Hong Kong government and two power companies (CLP Power and Hong Kong Electric) signed demand-side management agreements

in May 2000 for a three-year agreement period. Under the program, consumers received rebates from the power company, which in turn collects demand-side management incentive earnings from the Government. According to EEO, these programs led to early replacement of inefficient equipment. However, there is no information available that shows the current situation of this program.

Green Building Movement

Hong Kong is prominent in Asia in terms of non-government green building initiatives. The Building Environmental Assessment Method (BEAM) is a voluntary certification scheme launched in 1996 by the HK-BEAM Society—a non-profit organization consisting of developers, building professionals, contractors and property managers. BEAM recognizes improved environmental performance in building design and management. A study shows that if buildings complied with the exemplary energy performance criteria in BEAM version 1/96R, the savings could be as great as 32 percent; exemplary performance meeting BEAM 4/04 energy performance criteria would achieve even greater improvement.[99] Through May 2005, there have been 100 buildings or over 60 million square feet (around 5.6 million square meters) of floor space assessed by BEAM. These include 52,000 residential units, equivalent to the homes of 150,000 people or slightly over 2 percent of Hong Kong's population. The numbers make BEAM the most widely used scheme of its kind in the world on a per capita basis.

In August 2005, the Hong Kong government's Building Department released a study proposing the development of a new voluntary building rating system, the Comprehensive Environmental Performance Assessment Scheme (CEPAS). According to the study CEPAS will rate buildings on a "five-star" grading system, with 34 criteria in eight categories, ranging from hygiene, ventilation, and energy efficiency to waste management and cultural preservation during the design and construction stage. The best buildings will be given the platinum label. The other grades are

gold, silver, bronze and unclassified. The certificate will be valid for five years. This system is meant to become a benchmark for all construction in Hong Kong, making environmental awareness a business plus.

However, the government's proposal of a new rating system has not received a positive response from the industry. A study by the Construction Industry Council (CIC) shows that CEPAS and BEAM embodied roughly the same scope of assessment, while BEAM has been operational for a significant period of time and is recognized and utilized by a range of major clients. There is no necessity to take forward two similar systems, according to the study, and the pragmatic way forward is to endorse BEAM as the industry environmental performance assessment system while incorporating the few desirable elements contained in CEPAS into BEAM. The HK-BEAM Society is now studying the possibility of incorporating the CEPAS features.[100]

Building Energy-Consumption Databases

The Hong Kong Energy End-Use Database was established in 1997 to give an overall view of energy consumption data and patterns in Hong Kong. The database contains categorized annual energy consumption data of Hong Kong's energy end-users. Updated annually, it contains data from 1984 to 2002. Meanwhile, the EEO has established energy-consumption benchmarks for nine different energy-consuming groups and their sub-groups. Software benchmarking tools have been made available to the public (www.emsd.gov.hk). A numbers of other types of databases have also been established, such as the Renewable Energy Installations Database.

Education Programs

The Hong Kong government has designed a series of school outreach programs that cover virtually the entire education system, from kindergarten pre-schoolers to students in primary and secondary schools and universities. An interactive education web site, EnergyLand[101]

has been launched for students and the general public. At the same time, the EEO plays a monitoring role in the Scheme of Control Agreements with the power companies. Under the agreements, the power companies have the obligation to promote energy efficiency and conservation to the public. With the sponsorship of the two power companies, the Energy Efficiency Centre was opened to the public in 1996, and energy-efficiency education kits for the general studies subject for primary schools were developed. More recently, web-based energy-efficiency education kits have been designed. The government also organizes other activities and makes use of mass media to convey the message of energy efficiency.

Government Demonstration Programs

The government uses some of its buildings as showcases of energy-efficiency technologies and practice. For example, EMSD's new headquarters building employed a variety of energy-efficiency technologies to improve its performance. It used more than 2,300 building-integrated photovoltaic (BIPV) panels, the largest number in a project in Hong Kong. The panels can generate 3 to 4 percent of the electricity consumption of the building.

Life-Cycle Energy Analysis (LCEA) of Building Construction

In 2002, EMSD initiated a consultancy study titled Life-Cycle Energy Analysis of Building Construction. The study aimed to develop an assessment tool with model and data that appraises life-cycle costs and life-cycle performance of building materials and components; and provides guidelines on the use of alternative materials and systems that could help improve the environmental, energy and economic performance of buildings. Based on the study, the government developed the Life Cycle Assessment (LCA) tool[102] which is available for free on the government web site. The LCA tool provides a processing template, with design-oriented data-entry sheets and informative reporting documents for users.

India

Summary

- India is the world's sixth largest energy consumer. Its continuing population increase and rapid economic growth, along with a move toward urbanization and industrialization, has placed great strain on the country's energy resources and environment.
- Lowering energy intensity of GDP growth through higher energy efficiency is key to meeting India's energy challenge and ensuring its energy security.
- With a near consistent 8 percent rise in annual building energy consumption growth, it has increased from 14 percent in the 1970s to nearly 33 percent in 2005.
- India has just developed a first-generation building energy code that is yet to be formally adopted. Effective implementation of the code is hindered by such factors as a lack of (1) an uniform and practicable energy code; (2) clear implementation guidelines; (3) effective local implementation infrastructure for code administration and enforcement including code checking and inspections; (4) incentives from the government; (5) technical expertise; and (6) appropriate materials and equipment to meet requirement of codes, etc.
- Non-government initiatives from industry associations and private companies have played an important role in promoting the green building movement in India, a movement which has gained tremendous momentum during the past few years.

Data Profile[103]

Despite its large annual energy production, India is a net energy importer due to the large imbalance between production and consumption. It

currently ranks as the world's sixth largest energy consumer, accounting for about 3.3 percent of the world's total annual energy consumption, and as the world's eleventh largest energy producer, accounting for about 2.4 percent of the world's total annual energy production.[104] More than 70 percent of its crude oil consumption is met via imports.

In terms of per capita energy consumption, India is well below most of the rest of Asia and is one of the lowest in the world.[105] But, to a great extent, this low figure is a result of India's large rural population (70 percent of the total, or about 700 million people), which still has very limited access to electricity. India's urban population is expected to grow to about 473 million in 2021 and 820 million by 2051, compared with just 285 million in 2001. Its booming metropolises, with 35 cities with populations in excess of 1 million and more joining the list, are straining the limits of its energy supply and causing serious air pollution problems. From 1980 to 2001, total energy consumption in India increased 208 percent, while per capita consumption rose 103 percent. Higher energy consumption in the industrial, transportation, and building sectors continues to drive India's energy usage upwards at a rate even faster than China.

An analysis of consumption by sectors shows that industry accounts for nearly half of final commercial energy consumption, followed by the transport and building sectors. With a near consistent 8 percent rise in annual building energy consumption growth, it has increased from 14 percent in the 1970s to nearly 33 percent in 2005. The gross built-up area added to commercial and residential spaces was about 40.8 million square meters in 2004-05, about 1 percent of the world's annual average constructed floor area. The trends show a sustained growth of 10 percent over the coming years, highlighting the pace at which energy demand in the building sector is expected to rise in India.

With the huge growth in the construction sector and changing lifestyles, there is an increasing gap between supply and demand, with the resultant effect of long hours of power cuts in cities. It is not rare

for Indians to have 7 to 8 hours of power cuts every day, especially during the summer when the air conditioning load is at its peak.

In 2004, India ranked fifth in the world in carbon emissions, behind the United States, China, Russia and Japan.[106] Between 1990 and 2004, India's carbon emissions increased by an astonishing 82.5 percent, a rate surpassed only by China's 93.9 percent increase during the same time period.[107] For the coming decade, carbon emissions in India are expected to continue to increase because of low energy efficiency and rapid population growth and urbanization.

National Energy Policy

Energy is poised to be one of the biggest constraints to India's growth. Problems such as fuel shortages, an increasing dependency on imported oil, and poor financial and technical conditions of the power sector are discouraging growth in India.

Against such a background, energy policy in India focuses on 'energy for all' and intends to build an environment-friendly sustainable energy supply industry. With these primary objectives, the Planning Commission in 2006 unveiled the latest version of India's national energy policy, the Integrated Energy Policy, which is linked with sustainable development. The Integrated Energy Policy covers all sources of energy and addresses all aspects of energy use and supply including energy security, access and availability, affordability and pricing, as well as efficiency and environmental concerns. It highlights the following key elements that are needed to achieve the objective of 'energy for all';

- Markets that promote competition;
- Market-oriented energy pricing and allocation under effective and credible regulatory oversight;
- Transparent and targeted subsidies;
- Improved efficiencies across the energy chain;
- Policies that reflect externalities of energy consumption; and
- Policies that rely on viable incentives.

The Integrated Energy Policy expresses concerns over climate change and suggests a number of initiatives that will reduce greenhouse gas emissions:

- Energy efficiency in all sectors;
- Emphasis on mass transport;
- Active policy on renewable energy including bio-fuels and fuel plantations;
- Accelerated development of nuclear and hydro-electricity;
- Technology missions for clean coal technologies; and
- Focused R&D on climate-friendly technologies.

Energy-Efficiency Policies

India's first government initiative towards energy efficiency came when Parliament passed the Energy Conservation Act in 2001 and established the Bureau of Energy Efficiency (BEE) under the Ministry of Power to implement the Act. According to the Act, the target for energy savings by 2012 is 13 percent of estimated demand. The Act requires large energy consumers to adhere to energy consumption norms, new buildings to follow the Energy Conservation Building Code, and appliances to meet energy-performance standards and to display energy consumption labels.

The Integrated Energy Policy unveiled in 2006 has placed heavy emphasis on energy efficiency and conservation, with particular focus on efficiency of electricity generation, transmission, distribution and end-use. It points out that, over the next 25 years, energy efficiency and conservation will be critical to ensure energy security and economic growth.

The Integrated Energy Policy identified the following 10 leading areas where significant savings can make a substantial impact, half of which relate to the building sector:[108]

- Mining;
- Electricity generation, transmission and distribution;

- Water pumping;
- Industrial production, processes, hauling;
- Mass transport;
- Building design;
- Construction;
- Heating, ventilation and air conditioning;
- Lighting; and
- Household appliances.

Building Energy-Efficiency Policies and Initiatives

Building Energy-Efficiency Codes

India has many central and local authorities and bodies that help compile building codes and standards that are applicable at the local and national levels. As of now, there are three different codes/regulations that have been developed by national bodies:

- The Bureau of Indian Standards, National Building Code (NBC), which covers all aspects of building design and construction;
- The Bureau of Energy Efficiency, Energy Conservation Building Codes (ECBC), which target building energy efficiency; and
- The Ministry of Environment and Forests, Environmental Impact Assessment (EIA) and Clearance.

Among these codes/regulations, the ECBC is expected to have the most significant impact on building energy performance. The Indian government intends to integrate NBC and ECBC in the future.

National Building Code

Building by-laws in India fall under the purview of state governments and vary with administrative regions within the state. However, the central government realized the need to develop a unified building code to reflect the latest trends in construction. The Bureau of Indian Standards developed the National Building Code, or NBC, in the early 1980s as a guiding code for municipalities and development authorities

to follow in formulating and adopting building by-laws. The voluntary code is meant to serve as a guide to all governmental and private agencies controlling building activities. It covers most aspects of building design and construction, with a small part dedicated to energy efficiency.

India revised the NBC in 2005. In the latest version, the code provides guidance on aspects of energy conservation and sustainable development in various parts and sections concerning appropriate design, usage and practices with regard to building materials, construction technologies, and building and plumbing services. The document provides general guidance on potential energy-efficiency aspects of such factors as daylight integration, artificial lighting requirements, and select HVAC design norms.

Energy Conservation Building Codes

Energy Conservation Building Codes is the first stand-alone national building energy standard/code, developed after the enactment of the Energy Conservation Act of 2001. It represents India's first effort to manage energy efficiency in buildings. However, ECBC is yet to be formally adopted by authorities.

The ECBC aims to reduce India's baseline energy consumption by supporting adoption and implementation of building energy codes. It takes into account location and occupancy of the buildings and provides minimum standards for reducing energy demand of the buildings through design and construction practices while enhancing occupants' comfort.

Unlike the NBC, which provides general guidance relative to energy without setting any limits, the ECBC lists specific maximum and minimum limitations on a number of key building features that affect building energy use. The ECBC is mandatory for large commercial buildings[109] and applicable to all buildings with a large air-conditioned floor area.[110] The code is recommended for all other buildings.

ECBC has both prescriptive and performance-based compliance paths. The prescriptive path calls for adoption of minimum require-

ments for the building envelope and energy systems (lighting, HVAC, service water heating and electrical). The performance-based compliance path requires the application of Whole Building Simulation Approach to prove efficiency over base building as defined by the code. There is also a system-level performance compliance option for the building envelope. This leaves the code inherently flexible and easy to adopt.

The Bureau of Energy Efficiency is the primary body responsible for implementing the ECBC; it works towards policy formulation as well as technical support for the development of the codes and standards and their supporting compliance tools, procedures, and forms. In developing the ECBC, the bureau has orchestrated a diverse group of in-country and international technical experts. It is also working closely with national and state-level government entities to administer and enforce the ECBC and other energy-related codes and standards.

Environmental Impact Assessment and Clearance

The Environmental Impact Assessment (EIA) is an important management tool for ensuring optimal use of natural resources for sustainable development. EIA was made mandatory in India under the Environmental Protection Act (1986) for 29 categories of developmental activities involving investments of Rs. 50 crore (US$11.6 million) and above. Builders and developers must receive environmental clearance from the Ministry of Environment and Forests before beginning construction. The requirement for building energy performance in the EIA is a combination of related terms in NBC and ECBC.

Council interviews with builders and developers in India for this study show that environmental clearance leads to additional delays as the clearance process is very time and resource consuming. Also, due to the absence of normative guidelines, builders and developers are often left unsure of the options that they have to adopt in their projects to make the projects environmentally sensitive.

Implementation of above codes/regulations

Building energy codes and regulations in India are still far from being well implemented. In fact, ECBC has still not been formally adopted. Effective implementation of the code is hindered by such factors as:

- Lack of a uniform and practicable energy code;
- No clear implementation guidelines;
- No effective local implementation infrastructure for code administration and enforcement including code-checking and inspections;
- Lack of incentives from the government;
- Lack of technical expertise; and
- Lack of appropriate building materials and equipment to meet requirement of codes.

Some progressive state governments have taken initiatives to legislate select measures (e.g., use of solar water heating in residential/commercial buildings, or the use of compact fluorescent lamps in public buildings), but these initiatives are too few in number to be able to make a significant impact on the country's overall energy efficiency.

Appliance/Equipment Labeling and Standards

The Bureau of Energy Efficiency's standards and labeling program, currently under development, aims to ensure the availability only of energy-efficient equipment and appliances. Until now, this program covered just nine types of equipment/appliances for labeling and three types for minimum performance standards. It is a voluntary scheme and offers no direct financial incentive for industry to participate.

Other Initiatives

Green Building Standard and Certification System

Industry associations and private companies have played an important role in promoting the green building movement in India. The Indian Green Building Council (IGBC), founded by the collaboration

between the Confederation of Indian Industry (CII) and the private manufacturer Godrej, has taken steps to promote the green building concept in India. Currently, IGBC is facilitating the LEED rating of the U.S. Green Building Council in India. There are about five buildings that have been rated and 25 projects are registered for rating under the LEED system. The IGBC headquarters building (see Part II) in Hyderabad was the first platinum-rated building outside of the U.S., and has generated considerable public awareness of green building.

The LEED rating system was developed around the premise that buildings are air-conditioned, whereas in India, a large number of buildings built to date are not air-conditioned or partially air-conditioned. To bridge the demand for a rating system for non-air-conditioned buildings while taking into account the possibility of a partially air-conditioned building, The Energy and Resources Institute (TERI) has developed its own system known as GRIHA (Green Rating for Integrated Habitat Assessment) for the new large energy-consuming segment, i.e. commercial, institutional and residential buildings (new construction). This system responds specifically to India's prioritized national concerns about extreme resource crunches in the power and water sectors and rapidly eroding biodiversity. It attempts to stress passive solar techniques for optimizing indoor visual and thermal comfort and relies on refrigeration-based air conditioning systems only in cases of extreme discomfort. There are eight registered projects under GRIHA that are under construction. TERI is in the course of developing a similar standard to address the needs of other building typologies such as existing buildings.

Planned National Green Building Rating System

Now, in consultation with experts from various related fields in India, the Ministry of New and Renewable Energy Sources (MN&RE) is planning to develop a national rating system for green buildings. This system will be voluntary, to be adopted by builders and individuals

alike. The MN&RE hopes to develop an incentive mechanism for this rating system.

Planned Energy Audit Program

The Bureau of Energy Efficiency has planned to mandate energy audits (by 2007) for all existing commercial buildings above a certain threshold of connected load; it would also develop mechanisms to ensure that the recommendations of the audit are implemented within a stipulated timeframe. There would thus be a large demand for energy service companies (ESCOs), and those establishing themselves more quickly would reap maximum benefits of the mandate.[111]

Demand-Side Management (DSM) Program

It would be fair to say that demand-side management is viewed by the government as the primary strategy for energy conservation in residential buildings. Studies show that implementation of demand-side management options to reduce demand for electricity through energy-efficient processes, equipment, lighting and buildings can help reduce the demand by an estimated 15 percent by 2032 in India.[112] In September 2002, five states in India established demand-side management cells at utilities, and Karnataka and Maharashtra designed pilot projects. Through 2002-03, MEDA (Maharashtra Energy Development Agency) and BESCOM (Bangalore Electricity Supply Company) initiated and completed capacity-building exercises. Since then, additional capacity-building exercises for the electric utility regulators, as well as the preparation of investment-grade feasibility reports for implementing demand-side management projects, have been under way. [113]

Renewable Energy Sources in Buildings

India is the only country that has a separate government ministry exclusively for non-conventional energy sources, the MN&RE, and it has one of the largest national programs to promote the use of solar energy.

MN&RE have initiated several programs focusing on utilization of renewable energy sources in buildings. For example, the solar buildings program disseminates information and provides financial support for the design and construction of energy-efficient and passive solar buildings. Solar buildings have been attempted in a few states. The government of Himachal Pradesh has made it mandatory to construct all its future buildings using passive design features.

Information Distribution

The Bureau of Energy Efficiency web site is a comprehensive information source for energy conservation-related developments and issues.[114] It provides an update on the related policy framework, especially in the context of EC Act 2001, as well as topical write-ups, news and highlights on India's progress with energy efficiency.

Indonesia

Summary

- Indonesia is expected to change from a net exporter of energy to a net energy importing country within the next 10 to 20 years, if energy demand follows current trends.
- The Indonesian government has formulated its Green Energy Policy, which harmonizes the concepts of optimizing renewable energy, the use of efficient technology and the creation of an energy-saving life style. The potential for energy conservation in all sectors in Indonesia is in the range of 15 to 30 percent.
- Indonesia has had energy-efficiency programs for buildings for more than 15 years, but these programs have had very limited results due to several key barriers and constraints, including lack of mandatory minimum energy performance standards and codes, subsidized energy prices that limit consumer incentives to use energy efficiently, lack of financial incentives, and weak institutional support for energy-efficiency programs.

Data Profile[115]

Indonesia is one of only two net exporters of energy among the 11 economies examined in this study, with oil and gas exports representing more than 30 percent of the nation's domestic revenues. It is the world's largest exporter of LNG, with an export of 28.6 million metric tons (MT) or 38 percent of the world's total LNG exports in 2001.

Fossil fuels, especially oil, are the main source of energy and the main source of Indonesia's domestic revenues. However, oil reserves in Indonesia have gradually been depleted while energy consumption

is constantly increasing in line with the rate of economic and population growth. Indonesia currently has proven oil reserves of 5 billion barrels, which represents a 14 percent decline in proven reserves since 1994. Indonesia is expected to become a net oil importing country within the next 10 to 20 years if the energy demand follows current trends. This expectation holds true even if Indonesia implements a conservation program and drastically improves its energy efficiency.

During 1970 to 2004, average annual growth of final energy consumption in Indonesia was about 8.4 percent. The building sector (residential and commercial) is the third largest in terms of energy consumption, following the industrial and transportation sectors. In 2004, the building sector accounted for 27 percent of total final energy consumption (with industry at 39 percent, and transportation at 33 percent), and is expected to rise to 39 percent by 2030.[116]

The rate of CO_2 emissions is greater than the rate of energy consumption in Indonesia because of the higher share of fossil energy in the national energy mix. CO_2 emissions in Indonesia more than doubled from 1990 to 2004, and are expected to increase by more than 160 percent from 2004 to 2030.[117]

National Energy Policy

The national energy policy in Indonesia is enforced by Presidential Decree No. 5 of 2006. Aware of the incontrovertible trend that will see the country become a net energy importer, the Indonesian government is implementing five strategies in its energy policy to support sustainable development, by providing an adequate supply to satisfy the current domestic energy needs and securing sufficient supply for future generations:

- Energy diversification: Indonesia aims to accelerate the use of other energy sources, including renewable energy.
- Intensification in energy exploration: A major policy focus is on optimization of energy resources, which involves both promoting

renewable energy and intensifying energy exploration.

- Energy conservation: Indonesia hopes to reduce national energy consumption, without slowing national development growth. The potential to conserve energy in Indonesia is high, with estimates ranging from 15 to 30 percent.
- Energy price based on market mechanism: The government is restructuring energy pricing to gradually eliminate subsidies and promote energy conservation.
- Promotion of environmental protection: The environment has become an important element of national energy strategy, with sustainable energy supplies and utilization of them a key topic on Indonesia's energy agenda. As part of the framework supporting sustainable energy development, the Indonesian government has formulated its Green Energy Policy, which harmonizes the concepts of optimizing renewable energy, the use of efficient technology and the formation of an energy-saving lifestyle.

Energy-Efficiency Policy

Indonesia stands to gain 10 to 30 percent in energy savings from conservation strategies in all sectors. With little or no cost, savings could reach between 10 and 15 percent, while if Indonesia invests in conservation, 30 percent savings of energy could be achieved.[118]

The government of Indonesia has developed a raft of policies to promote energy conservation. In 1995, the government established the National Blueprint on Energy Conservation to outline national energy conservation measures and subsequent programs as well as activities, under the Energy and Mineral Resources Minister Decree No. 100. K/48/M.PE/1995.

In 2004, the Ministry of Energy and Mineral Resources established its Green Energy Policy, consolidating a number of programs to optimize the use of both traditional energy stocks and renewable energy and increase public awareness and behavior about energy ef-

ficiency. To enforce the implementation of its energy conservation policy, the government also enacted Presidential Instruction No. 10 of 2005, which defines the means and institutional set-up, identifying the responsibilities of state bodies and their coordination with users and other organizations. The government, through the Energy and Mineral Resources Minister Decree No. 31 of 2005, also provides a guideline for activating energy-saving measures.

Focused principally on Indonesia's greatest energy consumers, the industrial and transportation sectors, energy-efficiency policies in Indonesia address four critical areas: campaign, training and education; demand-side management (DSM); partnerships with the private sector; and energy-efficiency standards and labeling.

The partnership program addresses improvements in energy efficiency in energy-intensive industries and buildings. The program is voluntary, and aims to enhance energy efficiency by an average 20 percent. Government provides support to participating companies in the form of training, free energy audits, technical assistance and seminars and workshops on conservation. Company commitments include agreeing to conduct energy audits, implement energy-saving measures, and support the activity of energy conservation forums.

Indonesia's energy-efficiency labeling program aims to educate consumers about the energy efficiency of electrical appliances they purchase and use. Labels carry data that inform consumers about products and equipment.

Even though there is no explicit proof of energy-efficiency improvements, several indicators show that energy consumption decreased in early 2006. From January to April 2006, peak load was about 650 MW lower than of the same period in the 2005. Petroleum fuel consumption reduced from about 191,000 kiloliters per day in October 2005 to about 166,000 kiloliters per day in February 2006.[119]

Building Energy-Efficiency Policies

Building Energy-Efficiency Standard

Indonesian building energy-efficiency standards were established with funds from international sources or as part of international aid programs. In 1988 and 1989, Indonesia developed its first voluntary energy-efficiency standard for commercial, government and institutional buildings with technical assistance from Lawrence Berkeley Laboratory under an ASEAN-USAID cooperative agreement.

The standard addressed five building elements: (1) the building envelope; (2) air conditioning; (3) lighting; (4) the electrical system; and (5) service water heating. This first version of the standard drew much of its overall approach and considerable material from the 1979 Singapore standard and early drafts of the emerging 1989 ASHRAE standard in the U.S. The Indonesian standard was estimated to result in potential energy savings of about 20 percent.[120]

In 1994, Indonesia issued its Standard on Building Energy Conservation, the Method for Energy Conservation Design in Buildings. The standard remains voluntary. An APEC report from 2003 indicated that the voluntary building energy standard in Indonesia had not yet been widely adopted by builders or designers.[121]

Appliance/Equipment Labeling and Standards

The Indonesian government has been developing residential appliance efficiency standards and labeling programs since 1992. Although no standards currently exist for any products, voluntary labels have been established for five products.

Other Initiatives

Phasing out Energy Subsidies

Indonesia has long had substantial energy subsidies, which have reduced both the consumer's cost of energy and incentive to use energy

efficiently. The Indonesian government has been trying to phase out oil and electricity subsidies significantly, and increased domestic petroleum product prices in March and October 2005. As a result, the difference between the subsidized price and the market price of gasoline dropped from about 60 percent to around 20 percent, while that of kerosene dropped from about 85 percent to about 60 percent.[122]

Demand-Side Management (DSM) Program

The National Electricity Company (PLN) introduced a demand-side management program in 1992 in an effort to slow the growth of power demand. PLN studied potential demand-side management programs and proposed programs to improve motor efficiency, and introduce high-efficiency lighting and time-of-use tariffs; this effort received assistance from the United States Agency for International Development (USAID). As of October 2002, the demand-side management programs had fallen far short of the targets established in the 1990s. Further information showing the recent development of the program is not available.

Energy Information Center

An Energy Information Center was formed in 2001 under the Department of Energy and Mineral Resources to enhance dissemination of energy information.

Regional Energy-Efficiency Activities

Indonesia participates in such ASEAN regional energy-efficiency activities as regional building award programs.

Japan

Summary

- Japan has emphasized energy conservation and efficiency since the 1970s oil shocks. Most specialists believe it is the most energy-efficient developed country in the world.
- Since the Kyoto Protocol was ratified in 1997, Japan has placed higher priority on environmental issues, especially the restriction of CO_2 emissions, in its energy policy.
- In the 30-plus years since Japan's government identified energy efficiency and conservation as a high priority, the country has established a multi-tiered system for promoting building energy efficiency through building energy standards and market-based incentive programs.
- Building energy standards were first enacted in 1980 and revised several times subsequently. Mandatory reporting of energy conservation measures was required for non-residential buildings starting in 2003, and for residential buildings over 2000 square meters starting in 2006.
- Market-based incentive programs include housing performance assessment and labeling systems, model environmental projects, and the Comprehensive Assessment System for Building Energy Efficiency (CASBEE) for green buildings.

Data Profile[123]

Japan is the fourth largest energy consumer in the world. Final energy consumption has been growing constantly since the mid-1980s, even in the period following the collapse of the bubble economy in the early 1990s.

Annually, Japan's GDP grew at an average rate of 1.1 percent from 1990 to 2004, and its final energy demand grew comparably at 1.0 percent per year during the same period. Energy consumption of the industrial sector remained generally steady, while demand in the residential and commercial building sectors and the transportation sector increased significantly, with an average annual growth rate of 1.9 percent and 1.5 percent, respectively. In 2004, total final energy consumption was 15 percent higher than in 1990. Industry is the largest energy-consuming sector, at 47.8 percent, followed by building (27.5 percent) and transport (24.7 percent).

According to an estimate of the Institute of Energy Economics, Japan (IEEJ), Japan's final energy consumption is expected to level out by 2020, considering Japan's economic and social trends (notably a smaller population with declining birth rates and an aging society, the upgrading of the economic and industrial structure towards a higher value-added system, and the long-term effects of various energy-saving efforts). After leveling off, final energy consumption is estimated to decrease slightly.

The growth of energy consumption by the residential and commercial sector in the future will be slower than in the past, due largely to improved efficiencies, the decrease in population and number of households, and decelerated increase in floor space for business operations.

CO_2 emissions, however, are expected to trend upward during the same period. Japan's CO_2 emissions in 2004 increased 15.3 percent above the 1990 base year level, which has raised public concern that the government target of reducing CO_2 emissions by 2 percent below the 1990 level by 2010 will be very difficult to achieve.

National Energy Policy

Japan is poorly endowed with energy resources. It suffered serious economic difficulties during the two oil crises in the 1970s. Because Japan is dependent upon imports for more than 80 percent of its primary en-

ergy supply and 99.7 percent of its petroleum, energy security has been the preeminent energy policy goal for this country. Measures taken to enhance Japan's energy security during the 1980s and 1990s included diversifying sources of energy, expanding the use of nuclear energy, and implementing strict energy-efficiency measures for the industrial, building and transportation sectors.

Since the Kyoto Protocol was issued in 1997, there have been some shifts in the basic strategies in Japan's national energy policy in response to the worldwide energy situation.[124] In 1998, the Ministry of International Trade and Industry reviewed Japan's Long-Term Energy Supply and Demand Outlook, which had been originally presented in 1994 to guide Japan's energy supply and demand through 2010. Environmental concerns, especially the restriction of CO_2 emissions, have been accorded higher priority. The review established the need for greater promotion of energy conservation and of new and renewable energy, and for fuel switching, in order to achieve the greenhouse gas emissions reduction target.

Following the 1998 outlook review, the Minister of International Trade and Industry announced an overall review of energy policy in 2000. The objectives of the 2000 energy policy can be summarized as three Es, which must be achieved simultaneously:

- Environmental Protection, aimed at reducing CO_2 emissions to counter global warming;
- Energy Security; and
- Economic Efficiency, aimed at reducing energy supply costs through deregulation and liberalization measures.

The 2000 policy focused on strong energy conservation measures in the industrial, residential/commercial, and transport sectors, and on the supply side by promoting nuclear power and renewable energy supplies.

After the Kyoto Protocol entered into force in February 2005, and in light of the recent surges in the global price of oil and tight energy

supply-demand conditions, the government of Japan established a new National Energy Strategy and published it in May 2006. In the 2006 policy, the 3Es are still the three main pillars, with energy security receiving the highest priority. Reducing greenhouse gas emissions to achieve Kyoto Protocol targets is also a pillar. Reflecting Japan's status as a major international voice on economic and environmental matters, the 2006 policy sets forth three objectives, with energy efficiency being one of the key measures to achieve these objectives:

- To establish Japan's energy security;
- To solve the energy problem and the environment problem together; and
- To contribute actively to a worldwide solution to energy problems.

Energy-Efficiency Policies

Japan's energy-efficiency performance is remarkable. According to most specialists, it is the most energy-efficient developed country on Earth.[125] Its energy consumption per unit of GDP is the lowest in the world, due to various conservation measures pursued by the government and adopted by Japanese citizens.

Because Japan is resource-poor and must import most its energy from the Middle East, Japan has emphasized strict efficiency and conservation measures since the 1970s shocks. The Japanese have put in place a comprehensive energy-efficiency program that reaches across all sectors of the economy. In 1979, the Energy Conservation Law established standards for all energy-consuming sectors (including vehicles, factories, commercial buildings, residential housing, electrical household appliances, office equipment, etc). Amended several times, the last major revision to this law was in 1999.

To force households and companies to conserve, the Japanese government used the Energy Conservation Law to raise the cost of gasoline and electricity far above market levels. The government in turn used

these tax revenues to help Japan take the lead in investing in such renewable energies as solar power, and more recently, home fuel cells.

In 1998, in order to achieve its target set forth at the Kyoto Conference on Climate Change (COP 3), Japan reviewed its efficiency measures. These measures were further reviewed in 2000 and 2006, and are expected to be expanded and strengthened in the future to promote additional energy conservation in the residential, commercial and transport sectors. The government will further restrict energy consumption on the demand side and will also introduce financial incentives aimed at encouraging the use of more energy-efficient household appliances and automobiles.

Building Energy-Efficiency Policies and Initiatives

Building Energy-Efficiency Standards

Japan's building energy regulations are part of the national Energy Conservation Law. Within the Energy Conservation Law, several sections apply to the building sector. Although these standards are defined as voluntary, there are numerous aspects that are enforceable. For example, starting in 2003, a mandatory report on energy conservation measures prior to new construction, extension, alteration, as well as major renovations, of any commercial building must be reviewed and approved. In 2006, this requirement was also extended to any residential building larger than 2,000 square meters.

There are separate building energy standards in Japan for "buildings," i.e., non-residential commercial buildings, and "houses," i.e., residential buildings. The commercial standard was first adopted in 1979, and the residential standard, in 1980, as parts of Japan's national Energy Conservation Law. The current versions of the two standards were adopted on March 30, 1999, although further additions have since been made to broaden their scope or reporting requirements.

The residential building energy standard ("Design and Construction Guidelines on the Rationalization of Energy Use for Houses") has

both a prescriptive and a performance option. The standard lists such prescriptive requirements as heat transfer coefficients, resistance of insulation materials, requirements for adding air barriers, heat transfer coefficients for doors, and "summer insulation entry rate," i.e., summer solar heat gain coefficients (SHGC), of windows, etc. The 1999 revision also added a performance option that specifies criteria for the maximum allowable annual heating and cooling loads, or heat loss coefficient and summer solar heat gain coefficient. The commercial building energy standard ("Criteria for Clients on the Rationalization of Energy Use for Buildings") is a performance standard.

Jurisdiction

The development of building energy standards falls under the jurisdiction of the Ministry of Land, Infrastructure and Transport (MLIT), which was established in 2001 through the consolidation of the former Ministry of Construction, Ministry of Transportation, National Land Agency, and the Hokkaido Development Agency. However, the standards are the joint responsibility of MLIT and the Ministry of Economy.

In addition, the Energy Conservation Center of Japan (ECCJ), a non-government organization established in 1978 with numerous industrial partners to promote the efficient use of energy, protect against global warming, and promote sustainable development, is also active in providing technical assistance in energy-efficient building construction and operations.

Compliance

Government statistics show that the compliance rate has been growing in recent years, increasing from 13 percent in 2000 to 32 percent in 2004 for residential buildings, and from 34 percent in 1999 to 74 percent in 2004 for commercial buildings. The higher compliance rate for commercial buildings can be attributed to the mandatory reporting of

energy conservation strategies since 2003. Now that mandatory reporting is also required for residential buildings over 2,000 square meters, compliance is likewise expected to approach 80 percent as well.

Appliance/Equipment Labeling and Standards

The Top Runner Program

Since 1998, Japan has been implementing the Top Runner Program to set energy conservation standards for home and office appliances and a fuel economy standard for automobiles. In many countries, the energy efficiency of electrical appliances is enhanced by minimum efficiency performance standards. Japan followed a different strategy. Instead of setting a minimum standard, Japan's Top Runner Program searches for the most efficient model on the market and then stipulates that the efficiency of this top runner model should become the standard within a certain number of years. By the target year, each manufacturer must ensure that the weighted average of the efficiency of all its products in that particular category is at least equal to that of the top runner model. This approach eliminates the need to ban specific inefficient models from the market. At the same time, manufacturers are made accountable and, perhaps most importantly, they are stimulated to develop products voluntarily with an even higher efficiency than the top runner model. In the Kyoto implementation plan, Top Runner is projected to prevent 29 million tons of CO_2 emissions by 2010, which amounts to 3 percent of the Japan's greenhouse gas emissions target for 2010. As of August 2005, 18 products have been designated top runners.

Energy-Efficiency Labeling System

Japan's voluntary energy-efficiency labeling system was introduced in 2000. As of April 2005, labeling has been applied to the following 13 products: air conditioners, refrigerators, freezers, fluorescent lights, televisions, space heaters, gas cooking appliances, gas or oil water heaters, electric toilet seats, computers, magnetic disks, and transformers.

Other Initiatives

In addition to the mandatory building standards, Japan also has implemented an assortment of voluntary programs to stimulate building energy efficiency.

The Housing Quality Assurance Law (2000)

This voluntary housing performance labeling system is meant to protect consumers. It contains standardized criteria for evaluating a wide variety of housing materials performance, including the building's structural stability, fire safety, indoor air quality, acoustics, lighting and thermal environment, consideration for the aged, etc. Building energy efficiency is rated as part of the assessment of the building's thermal environment. The government establishes the assessment standards and registers private companies qualified to do the assessments.

Environmentally Symbiotic Housing Model Projects (1993)

MLIT subsidizes one-third of the costs for surveys, planning, and installation of "environmentally symbiotic facilities," including permeable pavement or facilities that utilize natural energy sources or those that use recycled materials.

Comprehensive Assessment System for Building Environmental Efficiency (CASBEE)

CASBEE is a green building rating system developed by the Japan Sustainable Building Consortium in 2004 to assess the environmental efficiency of buildings. It is a voluntary program being implemented by local governments, with training for assessors and third-party assessments. Developers, builders, architects and others can download a program that allows them to assess any new building or renovation on their own. They may also hire trained architects who have passed a CASBEE assessor exam to conduct the assessment.[126] CASBEE has received a great deal of publicity among both government and industry,

as well as in other Asian countries such as China (where the CASBEE rating system has been adopted for Beijing's Green Olympic Building Assessment System) and India.

Training Programs

The government provides voluntary training of construction techniques for building contractors to construct buildings that follow the newest energy-saving standard for non-residential buildings.

Financial Incentive

The government provides financing of up to 2.5 million yen through the Housing Loan Corporation to adapt houses to energy-saving standards.

Energy-Efficient Product Retailer Assessment System

Introduced in 2003, this system gives recognition to retailers who actively promote energy-efficient products or provide appropriate energy conservation information.

Other Programs

In addition, the government has programs to promote high-efficiency boilers, air conditioning systems, and energy management utilizing information technology.

Malaysia

Summary

- Malaysia is an energy exporter. However, its high growth rate in energy consumption is gradually diminishing Malaysia's fossil fuel resources, and will cause constraints on its ability to meet future energy demand.
- The Malaysian government has recognized that the nation has to be more prudent in its energy consumption; energy efficiency is emphasized in Malaysia's energy policy so that the indigenous resources can last longer, thereby enhancing the security of supply in the future.
- In Malaysia, a voluntary code of practice for non-residential buildings has been developed, some energy-efficient technologies have been identified as entering the building industry market, and a number of buildings with energy-efficient features exist. But plans for implementing the code are still being developed and efforts in other areas, except for standards, are still in the beginning stage.

Data Profile[127]

Malaysia is an energy-exporting country. Its current reserves-to-production ratio will make its indigenous oil last until 2017. By then, 100 percent of its oil needs will have to be imported if new reserves are not discovered. While it sounds much more promising for natural gas, with a reserves-to-production ratio of around 45 years, the country's domestic needs are growing very rapidly. Malaysia is now unable to meet this new and extra domestic demand, since its reserves are all committed to meet and honor existing domestic and export contract agreements. [128]

For the last two decades or so (with the exception of a few years during the financial downturn of the late 1990s), Malaysia has undergone fast economic growth with the inevitable result of higher energy consumption. Total final energy consumption grew at an average rate of 7.3 percent per year, with a total increase of 3.7 times from 1980 to 2002. Studies show that Malaysia's economy and energy demand will continue to grow robustly through 2030, with final energy consumption expected to grow at 3.9 percent annually. By 2030, total energy demand is expected to be almost three times that of 2002, and 14 times that of 1980.

The industrial and transport sectors have been the biggest energy consumers during the last decade, accounting for around 42.6 percent and 40.0 percent of total energy consumption in 2002 respectively, while the building sector accounted for 17.3 percent of the total consumption. From 2002 to 2030, the industrial sector will have the highest growth rate of 4.3 percent, followed by transport at 3.9 percent and buildings at around 3 percent.

From 2002 to 2030, CO_2 emissions from the energy sector are projected to grow at 4.2 percent per annum, reaching 414 million tonnes of CO_2 in 2030, a three-fold increase over 2002.

National Energy Policy

Rapidly increasing energy demand, depleting indigenous resources and steeply escalating energy prices are the main problems for Malaysia in the energy-consuming sector, and this country is trying to address the energy issue from three angles: the supply side, the demand side, and the environmental side. In the national energy policy, three principal objectives are instrumental in guiding the future energy sector development:

- The Supply Objective: To ensure the provision of adequate, secure and cost-effective energy supplies through developing indigenous energy resources both non-renewable and renewable energy resources using the latest cost options and diversification of supply sources both from within and outside the country;

- The Utilization Objective: To promote the efficient utilization of energy and discourage wasteful and non-productive patterns of energy consumption; and
- The Environmental Objective: To minimize the negative impact of energy production, transportation, conversion, utilization and consumption on the environment.

To achieve the national objectives, the government is pursing the following strategies:

- Secure supply: Diversify fuel types, sources, and technology, maximize the use of indigenous energy resources, secure adequate reserve capacity for contingencies, secure adequate reserve margin for generation, upgrade transmission and distribution networks and distributed generation;
- Sufficient supply: Forecast demand properly, set the right energy price, and formulate plans to meet demand;
- Efficient supply: Promote competition in the electricity supply industry;
- Cost-effective supply: Promote competition and provide indicative supply plans to meet demand based on least-cost approach using power computer software;
- Sustainable supply: Promote the development of renewable energy and co-generation as much as possible;
- Quality supply (low harmonics, no surges and spikes, minimal variation in voltage): Match quality with customer demand with variable tariffs;
- Efficient utilization of energy: use bench marking, auditing, financial and fiscal incentives, technology development, promotion of energy service companies (ESCOs), labeling, ratings, correct pricing, energy managers; and
- Minimizing negative environmental impact: Monitor the impact, improve efficiency of utilization and conversion, and promote renewable energy.

Energy-Efficiency Policies

Energy-efficiency promotion has been formally part of Malaysia's national energy policy for the last decade.

In Malaysia, the efficiency of energy supply is governed by three laws.[129] However, in terms of effective and efficient utilization of energy, there are no laws enacted so far. To promote efficient utilization of energy, the government has enacted principles and measures on energy efficiency. Principles include:

- Improvement of the transformation plant (better efficiency of power plants, refineries, LNG plants), transmission and distribution sectors (e.g. lowering of electricity losses), up to final energy supply;
- Improvement of energy efficiency at the end-use level, mainly through energy savings in the existing industrial sector, building sector and transport sector;
- Implementation of innovative processes using new technologies; and
- Implementing co-generation, which is recognized to improve production efficiency, particularly at the time when natural gas becomes more available.

During the 9th Malaysia Plan Period (2006-2010) the implementation of energy-efficiency programs will focus on energy-saving features in the industrial and commercial sectors. In this regard, energy-efficient features such as efficient lighting and air-conditioning systems as well as establishing a comprehensive energy management system will be encouraged.

Building Energy-Efficiency Policies and Initiatives

Building Energy-Efficiency Standards

In 1986 and 1987, Malaysia developed a first draft of energy-efficiency guidelines for commercial buildings, launching it as a national voluntary guideline in December 1989.

The scope of the guidelines included: (1) building envelope; (2) air conditioning; (3) lighting; (4) electrical power and distribution; and (5) energy management. This first version of the guidelines drew much of its overall approach and considerable material from the 1983 Singapore standard and early drafts of the emerging 1989 ASHRAE 90.1 standard in the U.S. The guidelines included appendices on sample overall thermal transfer value (OTTV) calculations and energy and cost impacts.

In 2001, the guidelines were revised and incorporated into Malaysian Standard (MS) 1525 as a "Code of Practice on Energy Efficiency and use of Renewable Energy for Non-residential Buildings." This new version is reported to contain additional emphasis on building architectural features and passive solar compliance options.[130]

Compliance

Compliance with this code of practice has been voluntary. In 2006, the code was revised and updated again, and is undergoing public review at the time of this writing. Actions are also now underway to incorporate several sections (building envelope, air conditioning, and lighting) of the latest version of the code into the Uniform Building By-Laws so that they become mandatory.[131]

Jurisdiction

The Ministry of Energy, Water and Communications (MOEWC) (formerly the Ministry of Energy, Communications and Multimedia) has been the responsible ministry for developing and promoting the energy-efficiency buildings standards.

Implementation and Impact

In the late 1980s, potential savings of 20 percent were estimated from the use of the code.[132] However, Asia Business Council researchers are not aware of any information about the use of the building energy

code over the past 15 years, or about how many buildings might have complied with part or all of it on a voluntary basis. There are indications of the general effectiveness of Malaysian energy policies applied to buildings. In lighting, for example, more efficient products such as compact fluorescent lamps or low voltage quartz halogen lamps with glass mirror reflector and dichroic reflector coating have been widely used in place of less-efficient products. For air conditioning, more efficient products are used such as multi-compressor chillers, variable air volume systems, etc., and the ice storage technique is used in air-conditioning systems to reduce peak power demand. A number of new buildings in Malaysia since 1990 have adopted energy-efficiency designs that exceed the requirements of MS 1525.

Appliances/Equipment Labeling and Standards

In December 2003, the High Efficiency Electric Motor Agreement (HEEMA) was formalized under the Suruhanjaya Tenaga (Energy Commission)—Danish International Development Agency capacity-building project. The HEEMA is a voluntary agreement signed by eight local motor manufacturers, dealers and importers to promote high-efficiency motors in Malaysia and to minimize and ultimately eliminate low-efficiency motors from the local market. On the same day, nine companies from the Malaysian refrigerators, manufacturers and importers association signed a voluntary Memorandum of Understanding (MOU) on the promotion of energy-efficient refrigerators. The implementation of the motor labeling and refrigerator labeling is on a voluntary basis.

Other Initiatives

Energy Center

There has evidently been an effective, long-term collaboration between government and academia in Malaysia that has contributed to the development and refinement of the building energy standards. Considerable

technical capabilities for energy efficiency are resident in Pusat Tenaga Malaysia (PTM), or the Malaysia Energy Center. This organization was established in 1998 as a focal point for various energy-related government and private-sector activities, including energy planning and research, energy efficiency, and technological research, development and demonstration. While PTM is registered as a non-profit company, it receives administrative support from MOEWC.

Demonstration Projects

Malaysia has a number of buildings to demonstrate energy-efficient features. The most famous ones include the Securities Commission building and the Low-Energy Office Building (LEO) (see Part II for the cases).

Building Energy Benchmarking

The PTM has initiated a web-based energy-benchmarking program for office buildings that aims to establish a database for benchmarking energy consumption and efficiency. The program description is available on the PTM web site, allowing readers to download and complete a 4-page office building benchmarking form.[133]

Building Energy Audits

One of the most promising programs in Malaysia is the energy auditing program that aims to encourage industries and building owners to audit their energy use with a goal of reducing energy costs and increasing productivity. Under this program, about 40 buildings and industries have been audited between 1993-1995 through bilateral and multilateral cooperation. This is the first energy audit program carried out under the Malaysia Development Plan 1991-1995.[134] Further energy audits have been done since then—audits of 12 government buildings in 2002 and audits of 48 industries under the Malaysia Industrial Energy Efficiency Improvement Project since July 2000.

Financial Incentives

As for financial incentives, there is provision for import duty and sales tax exemption on equipment used in energy conservation that is not produced locally. Equipment purchased from local manufacturers is given sales tax exemption.

New Energy Tariff

Energy prices for commercial buildings are highly subsidized in Malaysia. A non-subsidized price for electricity is more than double the subsidized price. A new electricity tariff was implemented in June 2006 to discourage inefficient energy use amongst the larger consumers.[135]

Regional Energy-Efficiency Activities

Malaysia actively participates in ASEAN regional energy-efficiency activities. Such activities include (1) participation in the development of regional energy benchmarking of buildings and (2) regional energy-efficient building award programs.

Philippines

Summary

- Energy consumption in the Philippines has grown more rapidly than economic output, as energy-to-GDP ratios have increased in different sectors over the past decade.
- Attaining energy independence is the over-arching objective for the energy sector in the Philippines. While emphasizing the development of indigenous energy sources that will eventually lead to increased self-reliance, promoting energy efficiency is seen as another effective approach to achieve the objective.
- The Philippines has had mixed results in its energy programs over that past 15 years. The government has taken substantial action to establish a mandatory building energy code and appliance/equipment standards and labeling. However, there is a lack of significant implementation or enforcement of the building energy code.

Data Profile[136]

Energy consumption rose more quickly than economic growth in the Philippines between 1980 and 2004. GDP grew at an average rate of 6.0 percent, while total final energy consumption increased by a rate of 8.3 percent. As a result, GDP in the Philippines increased about 85 percent, in contrast to a more than 140 percent increase in total energy consumption during the same period. It is estimated that energy consumption in the Philippines will continue to rise at an average rate of 4.5 percent from 2004 to 2030, with a total increase of around 210 percent.

The transport sector is the largest energy consumer in the Philippines in 2004, accounting for 48.4 percent of the total, followed

by the building sector (25.8 percent) and the industrial sector (22.6 percent).

As for the building sector specifically, energy consumption of this sector increased more than 80 percent from 1980 to 2004, and is estimated to increase more than 185 percent from 2004 to 2030.

Energy self-sufficiency in the Philippines was 53.9 percent in 2003. The country's dependence on energy imports will continue on a more restrained level at an average annual growth rate of 3.9 percent over the ten-year planning period due to policies that promote greater utilization of indigenous fuels.[137]

The Philippines is notable among reviewed economies in utilizing renewable energy such as biomass, solar and wind. It is the world's second largest producer of geothermal power, and is also exploring the use of other renewables such as wind energy. The renewable power share in the power generation mix was 42 percent in 2003, rising from 38 percent in 2002.[138]

National Energy Policy

The Philippines has a wealth of potential energy resources. However, indigenous energy sources are underdeveloped, which hampers the Philippines' progress in energy self-reliance. The main theme of the Philippines' energy policy is to seek growth and self-sufficiency in energy production and to provide adequate supply to meet increasing energy demand, while environmental and social aspects of energy are also emphasized. The goals of the national energy policy include:

- Supply security and reliability;
- Energy affordability and accessibility;
- Environmental quality; and
- Consumer protection.

With energy independence as the over-arching objective, the Philippine Energy Plan (PEP) of 2005 calls for the development of indigenous energy resources that will eventually lead to increased self-

reliance. At the same time, promoting efficient and judicious utilization and conservation of energy is seen as another effective approach to achieve the objective and to keep greenhouse gas emission levels at a lower growth rate. The Department of Energy (DOE) has set forth a goal of a 60 percent self-sufficiency level in 2010, and hopes to achieve this by:

- Increasing indigenous oil and gas reserves;
- Aggressively developing renewable energy resources;
- Increasing the use of alternative fuels;
- Forging strategic alliances with other countries; and
- Promoting a strong energy-efficiency and conservation program.

Energy-Efficiency Policies

Currently, the DOE is promoting the "EC (energy conservation) way of life" and pursuing an energy-efficiency program that covers two areas: fuel efficiency and conservation, and power conservation and demand-side management. The objectives of the program include:

- Enhancing consumer understanding of energy use;
- Lowering consumer energy expenditures without constraint on productivity;
- Reducing capacity/ transmission expansion requirements; and
- Reducing greenhouse gas emissions.

  Policies and strategies in the program include:
- Promoting energy-efficiency measures through the existing specific programs to sustain economic, environmental and social benefits;
- Enhancing private-sector involvement in the energy-efficiency program through the development of an Energy Service Industry and the promotion of energy-efficient technologies, goods, and services at the lowest possible price, with the highest possible quality;
- Promoting voluntary agreements with energy-intensive industries;
- Continuing implementation and expansion of the appliance energy standards and labeling program;

- Encouraging consumer purchase of more energy-efficient technologies by providing accurate information on these products;
- Integrating energy-efficiency concepts in the procurement practices of the government;
- Integrating energy-efficiency policies in all sectors of the economy;
- Periodic program monitoring and evaluation to assess the effectiveness of the energy-efficiency program;
- Intensifying collaborative efforts with the private sector, trade allies and industry associations;
- Developing energy-efficiency intensity indicators for each sub-sector;
- Expanding opportunities for energy-efficiency and load management through competitive bidding vis-à-vis other resources; and
- Promoting international cooperation on energy technology application.

Both the government and private sector have initiatives to improve energy efficiency. Government efforts include providing direct services and regulatory measures, while the private sector will focus on market-driven services. Market transformation activities, such as in appliances and lighting, will be the responsibility of both government and private sectors.

Building Energy-Efficiency Policies and Initiatives

Building Energy-Efficiency Code

In 1988 and 1989, the Philippines developed a first-draft energy-efficiency code for buildings, The Guidelines for Energy Conserving Design of Buildings and Utility Systems, which is mandatory. The scope of the code included: (1) building envelope; (2) air conditioning; (3) lighting; (4) electrical; and (5) service water heating. This first version of the standard drew much of its overall approach and considerable material from the 1979 Singapore standard and early drafts of the emerging 1989 ASHRAE standard in the U.S.

The process of adopting the first energy-efficiency code took several steps. In 1992, the Department of Public Works and Highways (DPWH), which is responsible for issuing the National Building Code (NBC), approved the building energy code as a referral code. The NBC and all referral codes are mandatory. In 1994, the government changed the building energy referral code into a national building energy code to cover all new buildings with an installed air conditioning electrical demand of at least 150 kW.[139] In October 2005, the government began upgrading the code, which it expects to finish in 2007.

In the mid-1990s, major changes occurred in the building energy code's implementation, and responsibility for enforcement shifted to the Department of Interior and Local Government (DILG), with enforcement intended to occur at the local level. This approach is consistent with enforcement and compliance approaches for buildings in many other countries.

There has been no sign of effective implementation of the Philippines' mandatory national building energy code. In 1997 and 1998, studies indicated that the requirements of the energy code were not being followed.[140] In the late 1990s, the local electricity distribution company for Manila (MERALCO) suggested that it thought it would be capable of effectively managing compliance, threatening not to hook up non-compliant buildings to the electrical grid. Eight years later, there was no evidence of implementation of the 1994 energy code, or compliance with it. In a recent presentation on energy-efficient lighting by DOE, the lack of implementation and out-of-date status of the 1994 energy use guidelines were cited as barriers to energy conservation.

Appliance/Equipment Labeling and Standards

The Philippines began its first energy-efficiency labeling and standards program for air conditioners in 1992. Currently, there are four subprograms: efficiency standard and labeling for room air conditioners; energy labeling for refrigerators and freezers; fluorescent lamp ballast

energy-efficiency standard; and performance certification of fans and blowers. These programs are mandatory and are estimated to contribute a cumulative potential energy savings of 0.9 million barrels of fuel oil equivalent (MMBFOE) in 2002 to 9.7 MMBFOE in 2011.

The Philippine Efficient Lighting Market Transformation Project (PELMATP) is a five-year project led by DOE with support from the Global Environment Facility (GEF) and the United Nations Development Program (UNDP). The project aims to address the barriers to the widespread utilization of energy-efficient lighting systems in the Philippines and contribute to the reduction of greenhouse gas emissions to the environment.[141]

Other Initiatives

Energy Management of Government Buildings

To make government buildings a showcase of energy efficiency, in late 2000 the Philippines launched an "Enercon program" that required all government agencies, bureaus and offices to reduce their annual electricity and fuel consumption by at least 10 percent by adapting energy-efficiency technologies and practices.[142] The program requires monthly reports be submitted to DOE. An "Energy Efficient Best Practices Awards in Government" program was set up to recognize agencies that achieve this objective.

In 2002, DOE established a Government Energy Management Program to implement energy-efficient technologies and practices in all government facilities. However, there is no information disclosing the efficacy of this program over the past several years.

Labeling of Government Buildings

The DOE has an Energy Spot Checks program wherein inspectors visit the national government agencies' buildings and issue energy ratings based on energy use criteria. Energy ratings are then placed in the lobbies or entrances of the buildings that have been spot-checked.

Energy Management Services

This program assists commercial and industrial establishments in identifying effective measures towards more efficient use of energy. These energy-management services, most of which are presently being provided by the government, include energy audits, financing, information on energy utilization performance, technology promotions, and recognition programs. The private sector (engineering companies and/or energy service companies) are expected to become a major player in providing these services in the future.

Information and Education Campaign

The government has two major programs in this area: the Power Conservation and Demand Management (Power Patrol) and the Fuel Conservation and Efficiency in Road Transport (Road Transport Patrol). The Power Patrol directs its information and education efforts to the residential, commercial, and industrial sectors mainly through seminars and workshops.

Demand-Side Management (DSM) Program

There is an ongoing initiative to review, amend and improve the 1996 Demand-Side Management Regulatory Framework. To date, however, the national demand-side management program has remained in the pre-implementation stage.

Regional Energy-Efficiency Activities

The Philippines participates in ASEAN regional energy-efficiency activities. Such activities include participation in regional energy-efficient building award programs. Several Philippine buildings have been cited in the ASEAN Energy Awards.

Green Building Movement

According to the World Green Building Council, there is a move to organize a Philippine Green Building Council.

Singapore

Summary

- Singapore is a city-state with no natural resources and no domestic oil reserves, and depends entirely on imports for its energy needs. To reduce its increasing rate of energy consumption, Singapore's national energy policy focuses on energy conservation and efficient use.
- Energy-efficiency policy in Singapore is closely integrated with its environmental policies. Clean energy, energy efficiency and conservation are all key strategies for enhancing sustainable development and mitigating greenhouse gas emissions in Singapore's environmental policy.
- Singapore was the one of the first countries in the region to develop and implement a building energy code, and ASEAN countries have used it as a reference model.
- Now, a comprehensive and exemplary set of mandatory and voluntary building energy-efficiency and green building programs that span the whole life cycle of a building are available in Singapore. The country has developed since the 1980s both the institutional infrastructure and expertise to handle the enforcement of its policies and programs.

Data Profile[143]

Singapore's energy needs have grown in tandem with its economic growth. Over the period from 1980 to 1995, average annual growth rate in energy demand was 11.9 percent, much higher than the 7.6 percent growth rate of GDP. Energy consumption in Singapore can be attributed to three main sectors, i.e. industry (about 29 percent),

residential and commercial buildings (about 34 percent), and transport (about 37 percent).

In the tropical climate of Singapore, much of the electricity consumed in buildings is for air conditioning and refrigeration (around 58 percent of total consumption of the building sector). In particular, energy consumption in commercial buildings, which are mostly designed to be fully air-conditioned, represents about 57 percent of the building sector's total consumption.

The carbon intensity (CO_2 emissions per unit of GDP) in Singapore was decreasing at an average rate of 8.8 percent between 1980 and 2002. The government's target is to reduce the carbon intensity to 25 percent below 1990 levels by 2012.

National Energy Policy

As the most highly industrialized and urbanized economy in Southeast Asia, Singapore is a city-state with no natural resources and no domestic oil reserves. It depends entirely on imports of fossil fuels and natural gas for its energy needs, making its economic and social development extremely vulnerable to factors affecting global energy supply. Since the 1970s, energy security has been a top concern on Singapore's energy agenda.

Singapore's energy policy places emphasis on environmental sustainability. Singapore is committed to slowing down or reducing its greenhouse gas emissions, and is focusing on clean energy, energy efficiency and conservation as key strategies to enhance sustainable development and mitigate greenhouse gas emissions.

In general, the national energy policy stresses six key strategies, with conservation and efficiency the top priority:

- Focus on conservation and efficiency: There is a clear focus on energy conservation and efficient use in Singapore's national energy policy in order to reduce the growth rate of energy consumption, enhance sustainable development, and mitigate greenhouse gas emissions.[144]

- Enhance its role as a regional petroleum refining and trading center: Despite its lack of domestic oil resources, Singapore is one of the major petroleum refining and trading centers of Asia. Securing its role as a regional petroleum refining and trading center will help reaffirm its national energy security.
- Promote the country as a regional hub for an integrated gas pipeline network: Use of natural gas is expected to play a major role in the energy market. Singapore is studying the viability of building a liquefied natural gas (LNG) import terminal, thereby freeing itself from dependence on neighboring states (Malaysia and Indonesia) for its gas supply.
- Restructure and privatize the power sector: Singapore is in the process of restructuring and privatizing its electric power sector, which will result in the transformation from a monopoly to a competitive market.
- Energy reserves: In Singapore, existing power plants are running with higher levels of reserve capacities, which is regarded as necessary for a nation like Singapore.
- Participate in overseas exploration and production: Although Singapore does not produce oil domestically, local companies have become active in overseas exploration and production.

Energy-Efficiency Policies

In Singapore, energy-efficiency policy is closely integrated with environmental policies. The National Energy Efficiency Committee, the key agency to address concerns over increasing energy consumption and to recommend policy measures to improve energy efficiency in Singapore, has recently been expanded in scope to cover climate change issues and has been renamed the National Climate Change Committee (NCCC).

Energy conservation policy in Singapore targets five areas: building, households, industry, transportation, and research and development. Main strategies include:

- Promoting energy conservation through the efficient use of energy in the industrial, building, transportation and consumer sectors;
- Encouraging the use of cleaner energy sources such as natural gas and renewable energy sources; and
- Promoting Singapore as a location for test-bedding of pioneering energy technologies and as the hub for development and commercialization of clean energy technologies.

Building Energy-Efficiency Policies and Initiatives

An exemplary set of mandatory and voluntary building energy-efficiency and green building programs are available in Singapore. These programs are mainly coordinated via the Building Energy Efficiency Master Plan formulated by the Building and Construction Authority (BCA). The plan contains programs and measures that span the whole life cycle of a building. BCA reviews the plan and updates it annually to incorporate the latest plans and changes necessary to keep building energy efficiency in Singapore an ever-improving goal.

Building Energy-Efficiency Code

Singapore was the one of the first countries in the region to develop and implement an energy code. Developed in 1979, its first energy code drew much of its overall approach and considerable material from the 1975 version of the ASHRAE energy standard in the U.S. The scope of the standard included: (1) the building envelope; (2) air conditioning; (3) lighting; (4) electrical systems; and (5) service water heating. Since the first version was adopted in 1979, the standard has been revised twice, in 1989 and 1999.

The 1989 version of the standard contained requirements for roof and wall insulation, air leakage, location of entry doors, zoning for temperature control, sufficient electric power metering, switching off air conditioning automatically in hotel guest rooms when unoccupied, and data-logging facilities for collecting data for energy audits.[145] In

1999, three codes of practice for buildings were updated: (1) Code of Practice for Energy-Efficiency Standard for Building Services and Equipment; (2) Code of Practice for Mechanical Ventilation and Air conditioning in Buildings; and (3) Code of Practice for Artificial Lighting in Buildings. The 1999 revisions, made effective in mid-2000, also included a new system analysis tradeoff compliance option in addition to the prescriptive compliance that had been in effect since 1979.

According to the BCA, further reviews will be targeted every three years, or sooner upon request by local professional institutes and boards.

Singapore's energy code has been mandatory since the first version, and the country has gained a reputation for strong and effective enforcement of its energy code.

Singapore has had extensive compliance guidelines available since the early 1980s. Until 2000, the Singapore energy code contained only a prescriptive compliance option. In 2000, a new system analysis compliance option became available to allow tradeoffs during compliance. This new method uses a software-based set of tools developed and made available by the National University of Singapore (NUS). It can be used by engineers, architects and building services professionals to demonstrate compliance with prescriptive and energy performance standards relating to air-conditioned buildings.[146]

The BCA has been the government entity responsible for developing and enforcing the energy-efficiency building codes of practice. It appears to have developed since the 1980s the institutional infrastructure and expertise to handle the enforcement of the building energy code requirements. The BCA also has ready access to additional technical resources through an excellent and long-standing collaboration with NUS, which provides technical and R&D input to various building energy-efficiency programs, such as analysis of energy code impacts and improvements, development of energy-efficiency indices and benchmarking of building performance, and compliance tools and software development.

An innovative aspect of the Singapore energy code within the region is that the code and supporting documentation is available on the Web. Several additional web sites contain a wealth of information about the energy-efficiency programs, including copies of the energy code provisions, compliance forms and tools, plus information and application forms for various related programs. For example, BCA and NUS have developed a joint Building Energy & Research Information Centre web site that serves education and outreach objectives, making available a wide range of data, tools, and information about the energy code and energy efficiency.[147] These web sites form a major resource, especially in comparison to some other countries in the region, where information about building energy code and energy-efficiency programs is not as easily available to review and use.

Appliance/Equipment Labeling and Standards

Currently, Singapore's mandatory minimum energy performance standard program covers only one product, the window type air conditioner.

The Singapore Green Labeling Scheme (SGLS), a voluntary labeling scheme, was launched in 1992 by the Ministry of the Environment. The scheme promotes the use of a wide range of environmentally friendly products, including ballasts. Generally, no energy performance is shown on the green label. A new comparative label, the Energy Labeling Scheme, was launched in 2002 under the umbrella of the SGLS. Currently, only two categories of electrical appliances (refrigerators and air conditioners) are covered by the scheme.

Other Initiatives

The Singapore government is running a wide variety of non-regulatory programs to promote building energy efficiency. Important ones are as follows:

Green Mark Incentive Scheme (GMIS)

In January 2005, BCA launched the Green Mark Scheme in order to promote environmental awareness in the construction and real estate sectors. The "Green Mark" is used to rate the environmental friendliness of a building. It encourages the adoption of various green building technologies to achieve a sustainable built environment by improving energy efficiency, water efficiency, and indoor environment quality and environmental management. The scheme is available for both new and existing buildings.

There are three levels of financial incentives (gold, gold plus, and platinum), corresponding to increasing levels of green technologies and energy savings obtained. For energy performance, the gold level requires energy efficiency at the level required by the building standard. The gold plus level requires energy performance 25 percent better than standard, while the platinum level requires energy performance 30 percent better than the standard. The incentives range from SGD$3 (around US$2) per square meter to SGD$6 (around US$4) per square meter of gross floor area (GFA) for new buildings; retrofit of existing buildings is eligible for about 40 percent of the incentive for new buildings per square meter.[148] The government is planning to make it mandatory for all new public sector buildings and those undergoing major retrofitting works to receive green mark certification.[149]

Energy Smart Buildings Scheme - Energy Smart Office

This voluntary program aims to promote the active management of energy use. It gives an energy label or "Energy Smart Badge" to high-performance buildings that are among the 25 percent most energy-efficient and meet both energy and indoor environmental quality criteria. Presently, the scheme is ready for office buildings. In late 2005, eight buildings were given energy smart badges.

Energy Audit of Selected Buildings

The BCA has embarked on a program to audit a selected number of buildings with high energy consumption, including large offices, hotels, shopping complexes, hospitals and institutions. It has just completed an exercise to band government buildings based on their energy consumption indices.

Energy Efficiency Index (EEI) and Performance Benchmark

To provide good information about building energy performance and related building energy features so that building owners can estimate the cost-effective potential for building energy savings, the BCA is trying to establish an EEI for all buildings with a sizeable air-conditioning load and to set an energy performance benchmark by building type. Building owners then will know how their building compares to the performance benchmark. To date, a study of data for 104 office buildings has been accomplished; the report is available on the BCA-NUS Building Energy & Research Information Centre web site.[150]

Energy Management of Public Sector Buildings

To provide landlord government agencies a rough indication of how they fare in comparison with other buildings of the same type in terms of energy performance, the BCA is planning to band all public sector buildings by type based on energy performance into three groups, i.e. the top 25 percent, middle 50 percent and bottom 25 percent. An initial banding of all large public office buildings has been completed.

Energy Training Program for Energy-Efficient Building Management

In the fall of 2006, NUS began a program to train building managers how to operate their buildings more efficiently and how to monitor the performance of their buildings in order to know how well (or poorly) their buildings were performing.

Financial Incentives

The Singapore government offers an approved accelerated tax depreciation scheme for (1) replacement machines and equipment and (2) energy-saving equipment and devices. Financial incentives are also provided in an investment allowance scheme (IAS), the local enterprise technical assistance scheme (LETAS), and the energy efficiency improvement assistance scheme (EEIAS).

Performance Contracting

The BCA plans to encourage performance contracting, based upon its successful application in the U.S. and elsewhere, and the BCA plans to work with the Ministry of Finance on a standard form of performance contract for public buildings.[151]

Showcase Buildings

To provide a showpiece of energy-efficiency measures that are viable, the Building Energy & Research Information Centre web site includes a description of a current showcase building, Revenue House, which is owned by the Inland Revenue Authority of Singapore. The building is the first of a new generation of intelligent buildings designed and built by the Public Works Department. It was completed in 1996, and consumes about 30 percent less energy than the average building. The building won the ASEAN Energy Efficiency Award in 2000.[152]

Energy-Saving Guide for Consumers

This guide offers tips and measures that consumers can adopt to reduce energy bills and help preserve our environment.

South Korea

Summary

- South Korea was the 10th largest energy-consuming nation in the world in 2001. Although the industrial sector is the largest energy consumer, energy consumption in the building sector showed higher growth in recent years.
- Since the mid-1990s, the South Korean government has been pursuing a new goal of sustainable development in its national energy policy, taking into consideration such factors as economic growth, environment, and energy security.
- Among the 11 economies reviewed, South Korea formally adopted a building energy standard the most recently, in 2004. However, South Korea has since put in place a comprehensive program to minimize building energy consumption, coupling mandatory standards with voluntary efforts in building energy labeling, a green building certification program, and financial incentive programs.

Data Profile[153]

South Korea is the 11th largest economy and 10th largest energy-consuming nation in the world. From 1980 to 2002, energy consumption in South Korea increased by about 400 percent, with an average annual growth rate of 7.5 percent. Per capita consumption increased about 290 percent during the same period, with a growth rate of 6.4 percent. Estimates show that, from 2002 to 2020, total energy consumption in South Korea will increase more than 60 percent, while per capita consumption will rise around 43 percent.[154]

South Korea has no significant energy sources. It relies heavily on imports to fuel its growing economy. From 1980 to 2004, overseas en-

ergy dependency in South Korea grew significantly, from 73.5 percent to about 97 percent.

The industrial sector is the biggest energy consumer, accounting for 55.4 percent of total energy consumption in 2003, with the building and transport sectors trailing at 21.5 percent and 21.1 percent, respectively. In recent years, however, energy consumption in the building and transport sectors has been growing faster than the industrial sector.

Within the building sector specifically, energy consumption of residential buildings grew at an average annual rate of 4.0 percent between 1998 and 2001, while that of commercial buildings increased at a rate of 10.3 percent during the same period.

CO_2 emissions in South Korea increased by more than 330 percent from 1980 to 2002, growing at an average rate of 6.9 percent. With the counter-climate change measures taken by the government, the growth rate of CO_2 emissions in South Korea is expected to slow down significantly, to 1.9 percent between 2002 and 2030.[155]

National Energy Policy

In the wake of the second world oil shock, South Korea immediately established the Ministry of Energy and Resources in 1978 (later incorporated into the Ministry of Commerce, Industry and Energy (MOCIE)) to administer the planning and enforcement of national energy policies.

South Korean energy policy has long focused on increasing the supply of energy to satisfy rapidly growing demand that is the result of strong economic growth over the last 30 years. Due to growing concern about the environment, since the mid-1990s the South Korean government has been pursuing a new goal of sustainable development in its national energy policy. Energy policy focuses on the same 3Es as Japan: Energy Security, Energy Efficiency, and Environmental Protection.

To achieve the 3Es, the South Korean government is pursuing these initiatives:

- Diversifying the supply of energy by promoting greater use of natural gas, encouraging the development of nuclear capacity and initiating steps to launch renewable energy markets.
- Introducing competition and increasing the efficiency of the energy market. The government has begun to withdraw gradually from direct operations in the energy sector through capital ownership, licenses and control, leaving the market free to allocate resources for investment.
- Developing an environment-friendly system by promoting conservation and more efficient use of energy.
- Lowering energy intensity. Compared with the 1990s, investments in energy-intensive industries are expected to fall sharply in the coming years, causing energy intensity to fall from its current levels, particularly as energy prices increasingly reflect full costs.

Energy-Efficiency Policies

The South Korean government views energy conservation and efficiency as one of the essential tools for achieving a sustainable energy supply and demand structure. According to the Second National Energy Plan (2002-2011), rational energy utilization is one of three basic pillars for policy initiatives supporting a sustainable energy policy.

South Korea runs a vigorous energy conservation program. The Rational Energy Utilization Act (REUA) was promulgated in 1979 to serve as a basic law for energy efficiency and conservation. Energy-efficiency programs and activities are planned and implemented based on the REUA by the South Korea Energy Management Corporation (KEMCO), a government agency which was established in 1980. KEMCO functions as the national energy-efficiency center responsible for the implementation of national energy-efficiency and conservation programs.

In South Korea, the Minister of MOCIE is expected every five years to draft a basic plan for the rational use of energy. According to the Second Basic Plan for Rational Energy Utilization (1999-2003), South Korea's energy-efficiency strategies include:

- Establishing a systematic energy-saving structure through identifying energy-saving sectors and facilitating investment in energy efficiency and conservation;
- Promoting voluntary energy savings in the private sector through market-oriented measures (e.g. economic incentives);
- Promoting demand-side management;
- Promoting the use of new and renewable energy; and
- Promoting R&D for fundamental energy-efficiency improvement.

Energy-efficiency policies in South Korea primarily target the industrial sector. From the mid-1970s to the mid-1990s, the South Korean government made a concerted effort to foster energy-intensive industries such as iron and steel, petrochemicals and machinery. This focus has resulted in an industrial sector that consumes more than half of the nation's energy. South Korea has now formulated extensive energy-efficiency programs particularly aimed at these energy-intensive industries.

At the same time, South Korea has applied a number of measures aimed at improving energy efficiency in the transport and building sectors, including energy-efficiency standards and labeling, financial incentives, training and education, energy audits, awareness raising, etc.

Building Energy-Efficiency Policies and Initiatives

Although government-affiliated research institutes, universities, and utility companies have been investigating building energy efficiency since the mid-1980s, South Korea did not formally adopt a building energy standard until 2004. However, despite its recent adoption, South Korea has since put in place a comprehensive program to minimize building energy consumption, coupling mandatory standards

with voluntary efforts in building energy labeling, a green building certification program, and financial incentive programs.

Building Energy-Efficiency Standards

South Korea has a mandatory building energy standard that was passed on December 31, 2004 under Notification 2004-459 of the Ministry of Construction and Transportation (MOCT).

Scope

This standard is mandatory for all buildings where high energy consumption is expected.[156] For these buildings, an energy conservation plan must be submitted before construction to show how much of the standard has been incorporated in the building design, and a point total estimated based on the energy-saving plan. All buildings must submit an energy-savings plan with a point total of at least 60 in order to comply.

Contents and Approach

The South Korean building energy standard was developed after a review of standards from several countries, including the U.S., United Kingdom, Germany, Japan, and Canada. Although the developers acknowledged the quality and detail of the more complex standards such as those in the U.S. and Germany, they adopted a simple prescriptive standard, such as that of the United Kingdom and Japan, as the most appropriate and easiest to implement in South Korea.

The standard contains three parts—mechanical, electrical, and architectural—each with mandatory and "encouraged" requirements. The mandatory requirements represent basic responsible design, while the "encouraged" requirements represent more innovative and best-practice strategies.[157]

The use of a point system for compliance effectively turns the South Korean standard into a quasi-performance-based standard. To

arrive at the required 60 points for compliance takes more than simply meeting all of the mandatory requirements. The owner must also adopt at least some of the "encouraged" requirements, although their selection and choice are completely at the discretion of the owner. In the design of the point system, MOCT took into consideration not only the energy-saving potential of the "encouraged" measure, but also its ease of adoption in the actual building market. For example, a new technology that has good energy-saving potential but is expensive will be given higher points to encourage its use.[158]

Jurisdiction

The building standard was developed by MOCT, and is administered as part of the building permit process for new buildings. To get a building permit, the building owner must submit an energy conservation plan signed by a licensed architect, a professional mechanical engineer, and an electrical engineer, to the local government office in charge of building regulations. Some local offices review the plan by themselves, but those that lack the expertise can request help from KEMCO. KEMCO provides assistance voluntarily to local authorities, but the final decision and responsibility for approving an energy conservation plan rests with the local authorities. However, KEMCO does have the legal authority to pass energy conservation plans.

Compliance

The MOCT planned to examine and approve 1,450 energy-saving plans in 2005, 2000 in 2006, and 2500 in 2007. However, in actual practice, in the first year (2003-2004), 2,564 energy-saving plans had already been examined. To further improve South Korea's building energy standard, the government asked South Korea Institute of Construction Technologies (KICT) to investigate the status of the current standard and policies, and recommend improvements. This investigation was to be completed in 2006, with the expectation that the scope of the stan-

dard would expand to more buildings, and a performance-based energy standard limiting the total energy use per square meter of floor area in new buildings would be developed. However, the Asia Business Council researchers are not aware of any information showing the result of the investigation and consequent government actions. Simultaneously, the government also announced that the insulation standard would be made stricter over time, and extended it from new construction to include existing buildings. Finally, the government is considering requiring that all real estate transactions include an energy-efficiency certificate, with the associated document attached to all sales transactions.

Appliance/Equipment Labeling and Standards

High-Efficiency Equipment Certification Program

Since 1996, South Korea has been implementing a high-efficiency equipment certification program that certifies high-efficiency equipment and provides financial support and tax benefits. By 2001, 22 items had been certified, with plans to increase that number to 41 by 2009. The government provides financial support and tax benefits to companies making products that have been certified as high-efficiency equipment. Products are also conferred the right to use an "e" mark to certify the validity of the high-efficiency equipment. Meanwhile, the government applies an expanded rebate program to all high efficiency equipment items, granting financial support and tax benefits to energy-efficient companies. Regulations mandating the use of high-efficiency equipment are being expanded to cover construction standards to attain improved energy efficiency. Finally, the South Korean government is encouraging public institutions to purchase and install energy-efficient equipment.

Energy-Efficiency Standards (Grades 1-5) and Labels

Mandatory standards and labels have been among the most successful components of South Korea's conservation strategy. Since 1992, efficiency standards (grades 1-5) and labels have been marked on prod-

ucts, including refrigerators and automobiles, which have dramatically increased energy efficiency of common appliances. By 2001, 5,294 models of 11 items were classified and registered, of which 3,849 models were evaluated as high-efficiency products of grades 1 and 2, representing 73 percent of the total number of products. The government plans to add one to two items per year that are subject to its efficiency classification. For example, compact fluorescent lights (CFLs) were added in 2003. The South Korean government is also continuously upgrading the minimum energy performance standard.

Other Initiatives

In addition to the mandatory building standards and appliance standards and labeling, the South Korean government has also established an impressive number of voluntary programs to stimulate building energy efficiency. These include:

Energy-Efficient Labeling Program for Buildings

Under this program, newly built or repaired multi-dwelling units with more than 18 households will be classified into grades 1-3 depending on the use of energy-conserving facilities and equipment throughout the life cycle of the construction project. Buildings that are above a certain performance standard will be given a certificate of building energy efficiency and a construction loan at a lower interest rate. The government is planning to expand this program by targeting detached houses and business buildings.

Green Building Certification Program

This program evaluates the elements affecting the environment throughout the life cycle of the building construction process (production of material, design, construction, maintenance and dismantling of buildings) with the goal of improving the environmental performance of the buildings and reducing greenhouse gas emissions. Under this program,

certification audits will be targeted for existing buildings, but if the construction contractor desires an audit from the beginning stage of design, a preliminary certification will be endowed. This system has four grades and certification is valid for five years. An extension may be requested for an additional five years. After 10 years, the regulation requires renewal. This program is currently limited to multi-dwelling units, housing and commercial complexes, businesses (public and private buildings), commerce (schools, hospitals, etc.), and remodeled buildings.

Planned Financial Support

At the same time, KEMCO is planning to provide financial support to energy-efficient activities under Notification No. 2002-239 of the Ministry of Commerce, Industry and Energy (MOCIE). These activities cover co-generation, energy savings, energy service companies (ESCOs), demand forecasting, or use of alternative energy.

Energy Audit Program

Energy audits in South Korea have been conducted mainly by KEMCO. The corporation has different types of energy audit programs for industry and buildings, respectively. In the building sector, energy audits are conducted for large residential and commercial buildings at the request of the owners of those buildings. After auditing, the company identifies and recommends energy-saving measures, such as thermal insulation and double-glazed windows, together with technical assistance. The Minister of MOCIE may order the correction and improvement of energy-loss factors identified by the audit, and low-interest policy funds are available for making the improvements.

Between 1980 and 2001, a total of 377 energy audits were performed on buildings. Between 2002 and 2004, South Korea implemented a Three-year Plan for Energy Auditing and inspected a total of 2,096 businesses and buildings. The government is promoting expansion of this energy audit program.

Voluntary Agreement for Existing Buildings

This joint program between the government and building owners aims to reduce energy consumption and reach greenhouse gas emission reduction targets. It targets owners of buildings who use more than 2,000 tons of oil equivalent (toe) per year. Building owners who intend to join the agreement submit a concrete action plan and specify energy consumption and greenhouse gas emission reduction target (5 percent savings over five years is recommended). Under this program, government provides low-interest loans, tax incentives, technical support and public relations promotion to the building owners.

Energy Savings in Public Organizations

South Korea has an aggressive public sector energy conservation program that encompasses not only its national government, but also city and provincial governments and public corporations. Under this program, public organizations are expected not only to save money but also to inspire citizens to save energy. Both MOCIE and KEMCO carry out the program.

Three programs are particularly notable. The Prior Consultation on Energy Utilization Planning Program, begun in 1993, aims to affect energy-related projects such as the construction of new public buildings. The goal is to influence these projects while they are still in the planning stages. By the end of 2001, the program had influenced 245 projects, promoting the installation of energy-efficient equipment and systems, as well as larger-scale (e.g., cogeneration) and renewable energy installations. Currently, MOCIE and KEMCO are trying to broaden the program's reach through the use of financial incentives and on-site assistance to promote highly energy-efficient design.

The Energy Conservation Guideline for Public Institutions, started in 1997, directs the creation of annual energy conservation plans, including reduction targets, by public organizations. One element is

an efficient public building code requiring the installation of energy-efficient systems and equipment in new public buildings.

In the purchasing arena, South Korea maintains an Energy-Saving Product List that includes both products that fall under South Korea's national energy information labeling program, such as clothes washers and cars, as well as energy-consuming products that hold the South Korean endorsement label for being more efficient than others of the same type. In all, 55 product types are covered. Public sector buyers are required to purchase models with the endorsement label, which covers 43 classes of products.

Taiwan

Summary

- Over the past 20 years, Taiwan has substantially revised its national energy policy to find a balance between securing energy supply for its economic growth and strengthening its environmental policies.
- Energy efficiency and conservation is a major component of Taiwan's energy policy, with the building sector one of the six main target sectors. This sector alone is expected to contribute 8.7 percent of the total 28 percent energy-saving goal for 2020.
- Taiwan is among the leading economies in Asia in terms of the comprehensiveness and depth of building energy-efficiency standards. The standards are now well accepted as basic building requirements in Taiwan, with rigorous voluntary programs going beyond the baseline.

Data Profile

Taiwan's vibrant economic growth relies on a steady supply of energy. Statistics show that energy consumption in Taiwan increased by over 200 percent during the 20 years from 1984 to 2004, with an average annual growth rate of 6.0 percent. Per capita energy consumption increased by around 170 percent during the same period, with an annual average growth rate of 5.0 percent.[159] According to APEC's prediction, total final energy consumption will rise more than 75 percent from 2002 to 2020, while per capita consumption will rise 54 percent during the same period.[160]

With the evolution of its economy, there is a slight change in Taiwan's energy consumption structure. The industrial sector is still

the biggest consumer of energy, although its share of total energy consumption dropped from 60 percent of the total to 57 percent from 1984 to 2004. The building sector (residential and commercial), which accounted for 14 percent of total consumption in 1984, became the second largest sector, taking 18 percent of the total in 2004.[161] Energy consumption of the building sector rose two-and-a-half times from 1980 to 2002, while per capita consumption within the sector rose around 170 percent. It is predicted that from 2002 to 2020, energy consumption of the building sector will rise by 70 percent, and per capita consumption will rise by about 60 percent.[162]

Because Taiwan has a subtropical climate, nearly every building in Taiwan is equipped with an air conditioner, or a central air conditioning system. On a daily basis, the air conditioning load accounts for around 40 percent of the energy consumed in a typical building, while lighting accounts for another 35 percent. The cooling load is the main cause for summer peak power demand that is almost 1.4 times that of winter, sometimes causing power shortages.

The annual CO_2 emissions per capita in Taiwan are estimated to have been increasing at a rate of 7.5 percent. If Taiwan were to reduce its greenhouse gas emissions to 1990 levels by the year 2010, it would have to reduce the projected 2010 emissions by more than half.

Energy Policy

Taiwan is a densely populated island with only limited natural resources, relying heavily on imports in energy supply. Domestic energy production accounted for 10.8 percent of the total energy demand in 1984, but it dropped rapidly to only 1.8 percent in 2004. With growing energy use in Taiwan, securing energy supply is becoming increasingly difficult.

The first version of "The Energy Policy of the Taiwan Area" was promulgated in April 1973. Afterwards, in response to the impact of energy crises and changes in the local and international energy situation, the energy policy was revised in 1979, 1984, 1990, and 1996.

Revisions in Taiwan's energy policy show that Taiwan has been trying to find a balance between securing energy supply for its economic growth and strengthening its environmental policies.

In the 1970s and 1980s, the government focused primarily on securing a steady supply of energy resources and on accumulating reserves in order to prepare for global price fluctuations and energy crises. However, since the 1990s, environmental factors have featured more prominently in Taiwan's energy policy. Specifically, in 1996, the government announced its determination to establish a clean, efficient and liberalized energy-supply-and-demand system.

The aims of the current energy policy (last revised in 1996) are to establish a liberalized, orderly, efficient, and clean energy system based on the environment, local characteristics, future prospects, public acceptability, and practicability. Taiwan has set a goal of 28 percent energy savings of total consumption by 2020. The building sector alone is expected to contribute 8.7 percent of the total savings.

In responding to the new energy policy, the government encourages public and private industries to improve energy efficiency, restructuring their manufacturing processes to reduce emissions.[163]

Energy-Efficiency Policies

Energy efficiency and conservation is a major component of Taiwan's energy policy. The aim is to combine the efforts of the government and the private sector to meet the international trend of reducing greenhouse gas emissions.

Energy conservation policy in Taiwan targets six sectors: industry, transportation, residential and commercial building, power, education and guidance, and promotion of the development of the energy-saving equipment industry.

As the greatest energy consumer, the industrial sector is Taiwan's energy-efficiency policy priority. However, awareness of building energy efficiency has grown rapidly in Taiwan, and the residential

and commercial sector has become an indispensable segment of its energy-efficiency policy. Specifically, the government identified six measures to improve energy efficiency in the residential and commercial sector:

- Form an energy conservation service group for business and government organizations to strengthen technical services;
- Promote civil energy technology services;
- Strengthen the building envelope energy consumption index and expand the implementation of environmental architecture;
- Implement energy-saving measures in the government sector;
- Establish standards for energy-saving designs of air conditioners and illumination in buildings; and
- Popularize energy-saving applications in buildings and provide demonstrations of these applications.

Building Energy-Efficiency Policies and Initiatives

Taiwan adopted building energy standards for air-conditioned, non-residential buildings in 1995 and for residential buildings in 1997. These are mandatory standards that are being rigorously implemented, with demonstrated compliance needed in order for a building permit to be granted. At present, the standards cover only the performance of the building envelope, although for the non-residential standard, energy performance criteria for the HVAC and lighting systems have also been proposed. In addition to the mandatory building energy standard, Taiwan has also been working towards voluntary building energy-efficiency programs such as building energy labeling, a very successful green building certification program, as well as demand-side management (DSM) programs.

Building Energy-Efficiency Standards

There are two building energy-efficiency standards, one developed in 1995 for air-conditioned, non-residential buildings, and another in

1997 for residential buildings. These have been adopted at the national level and are mandatory for the building types to which they apply (offices, commercial buildings, hotels, and hospitals for the non-residential, housing for the residential standard). The compliance of the standards is estimated at over 80 percent, with compliance needed for a building permit to be granted.

The Taiwan non-residential building energy standard is a simplified performance standard that covers only the energy performance of the building envelope. Instead of prescribing the levels of wall and roof insulation, or the thermal and optical properties of the windows, the standard simply sets maximum allowable loads for the building envelope. Minimum allowable efficiencies for the HVAC and lighting system have also been proposed, but these have yet to be implemented. The concept of separating building energy performance into two parts—the building envelope for the perimeter, and HVAC system efficiency for the interior zones—is very similar to the PAL (Perimeter Annual Load) and CEC (Coefficient of Energy Consumption) methods used in the Japan building energy standard. The Taiwan residential building energy standard was adopted in 1997 and is a prescriptive code. The standard has been approved at a national level, but there are regional variations.

The government institutions responsible for building energy efficiency in Taiwan are the Bureau of Energy, Construction and Planning Agency of the Ministry of the Interior, the Architecture and Building Research Institute, and the Environmental Protection Administration. The building energy-efficiency standards were developed by the Bureau of Energy and the Architecture and Building Research Institute, in collaboration with several universities in Taiwan. The standards have become a part of the building permit process for new buildings, which is under the jurisdiction of the Construction and Planning Agency. To get a building permit, the building owner must submit documentation showing that the proposed building design meets the mandatory

requirements set forth in the standards. Failure to do so will result in denial of the building permit. It is estimated that, as of 2006, over 80 percent of new construction complies with the standards.

Appliance/Equipment Labeling and Standards

Household appliance energy standards have been established for 12 types of products in Taiwan. The regulation is mandatory, with manufacturers forced to comply to sell their products. At the same time, a voluntary comparison energy labeling program is under consideration.

Other Initiatives

In addition to the mandatory building energy standard, Taiwan has also developed voluntary building energy-efficiency programs, such as a very successful green building certification program called the Green Building Evaluation System, a building energy labeling program, and demonstration and education programs.

Green Building Programs

In 1999, the Architecture Research Institute of the Ministry of the Interior developed a green building evaluation system, called EEWH (Ecology, Energy, Waste and Healthy) that is a special chapter in Taiwan's national building code. EEWH evaluates buildings based on nine indicators, including biodiversity, green landscaping, site water conservation, CO_2 emissions reduction, waste reduction, indoor environment, water resources, sewage and garbage treatment, as well as energy conservation. This system has been simplified and localized for the subtropical climate of Taiwan.[164]

EEWH targets newly-built buildings and issues two types of certification to buildings, the Green Building Label and Green Building Candidate Certification. It is a voluntary program but is mandatory for any new public building construction project funded by the govern-

ment that exceeds US$1.5 million. According to some experts, EEWH has been very successful and in many ways has taken the public spotlight from the building energy-efficiency standards.

With the evaluation mechanism provided by EEWH, the Green Building Promotion Program of Taiwan was proposed in March 2001 and first revised in May 2003. The program forges a comprehensive mechanism providing resources, research, guidance, training, and education to support the adoption of green building in Taiwan. One of the major promotional strategies of this program is to initiate green building design for all public buildings. Mandatory Green Building Label based on EEWH for all new official buildings of the central government was required beginning in 2002 and for local government buildings starting in 2003. To date, Taiwan has more than 500 buildings certified as green building or green building candidates. Furthermore, the government also subsidizes green retrofitting projects for existing buildings. The green retrofitting projects employ a variety of green building technologies, including insulation improvement work such as the installation of sun shading devices, and ecological protection work such as constructed wetlands combined with the function of wastewater treatment and reuse. From 2002 to 2003, 28 green retrofitting projects were completed for official buildings and public schools. The green building policy can be viewed as successful in the public sector.

In 2005, the Taiwan Green Building Council, initiated by the Architecture and Building Research Institute (ABRI), was officially launched. The mission statement of the Taiwan Green Building Council focuses on the development in the construction industry, including: promoting green buildings, facilitating international cooperation, and assisting in the globalization of Taiwan's construction industry.

Building Energy Labeling

The Bureau of Energy has launched an Energy Labeling Program for appliances/equipment and many types of buildings and has also an-

nounced a voluntary energy benchmark for buildings.[165] However, the energy labeling program for buildings is not yet implemented

Demand-Side Management Programs

These programs are being promoted by the Bureau of Energy in conjunction with the Taiwan Power Company.[166]

Incentive Programs

Solar hot water systems have been promoted since 1986. Every square meter of solar collection qualifies for a US$66 cash rebate from a governmental incentive program. In 2000, the accumulated solar collection area exceeded one million square meters and the program was halted. However, in 2003, because of the program's significant energy savings, it was restarted.

Demonstration and Educational Programs

The Energy Commission under the Ministry of Economic Affairs in Taiwan has established web sites to promote the concept of energy savings by displaying data on demonstration projects and disseminating pamphlets and notes. The National Science and Technology Museum is displaying demonstration systems on a year-round basis to educate citizens.[167]

Thailand

Summary

- Thailand's energy policies mainly aim to reduce dependency on energy sources from foreign countries, with emphasis on conserving and developing energy resources, as well as promoting the efficient use of energy.
- The energy-efficiency and conservation program in Thailand, targeting mainly the industrial and building sectors, is one of the most advanced in ASEAN.
- In Thailand, compliance with building energy-efficiency codes has been mandated, with significant energy savings in some areas, but evaluation, monitoring and documentation are still weak.
- Thailand is the leader among ASEAN countries in establishing and implementing demand-side management (DSM) program. Its comprehensive, nation-wide demand-side management program covers appliance/equipment energy labeling, building energy efficiency, consumer education, etc, and has been successful in achieving overall energy reduction goals.

Data Profile[168]

Thailand's energy consumption soared over 250 percent from 1980 to 2002, with an average annual growth rate of 6.0 percent. Per capita energy consumption increased by more than 140 percent over the same period, with an annual average growth rate of 4.1 percent. Energy consumption is expected to continue rising at this rapid pace, with Thailand's final energy consumption increasing more than 150 percent from 2002 to 2020, while per capita consumption is expected to rise by around 130 percent during the same period.

Breaking consumption down by sectors, the building and industrial sectors have used 20 percent and 45 percent of the total energy consumed in recent years, respectively. These two sectors share 95 percent of the nation's electricity consumption. From 2002 to 2020, energy consumption of the building sector is projected to grow by 80 percent, and per capita consumption to rise by more than 60 percent.

In a typical commercial building in Thailand, the air conditioning load accounts for between 45 and 50 percent of the energy consumed, while lighting accounts for another 30 percent. For a typical residential building, lighting and air conditioning contribute some 30 percent of total energy consumption.[169]

Associated with this increase in energy use, CO_2 emissions in Thailand rose at an average annual rate of 8.0 percent from 1980 to 2002, and are estimated to increase at a rate of 4.9 percent from 2002 to 2030, both numbers being the highest among the 11 Asian economies reviewed in this study.

National Energy Policy

While energy demand has risen sharply, domestic sources of supply are limited, and imported energy exceeds 60 percent of total energy demand. With Thailand's predicted high economic growth, energy security will be a continuing challenge.

In the 1980s, with the rapid growth in energy demand, the primary objective of national energy policy was to procure sufficient energy to meet increasing demand. This was done mainly through investments on the supply side: power generation, transmission and distribution systems, oil refining and marketing as well as natural gas production and pipeline network.

Since the early 1990s, Thailand has begun to emphasize both the supply and demand sides, and both energy security and environmental protection. The 2002 Thai national energy policy emphasizes conserving and developing energy as well as promoting the efficient use of en-

ergy in balance with the country's environment and natural resources. While enhancing national energy security and reducing dependency on energy sources from foreign countries is still the primary objective, the government is proactively promoting efficient and economical use of energy and the use of renewable energy sources to reduce total energy demand and protect the environment.

In 2005, with a view toward reducing dependency on imported energy and strengthening energy supply security, the Thai government formulated the National Energy Strategy, which calls for reducing energy consumption by 13 percent and 20 percent in 2008 and 2009, respectively. Under this strategy, finding alternative energy and devising new technologies for energy efficiency and conservation are top priorities in the energy master plan.

Energy-Efficiency Policies

In 1992 the government launched the Energy Conservation Act (the ENCON Act), which has been the primary legislation guiding Thailand's energy-efficiency and conservation policy.

The ENCON Act, made effective in 1995 via a Ministerial Order, aims to promote energy conservation and to encourage conservation investments in factories and buildings. It includes mandatory regulations plus incentives to facilitate the implementation of the required energy-efficiency measures. It also includes an Energy Conservation Fund (ECF) that started with US$60 million and receives some US$57 million annually to provide working capital, grants and subsidies to promote energy conservation. Main contents of the ENCON Act include:

- A compulsory program for designated facilities that comprise approximately 4,500 large commercial and industrial facilities (buildings and factories);[170]
- A voluntary program for smaller facilities, primarily small and medium-sized enterprises (SMEs), that includes demonstration

and pilot projects, research and development, renewable energy, information campaigns, and other special projects; and

- A complementary program of public relations, human resource development, and administration of ENCON, as well as the monitoring of implementation of the funds allocated for program activities.

Building Energy-Efficiency Policies

Building Energy-Efficiency Code

First Version of the Code

The first-generation Thai energy code was first endorsed in 1995 as a set of building energy codes for designated buildings and government buildings and was further defined that same year as a Ministerial Regulation as part of the ENCON Act.

The energy code has been mandatory since 1995 for both existing and new buildings. A primary focus has been on mandatory enforcement for existing "designated buildings" as well as new "designated buildings" constructed after the enactment of the ministerial regulation in 1995.[171] The capacity and consumption limits used to define "designated" buildings indicate that most of these buildings have air-conditioned floor areas greater than about 10,000 square meters.

Energy audits were required for existing designated buildings, and several thousand reasonably detailed audits of existing buildings have been done. The conduct of such a large number of building energy audits was a major energy code implementation undertaking and is unparalleled in the Southeast Asia region, perhaps with the exception of Singapore. This mandate has spawned the development of a Thai energy auditing industry, and has also produced a valuable database of energy characteristics of larger Thai buildings.

In reviewing summary data from the many audits conducted, Asia Business Council researchers noted that many existing buildings apparently complied with the energy code requirements (about 60

percent met the envelope requirements,[172] 75 percent met the lighting requirements,[173] and close to 50 percent met the air conditioning requirements). Still, a substantial number of existing buildings did not comply with the building energy code requirements (about 40 percent for the building envelope, 25 percent for lighting, and over 50 percent for air conditioning).

The ENCON Act also requires that designated buildings that do not meet the code requirements undergo retrofit changes to comply with the requirements. For those designated buildings that do not, registered consultants prepare targets and plans that project owners agree to in writing. These plans are then submitted to the authorities and owners are obliged to follow the compliance plans for their buildings. A number of designated buildings received such retrofits for at least some systems, mainly the lighting system. For example, of some 2000 audits that have been analyzed, the required plans to retrofit the buildings' lighting systems to bring them into code compliance were actually accomplished. Thus, the ENCON Act has clearly had an impact, although not impressive. However, because of the poor organization and accessibility of the auditing data and weak follow-up monitoring and evaluation, it is not clear how many retrofits have occurred for the air conditioning and building envelope systems or how much energy has been saved as a result. This is unfortunate, since these systems can account for 50 percent or more of total building energy use under Thai climate conditions. The Thai data on the air conditioning and building envelope retrofits done for the ENCON compulsory program is a potentially valuable but untapped resource about building energy efficiency both in Thailand and in the region.

For new buildings, additions, or renovations, a key infrastructure issue exists. The individuals currently responsible for checking the energy code compliance are the staff of the technical departments in local building department administrations that issue building permits. However, there are few, if any, local staff skilled or trained in evaluating

the energy issues or energy compliance. Also, apparently, there are no detailed compliance forms or requirements to submit. Building owners and designers are knowledgeable about the general energy code requirements, but when an application for a building permit is submitted, it includes a general statement that the building complies with the energy code without any detailed justification. This could be because it is not required or because the staff at the technical department at the local authorities do not have the required skills to perform a proper check of the documentation.[174]

Planned Revisions to the Energy Code

In the past five years, the Thai government has developed a revised energy code based on substantial revisions. The original approach had been to identify prescriptive requirements for the thermal performance of building envelope, the efficiency of cooling/heating systems and maximum lighting wattage per square meter. The latest code revisions retain the prescriptive compliance approaches, but place more emphasis on compliance that assesses the energy performance of major building systems (envelope, lighting, air conditioning) or of the energy performance of the whole building. Some aspects of the new Thai code formats are quite innovative, such as the equations used for assessing the performance of the air conditioning systems. In terms of savings targets, the new code requirements will produce an estimated extra energy savings of 8-9 percent as compared with the current energy code. At the time of this writing, the new draft codes were being prepared to be submitted to the Thai cabinet for endorsement. The administration and enforcement procedures for these new codes are not clear at this time.[175]

Jurisdiction

Energy has become such an important issue to Thailand that a new Ministry for Energy was formed in 2002. Several primary government

agencies are responsible for energy-efficiency activities under the Ministry of Energy.

- The Department of Alternative Energy Development and Efficiency (DEDE) is the primary government agency that formulates and determines building energy code requirements.
- The Department of Public Works and Town & Country Planning under the Ministry of Interior administer and enforce the building energy codes.
- The Energy Policy and Planning Office (EPPO) formulates energy policy, as well as strategic policy for energy efficiency and renewable energy.
- The Electricity Generating Authority of Thailand (EGAT) is a state-owned electricity generating company that has been managing a demand-side management (DSM) program in Thailand since the mid-1990s.

There has evidently been an effective, long-term collaboration between government and academia in Thailand that has contributed to the development and refinement of building-energy standards. This cooperation has included various pilot training programs in the past that were implemented over time via government cooperation with various Thai academic institutions.

Appliance/Equipment Labeling and Standards

Energy Labeling

Thailand has been implementing energy labeling programs on a mostly voluntary basis since 1994 when the Electricity Generating Authority of Thailand (EGAT) began a voluntary energy-labeling program for household refrigerators, which is part of Thai's nation-wide demand-side management (DSM) program. In the following years, EGAT launched labeling programs for a number of products such as air conditioners, ballasts, electric fans, fluorescent lamps, rice cookers, and the like. The original savings target of this program set in the Five-Year Master Plan

was 238 MW. By June 2000, after less than six years of implementation, EGAT had exceeded this five-year peak target by 138 percent (566 MW) and by June 2001, it had exceeded the target by 168 percent (638 MW). A significant and growing portion of these program savings were due to the energy labeling programs for refrigerators and air conditioners.

Minimum Energy-Performance Standards

Development of minimum energy performance standards has lagged behind implementation of energy labeling. Under the direction of the National Energy Policy Office, a study was carried out in 1999 on the introduction of minimum energy-performance standards for five classes of products: compact fluorescent lamps; fluorescent lamp ballasts; refrigerators; air conditioners; and electric motors. These standards were to begin taking effect in 2003 and 2004. Implementation has been delayed, however, and the first standard began to take effect on a voluntary basis for refrigerators and air conditioners only in 2005.

Other Initiatives

Demand-Side Management (DSM) Program

Following the enactment of the ENCON Act in 1992, the Electricity Generating Authority of Thailand (EGAT) established a large nationwide demand-side management program in 1993, starting with the implementation of appliance energy labeling. This US$189 million program was funded mostly by Thailand (79 percent) with an automatic fuel tariff while three international sources together contributed 21 percent (the Global Environmental Facility (GEF), Australia, and Japan). EGAT created a Demand-Side Management Office (DSMO) that grew to 177 people by 2000 and implemented a broad range of demand-side management programs for three sectors: commercial, residential, and industry.[176]

In late 1995, the demand-side management program expanded to include energy efficiency in existing commercial buildings. The

DSMO offered energy audits and investment consultation for high-return energy measures of building lighting, cooling, envelope and load management systems.[177] This program has been coordinated with the compulsory program conducted under the ENCON Act. By 2000, 433 owners/managers had applied to participate, and 252 preliminary audits had been conducted. But only 34 had been approved because of a backlog of audits under review within the government agency responsible for the compulsory audits. Other issues included (1) a lack of secure funding sources for energy measures to be implemented, and (2) the need to improve coordination between the DSMO and the agency responsible for the compulsory audit program.

During the 1996-1998 period, EGAT began a major expansion of its demand-side management program and launched about 15 new programs. The programs most germane to buildings are listed below:

- CFLs: Labeling, testing and promotion of compact fluorescent lamps (CFLs);
- Low-loss ballasts: Promotion of low-loss magnetic ballasts;
- Green leaf: Audits and certification of energy-efficient hotels;
- New commercial buildings: analysis of viability of energy measures and support for installation of measures that exceed code requirements;
- Small and medium enterprises (SMEs): promote predefined energy measures in SME premises, including ECF financing;
- Load management: DSMO support to another agency responsible to promote load management;
- Thermal storage: construction of demonstration facility; and
- Attitude creation: portfolio of publicity campaigns.

The first two programs might be categorized as labeling programs, while the other programs represent a diverse portfolio of demand-side management actions.

EGAT is now preparing to issue, by the end of 2007, new, more stringent labeling standards for electrical products, beginning with air

conditioners because they account for the largest portion of residential electricity bills.

In general, EGAT's demand-side management programs have achieved its overall peak and energy reduction goals.[178]

Energy Conservation Fund (ENCON Fund)

In conjunction with the legislation of the ENCON Act, the ENCON Fund was established to provide financial support to government agencies, state enterprises, non-government organizations, individuals and businesses that wish to follow the act by implementing measures to increase efficiency in energy utilization. The ENCON Fund receives revenues from a tax of THB$0.04 (US$0.001) per liter on all petroleum products sold in Thailand. The tax provides annual inflows of approximately THB$2 billion (US$50 million) per year. In June 2005, the ENCON Fund had a balance of more than THB$14 billion (US$350 million). The allocation of money from the ENCON Fund to activities that support energy efficiency and renewable energy is an important government priority.

To date, the ENCON Fund has funded 10 building projects and 56 factory projects. Results so far indicate that each dollar of lending results in more than 10 dollars in lifetime energy cost savings, and that every dollar lent from the fund leverages approximately 60 cents additional in commercial bank lending.[179]

Energy Efficient Building Award

The Department of Energy in Thailand has recently begun to provide awards to energy-efficient buildings, and the first round of awards was announced in 2006. In the Designated Building category, the Tesco-Lotus department store, Ratanathibet branch, received an energy award. Two buildings also received awards in the category of Creative Building for Energy Conservation: Tesco-Lotus at Rama 1 branch won for a new building; and the North NaNa branch of the Krungthai

Bank won for a retrofit of an existing building.[180]

Green Building Program

Green building activities for commercial and institutional buildings seem to be still in the early stages in Thailand. EGAT has had a green building program, but it evidently targeted a limited number of buildings and its effectiveness is not known. A Thai bio-solar house was featured as a case study in 2003 in *Architecture Week*.[181]

Regional Energy-Efficiency Activities

Thailand has actively participated in ASEAN regional energy-efficiency activities, including participation in the development of regional energy benchmarking of buildings and regional energy-efficient building award programs.[182]