

2.1 Buildings

A variety of factors have driven global efforts to improve energy efficiency in buildings. Firstly, energy efficiency investments in buildings are typically cost-effective over their lifetime and have short payback periods. Secondly, given that buildings account for 30% of the world's total energy consumption (Hong et al., 2007), there is a perception that economies that are net fuel importers can improve their energy security by reducing their consumption of energy from the buildings sector. Finally, some of the most cost-effective greenhouse gas abatement options, according to McKinsey's Global GHG Abatement Cost Curve (version 2.1), involve direct energy efficiency improvements in buildings. Enhancing building energy efficiency in new buildings and retrofitting residential heating, ventilation and cooling (HVAC) systems as well as residential insulation can together account for roughly 1.7 GtCO₂e of global abatement potential every year until 2030 (McKinsey & Company, 2010).

Despite the cost-effective nature of energy efficiency improvements in buildings, their uptake has been slow. As the Asia Pacific Energy Research Center (APEREC) (2003) points out, energy expenditures often constitute a small proportion of overall expenditures for most households and many small businesses (and are thus of low salience during decision-making), while energy efficiency measures also entail a certain degree of inconvenience as they can disrupt household and commercial activities. As a consequence, short payback periods may not be enough to incentivize energy efficiency improvements in buildings. Given issues such as low salience and risk of disruption, regulations have been used in several economies to drive building energy efficiency.

The most significant among such regulations are building energy codes i.e. energy efficiency requirements in building codes that dictate how new buildings are constructed. While primarily targeted at new buildings, where it is much less costly to integrate energy efficiency improvements, building energy codes can also serve as the efficiency target for refurbishments or other improvements of existing buildings (International Energy Agency, 2008a). By 2003, most APEC economies had already implemented building energy codes, although there were significant differences in coverage (residential vs. commercial buildings) and compliance mechanism (voluntary vs. mandatory codes) (Asia Pacific Energy Research Center, 2003). In addition, a range of other policies have been used to promote energy efficiency improvements in buildings, including building energy performance labeling, financial incentives, energy management and audits, lead-by-example programs (such as government modeling and demonstration projects), information and awareness programs, and research and development (R&D) programs (Asia Pacific Energy Research Center, 2003; Hong et al., 2007).

This section analyzes various regulations aimed at improving energy efficiency in buildings, focusing on the two cases of Japan and Thailand. The chosen case studies provide an ideal platform to study issues relating to regulatory practices in building energy codes (given that there are significant differences in how the two economies have chosen to implement codes) as well as the other types of regulations, most of which have been implemented in at least one of the two economies. For both APEC economies, we describe and evaluate policies enacted in order to boost energy efficiency in buildings. Where appropriate, we also compare how the policies in the respective economies have fared against one another.

2.1.1 Energy Efficiency in Buildings in Japan

Key findings

- Improving energy efficiency in buildings, which account for nearly one-third of Japan's total energy use, will be required if Japan is to achieve its targets of reducing oil dependence, reducing greenhouse gas emissions, and increasing energy efficiency.
- Building energy efficiency policies in Japan consist of an assortment of building energy codes, labeling programs, and a range of financial and fiscal incentives.
- Japan's building energy efficiency policies are comprehensive in their design, flexible and well-aligned, though the extent to which they have cost-effectively met Japan's energy efficiency objectives remains unclear.

Costs, benefits and promotion

- One area that requires attention in Japan is that the design of building energy codes does not take into account the lifetime economic benefits and costs. It is unclear if the design of building energy codes is maximizing societal benefits while minimizing costs.
- Residential and commercial buildings that comply with the building energy codes have reduced their energy consumption by 40% and 75% respectively. However, aggregate energy savings from the codes are constrained by the fact that they are not mandatory either for buildings with a floor area of less than 300 m² or for existing buildings of any floor area that have not recently undergone renovation or construction.
- The Comprehensive Assessment System for Building Environmental Efficiency (CASBEE) improves upon earlier labeling programs by providing a clear assessment of a building's energy efficiency performance, but its usage has been limited by the time-consuming nature of the evaluation.
- Financial incentives for energy efficiency improvements in buildings have contributed to the growth of the market for Energy Service Companies (ESCOs) in Japan.

Scientific integrity

- Japan's policies are typically comprehensive in their design and based on scientific analyses and evidence.

Flexibility

- Japan regularly revises its building energy efficiency policies so as to respond to changing circumstances.
- Individual policies adopted by Japan, including the building energy codes, the CASBEE labeling program, and financial and fiscal incentives, allow stakeholders the flexibility to achieve the policy target.

Transparency

- In general, information on various policies is readily available to the public.
- There is some degree of stakeholder engagement in the design of building energy codes. The level of stakeholder engagement in the design of the labeling program CASBEE is good.

Alignment

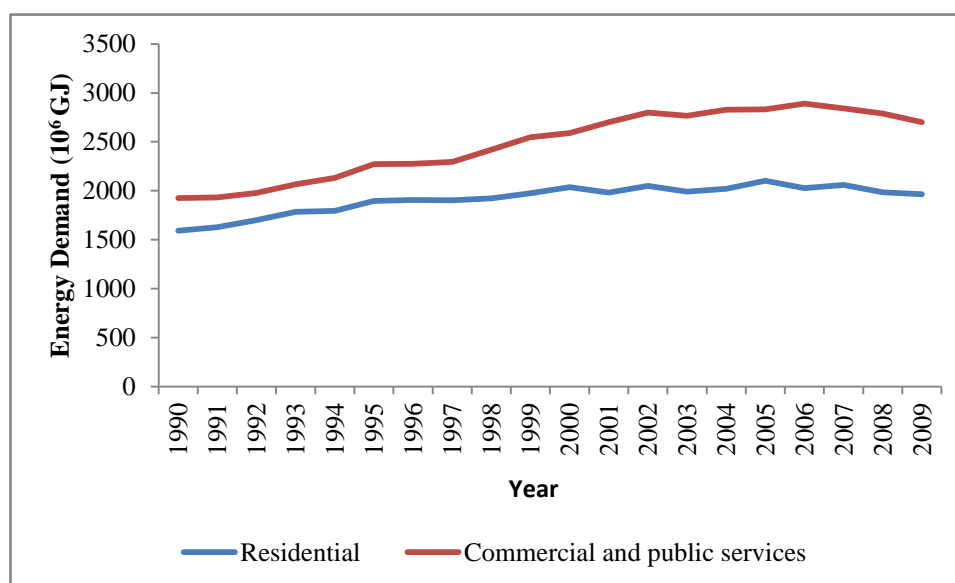
- Japan has taken measures to improve coordination and alignment among authorities, for instance by consolidating several ministries into a single Ministry of Land, Infrastructure and Transport (MLIT) and by relying on an inter-ministerial committee to carry out energy conservation policy changes.
- The different policies are generally well-aligned with one another, with financial incentives typically designed so as to complement building energy codes and labeling schemes.

A. Size and Significance

In 2006, Japan had 12.6 million non-residential buildings, with a total floor space of 0.68 billion square meters, and 32.1 million residential buildings, with a total floor space of 3.4 billion square meters. Single-detached houses account for 85% of the floor space of residential buildings and thus form the major component of Japan's building stock (Evans et al., 2009).

Buildings account for a significant proportion of Japan's energy use. Estimates range from 27.5% (according to estimates for 2004 from the Institute for Energy Economics, Japan (IEEJ)) (Hong et al., 2007) to 33% (according to IEA estimates for the year 2005) (Evans et al., 2009). Moreover, between 1990 and 2005, energy use in the building sector in Japan increased rapidly at a rate of 1.6% annually, in contrast to the industrial (-0.5%) and the transport (0.2%) sectors (Evans et al., 2009). As Figure 2.1.1 shows, energy consumption in both the residential sector and the commercial and public services sector grew swiftly between 1990 and 2005, before declining slightly in more recent years.

Figure 2.1.1 Energy consumption in Japan's residential and commercial & public services sectors (1990-2009)



Source: International Energy Agency, 2011

B. Policy Formulation

(i) History and Background

Improving energy efficiency (EE) forms one of the cornerstones of Japan's energy policy. Japan's Energy Conservation Law, first issued in 1979 and periodically updated (the latest being in 2008), is the foundation of Japan's energy efficiency policy. Energy efficiency policies have been pursued by Japan both to reduce its dependence on energy imports (which account for over 80% of its primary energy) and to reduce its greenhouse gas emissions (GHGs) (Hong et al., 2007). In 2006, the "New National Energy Strategy" was launched, which included energy efficiency and conservation policies to meet a target of 30% energy efficiency improvement (relative to existing levels when the strategy was announced in May 2006) and to reduce oil dependence to below 40% by 2030. On the environmental front, in 2009 the government announced its goal of reducing GHG emissions by 25% by 2020 compared to 1990 levels, while under the revised Basic Energy Plan (June 2010), it has set a target of reducing CO₂ emissions by 30% or more by 2030 compared to 1990 levels (Ministry of Economy, Trade and Industry, Japan, 2010). Environmental objectives provide an additional motivation for pursuing energy conservation policies.

Given that buildings account for a significant and growing proportion of Japan's energy use, the achievement of the aforementioned energy efficiency targets will not be possible unless building energy use reductions are realized. Under the Basic Energy Plan, Japan has adopted targets of a 37% reduction in CO₂ emissions from the commercial sector and a 34% reduction in CO₂ emissions from the residential sector by 2030 (relative to 1990 levels), which will constrain the energy consumption of its commercial and residential buildings respectively (Ministry of Economy, Trade and Industry, Japan, 2010). In addition, the Ministry of Economy, Trade and Industry (METI) has set a variety of targets, for both residential and commercial buildings, aimed at directly reducing energy consumption.

In the commercial sector, the overall consumption of energy increased by about 50% between 1990 and 2008, driven by increases in floor area and a 10% increase in the per floor area energy

intensity. METI has targeted a 3% reduction in the overall energy consumption of the commercial sector by 2020 and a 7% reduction by 2030. The METI also plans to decrease energy intensity in the commercial sector by 10% or more by 2020, and by 15% or more by 2030. At the same time, the METI plans to slow down overall increases in floor area (Ministry of Economy, Trade and Industry, Japan, 2008).

In the residential sector, per household consumption increased by approximately 8% from 1990 to 2008, while the average per-capita energy consumption increased by 30% in the same period. The METI aims to reverse this trend, targeting a 7% reduction in per household consumption by 2020 and a 13% reduction by 2030. The METI has also targeted a 6% reduction in per capita consumption by 2020 and a 14% reduction by 2030 (Ministry of Economy, Trade and Industry, Japan, 2008).

The revised Basic Energy Plan adopted in 2010 sets further energy efficiency targets for the buildings sector. The Plan targets increasing the availability of net zero energy houses by 2020 and realizing net zero energy buildings (both residential and commercial) on average by 2030. Targets for the residential sector also include having high efficiency water heaters in 80–90% of all households by 2030. A further target is to make all lights energy-efficient on a flow basis by 2020 and on a stock basis by 2030. The Ministry of Economy, Trade and Industry (METI) plans to promote measures such as high efficiency hot water supply devices, highly efficient illumination and energy conservation in information technology equipment in order to achieve these targets (Ministry of Economy, Trade and Industry, Japan, 2010).

A distinctive feature of Japan's building sector is the low life span of Japanese homes, only 26 years compared to 44 years in the US and 75 years in the UK (Sunikka-Blank et al., 2011). The low life-span can be attributed to the tradition of wooden houses and the threat of earthquakes and fires. This has negative implications for energy efficiency in buildings – frequent scrapping and construction add to the sector's energy use while the incentive for maintenance is lower (Smith, 2008). It also means a lower incentive to invest in energy efficiency during construction (Evans et al., 2009). Japan's Basic Program for Housing, issued in 2006, aims to address the low life-span by targeting an increase in the life span to 40 years, and in addition aims for 40% of housing to have energy saving measures (Evans et al., 2009).

(ii) Policy Description

MANDATES

Building Energy Codes

Japan's Energy Conservation Law specifies its building standards and codes, which are jointly administered by the Ministry of Economy, Trade and Industry (METI) and the Ministry of Land, Infrastructure, Transport and Tourism (MLIT). Separate energy codes, most recently updated in 1999, specify minimum requirements for the energy performance of commercial buildings and residential buildings or houses, and are adjusted based on the climate zone in which the building is located. The code for commercial buildings, Criteria for Clients on the Rationalization of Energy Use for Buildings (CCRUEB), is a mixture of performance-based and prescriptive energy codes. For houses, the Criteria for Clients on the Rationalization of Energy Use for Houses (CCRUEH) is a mixture of performance-based and prescriptive energy codes with a focus on heating, ventilation, and air-conditioning (HVAC). Houses are also covered by the prescriptive Design and Construction Guidelines on the

Rationalization of Energy Use for Houses, which covers insulation, HVAC, and water heating (Evans et al., 2009).

These building standards, while defined as voluntary, have a number of aspects that are enforceable depending on the floor space of a building. In particular, a specified number of buildings are required to submit a mandatory report on energy conservation measures prior to new construction, extension, alteration, or renovation. Over time, the number of buildings required to submit these reports has increased, as Japan has tried to increase levels of compliance with the standards. Starting from 2003, commercial buildings with a floor space that exceeds 2000 m² were required to submit energy conservation measures, and the requirement was extended to residential buildings with a floor space that exceeds 2000 m² in 2006 (Hong et al., 2007). After revisions to the Energy Conservation Law that were implemented in 2009, owners of both residential and commercial buildings with an area greater than 300 m² are required to submit energy saving plans before construction or renovation (Evans et al., 2009). If the energy use of these buildings is then found to be excessive, improvements are suggested, with ‘name-and-shame’ penalties as well as a possible sanction of up to US\$ 11,000 imposed in case of non-compliance (Sunikka-Blank et al., 2011). In addition, after the 2009 revision, construction companies building more than 150 houses per year are required to improve the energy performance of their buildings (Evans et al., 2009).

Performance standards for housing have a long history in Japan. They were first established in 1980. Table 2.1.1 below shows the evolution of the standards over the years.

Table 2.1.1 Changes to building standards since 1980

Policy	Year	Remarks
Act Concerning the Rational Use of Energy	1980	Establishment of performance standards for housing
Revision to Building Standards	1992	Strengthening of 1980 standards to levels comparable with those of the cold regions of Europe and North America
Revision of Long-Term Energy Policy	2001	Changes include imposing the regulations on buildings smaller than 2000 m ² and enhancement of the measures for buildings larger than 2000 m ² . There was stricter application of building standards for insulation. Improvements in both evaluation and labeling of energy efficiency were made to facilitate understanding by consumers (International Energy Agency, 2010) ¹⁴ .
Partial Revision of Building Standards	2003	Owners of specified buildings were required to notify the government of energy saving measures such as measures to prevent heat loss from external walls and windows and measures for effective energy usage of air conditioners and other specified equipment.
Revision of the Energy Conservation Law	2005	Energy conservation measures for the residential and construction sector were strengthened.
Revision of the Energy Conservation Law	2008	Owners of small to medium sized residences and buildings above a certain size to report on energy saving method.

Source: Compiled by the authors from various sources

¹⁴ International Energy Agency (2010), “Comprehensive Review of Japanese Energy Policy,” IEA Energy Efficiency Policies and Measures Database. <http://www.iea.org/textbase/pm/?mode=cc&id=675&action=detail>.

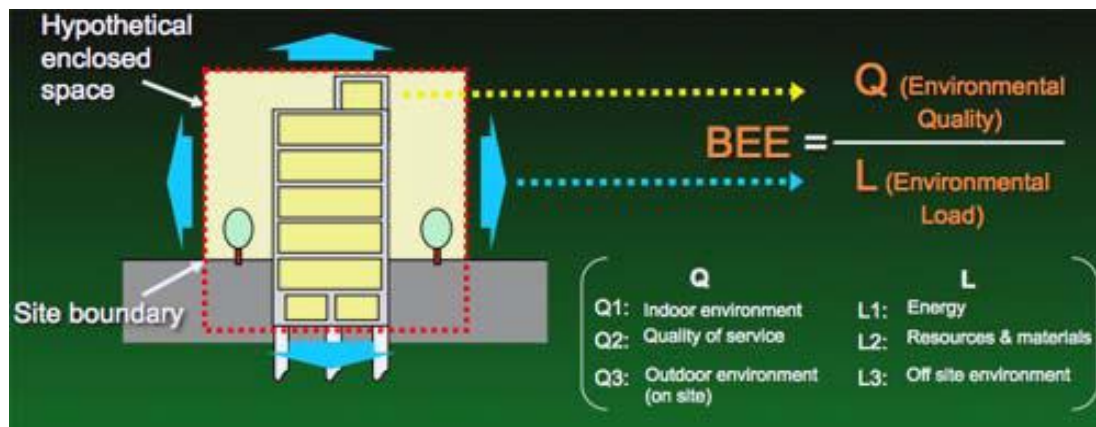
INFORMATION PROGRAMS

Building Labeling

Japan has instituted several rating and labeling programs over the years. These programs help evaluate a building's energy efficiency and sustainability and provide homeowners and buyers with this information. This can cut across incentive mismatches between owners and tenants that might otherwise impede energy efficiency improvements: with energy efficiency information easily available to tenants, owners have a bigger incentive to carry out such improvements in the first place (Evans et al., 2009).

The major labeling program in use in Japan is the Comprehensive Assessment System for Building Environmental Efficiency (CASBEE), developed by the Japan Sustainable Building Consortium in 2002 in conjunction with several other Japanese government agencies including the Ministry of Land, Infrastructure, and Transportation (MLIT) (Vare, 2010). CASBEE is an assessment tool that evaluates the Building Environmental Efficiency (BEE) based on both the environmental load of the building (including energy and materials used as well as impact on outside environment) and the environmental quality delivered by the building (including both the indoor and outdoor environments and service quality). A building with a high environmental quality and low environmental load is assigned a higher BEE score, as illustrated in Figure 2.1.2. The scores, or ratios, are labeled as Excellent (S), Very Good (A), Good (B+), Fairly Poor (B-), and Poor (C), in order of decreasing BEE value (Vare, 2010). The use of CASBEE is voluntary, but many local governments have provided incentives for buildings with a high rating on CASBEE, which include subsidies, access to lower interest mortgages, and permission to increase floor-area ratio (Sunikka-Blank et al., 2011).

Figure 2.1.2 Description of building energy efficiency (BEE) equation



Source: Vare, 2010

The historical evolution of labeling programs in Japan provides some perspective on why the CASBEE framework has been adopted. The oldest version of environmental assessment of buildings in Japan involved assessing the performance of building environments, with the aim of improving living amenities or enhancing the level of convenience for residents. The concept of environmental loading was not initiated and incorporated into building environmental assessments until the 1960s, when there was growing concern over air pollution problems, the effects of wind on pedestrians, and other environmental effects. A number of specific methods, such as the GB Tool, were proposed

amidst increased awareness regarding global environmental problems in the 1990's. These assessment methods consider Life Cycle Assessment (LCA), evaluating the lifetime environmental load of a building as well as (in some assessments) the building performance.

However, none of the above assessment tools clearly distinguish between these two basic assessment objects, the building performance and the environmental load of a building, which is what motivated the development of CASBEE (Japan Sustainable Building Consortium, 2005). In contrast to earlier assessment tools, CASBEE clearly defines and distinguishes between the building performance or environmental quality, and the environmental load, as is evident in Figure 2.1.2.

Other labeling programs include the voluntary “Environment and Energy Friendly Building Mark” system initiated in March 1999 for structures other than houses. Operated by the Institute for Building Environment and Energy Conservation (IBEC), it indicates the energy conservation performance level of a building above a certain minimum standard as specified by the building energy codes.¹⁵ Buildings can also be evaluated based on the amount of energy savings achieved due to the implementation of energy saving measures (Institute for Building Environment and Energy Conservation, 1999).¹⁶ In addition, the Housing Quality Assurance Law (2000) includes a voluntary housing performance labeling system designed to protect consumers. While it broadly covers housing performance, it includes a rating for the thermal environment that is based on the building energy codes discussed earlier and is used to assess the building’s energy conservation performance, as well as comparisons with other buildings (Evans et al., 2009).

The Environmentally Symbiotic Housing and Urban District Guidelines, issued in 1993, defines “model” housing complexes as those with “low impact” (energy-efficient and low use of natural resources), “high contact” (harmony with surrounding environment), and “health” (a healthy environment with amenities) (Evans et al., 2009). Finally, at the municipal level, the Tokyo Metropolitan Government has implemented a Green Building Labeling program, which ranks buildings according to four key areas: rationalization of energy use, appropriate use of resources, conservation of the natural environment, and abatement of the urban heat island effect (Vare, 2010).

Public Campaign and Awareness Programs

Like labeling programs, public campaign and awareness programs are also aimed at providing information in order to overcome informational and behavioral barriers to building energy efficiency improvements.

In July 2006, an inter-ministry committee coined the concept of “Lo-House,” intended to demonstrate options for sustainable housing by measures such as establishing the necessary infrastructure to allow for information sharing and provision on energy-saving housing (Ministry of

¹⁵ The standard is used to evaluate the building's energy performance level, which can be Level 1 (between 5% and 20% more efficient than the energy saving standard) or Level 2 (over 20% more efficient than the energy saving standard).

¹⁶ Level 1 is given to energy saving effects of approximately 5–15% after the energy saving measures while Level 2 is awarded to energy saving effects of more than 15% after the energy saving measures are implemented. Virtual comparisons can be carried out if the energy consumption of the building prior to the implementation of energy saving measures cannot be found.

Land, Infrastructure, and Transportation, 2006).¹⁷ In a November 2007 meeting, the “Inter-Ministerial Liaison Committee for the Promotion of Energy and Resource Conservation Measures” decided to implement “energy conservation contests” for households and draft an operating procedure on energy conservation for the commercial sector (Ministry of Economy, Trade and Industry, Japan, 2007). The government tries to raise public awareness on energy conservation through publicity drives such as the “Energy Conservation Day,” campaigns such as the “Energy conservation campaign in summer and winter” (Asia Energy Efficiency and Conservation Collaboration Center, 2010) and various awarding programs on energy conservation, including the “Awarding of Excellent Energy Conservation Factory and Building.”

Demonstration programs and projects have also been utilized in Japan. One such program, designed to encourage greater acceptance of fluctuations in comfort level, is the “Cool Biz” program. It is a voluntary demonstration campaign that encourages the setting of air-conditioning to 28 degrees Celsius in the summer. In addition, a number of demonstration projects have been set up to provide examples and models for green buildings. A notable example is Kobunaki Ecovillage in Omihachiman City, where each house fulfills standards for insulation in walls and has features such as natural ventilation, sun shading, and high efficiency appliances (Sunikka-Blank et al., 2011). The government has also implemented environmentally friendly practices in government facilities with the “Government Buildings Green Program” (Ministry of Land, Infrastructure, and Transportation, 2006).

FINANCIAL AND FISCAL INCENTIVES

The Japanese government supports the diffusion of energy efficient buildings by providing financial incentives such as low interest loans and fiscal incentives such as subsidies and tax reductions. Such incentives are used to counter both the negative externalities of high energy consumption as well as capital market barriers to energy efficiency investments. In Japan, moreover, energy efficiency investments are constrained by factors such as the short life spans of buildings, high land prices, and the fact that most of the housing is owned by private owners with little capital to invest, necessitating the use of fiscal and financial incentives to drive such investments (Sunikka-Blank et al., 2011). While these incentives can be designed as stand-alone mechanisms, in Japan fiscal and financial incentives have often been linked with building energy codes or labeling programs, with access to funding prioritized for buildings that comply with the codes or have a high rating under the labeling programs.

Low Interest Loans

The Japan Finance Corporation provides low interest loans of up to 720 million yen (approximately US\$ 7.2 million) to support energy efficiency improvements in both existing and new commercial buildings (Asia Energy Efficiency and Conservation Collaboration Center, 2010). There is a low interest loan program to support energy conservation renovation of existing buildings. The loan can be made to building owners to engage Energy Service Companies (ESCOs) to carry out energy efficiency improvement services, or can be made directly to ESCOs themselves. Low interest loans are also available for designing environmentally-friendly new buildings and are provided for

¹⁷ “Lo-House,” drawn from the concept of Lifestyles of Health and Sustainability (LOHAS), is intended to be promoted as a concept and image to demonstrate the options for sustainable housing. This will be done by establishing the necessary infrastructure to allow for information sharing and provision on energy-saving housing, developing new methods for evaluation of energy conservation performance in housing, and providing incentives to promote and popularize energy-efficient housing.

specific measures taken in the planning phase, such as energy conservation measures and roof-top greening projects. In 2008, the program was revised to apply only to small and medium-sized enterprises.

Low interest loans are also available for buildings that comply with the building standards (and thus are already energy-efficient). The Japan Housing Finance Agency (JHFA) allows for lower interest rates and preferential loans to be provided for energy efficient residential buildings. In the past (starting from 1996), an extra loan could be provided for houses meeting energy conservation standards, among other requirements such as earthquake resistance performance. Houses had to meet at least the 1980 thermal insulation standard, with an extra loan of US\$ 8,550 provided for those meeting the 1992 standards and a further loan of US\$ 2,137 provided for houses meeting the 1999 standards (International Energy Agency, 2008b). In 2003, direct loans were discontinued and the JHFA began underwriting a long-term and fixed interest rate loan called “Flat 35,” with energy conservation performance as one of the loan evaluation criteria. All houses applying for the loan must meet 1980 thermal insulation standards, and reduced interest rates are provided for those meeting the 1999 standards (Ministry of Economy, Trade and Industry, Japan, 2002).

Low interest loans for non-residential buildings are also available from the Development Bank of Japan, applicable for projects with a floor area of 2000m² or more. Applicants must commit to energy conservation efficiency of 20% or higher than the Energy Conservation Standards, utilization of water resources and retention of rain water (Murakami et al., 2007). Similarly, many local governments provide access to lower interest mortgages for buildings with a high rating on Comprehensive Assessment System for Building Environmental Efficiency (CASBEE). For example, in Kawasaki and Sapporo City, a B+ assessment may entitle the building owner to qualify for lower interest mortgages (Sunikka-Blank et al., 2011).

Tax Schemes

The Tax Scheme for Promoting Investment in the Reform of the Energy Demand-Supply Structure is available for businesses acquiring specified energy conservation equipment. It provides special depreciation rate applied for 30% of the acquisition cost, with small scale businesses also provided with a 7% tax deduction of the acquisition cost (Asia Energy Efficiency and Conservation Collaboration Center, 2010). In 2011, the tax scheme was replaced with a new scheme (with the same special depreciation and tax deduction rates on acquisition cost) that targeted highly-efficient equipment and systems used in the residential and commercial sectors, such as highly efficient air conditioning systems, high insulation windows facilities, and light-emitting diodes (International Energy Agency, 2010).¹⁸

Subsidies

The New Energy and Industrial Technology Development Organization (NEDO) currently provides subsidies for energy efficiency improvements in residential buildings (Energy Conservation Center, Japan, 2011). The subsidy project began in 1999 and set a 2010 target of reducing energy consumption in residential buildings by the equivalent of 3 million liters of crude oil. NEDO subsidies

¹⁸ International Energy Agency (2010), “Financial and Tax Incentives for Industry- Japan,” IEA Energy Efficiency Policies and Measures Database. Accessed at <http://www.iea.org/textbase/pm/?mode=cc&id=4029&action=detail>.

are provided to both newly constructed and existing houses to cover one-third of the expenses incurred in installing energy-efficient appliances, including electric/gas heat pumps, ultra high insulation windows and gas cogeneration systems (International Energy Agency, 2008b). Subsidies are also provided for introducing energy management systems in homes and buildings that enable automatic management of several appliances simultaneously, leading to energy savings and reduced environmental impact (International Energy Agency, 2010).¹⁹ In addition, NEDO subsidies are offered for renovation of residential buildings to meet building standards. To qualify for the subsidies, energy consumption must be reduced by 15% for newly constructed houses and by 25% for renovated houses. Subsidies amounting to a total of US\$ 49.8 million have been allocated to home-owners for energy efficient improvements from 1999 to 2006 (International Energy Agency, 2008b).

The Ministry of Land, Infrastructure, and Transport (MLIT) subsidizes one-third of the costs for surveys, planning, and installation of “environmentally symbiotic facilities” (Hong et al., 2007), where compliance with the Environmentally Symbiotic Housing and Urban District Guidelines is a prerequisite for financial support for the construction of these model complexes (Evans et al., 2009).²⁰ In addition, many local governments provide subsidies for buildings with a high rating on CASBEE e.g. in Osaka, only buildings ranked above ‘A’ by Comprehensive Assessment System for Building Environmental Efficiency (CASBEE) are eligible to apply for subsidies (Sunikka-Blank et al., 2011).

C. Regulatory Review

ECONOMIC EFFICIENCY AND EFFECTIVENESS

(i) Costs, Benefits and Promotion

Mandates

Although the benefits of the building energy code have yet to be quantified in monetary terms, it is estimated that residential buildings that comply with the energy code consume 40% less energy than non-compliant ones, while commercial buildings that comply consume 75% less energy than those that do not (Ministry of Land, Infrastructure, and Transportation, 2007). Thus, for buildings that do meet the latest standards, there is a significant downward effect on energy consumption and significant benefits in terms of energy savings. Whether the economy-wide energy savings achieved by the energy codes are significant depends on the proportion of buildings (both existing and newly constructed) that meet the standards. However, there is sparse information available on this, making it difficult to estimate the total level of energy savings achieved by the code.

As pointed out earlier, buildings with a floor space greater than 300m² are required to submit energy saving plans prior to construction or renovation. Within this set of buildings, compliance rates are mixed. Approximately 85% of the commercial buildings that submitted the mandatory reports in 2005 met the standards, whereas only 36% of new residential buildings complied with the standards in 2006. The difference is partly because residential buildings were first required to submit energy saving plans prior to construction or renovation in 2005, as opposed to 2003 for commercial buildings (Evans et al., 2009). Compliance rates have been on an increasing trend in recent years. The

¹⁹ International Energy Agency (2010), “Home Energy Management System, Building Energy Management System: Japan,” IEA Energy Efficiency Policies and Measures Database. Accessed at <http://www.iea.org/textbase/pm/?mode=pm&id=684&action=detail>.

²⁰ Please refer to the previous section on building labeling (pg. 14) for more details on the guidelines.

compliance rate for commercial buildings has increased from 34% in 2000 to 85% in 2005 (in large part as a result of the submission of energy savings plan being made mandatory in 2003) while that for residential buildings increased from 13% in 2000 to 36% in 2006 (Hong et al., 2007; Evans et al., 2009).

The actual stock of buildings includes a significant proportion of buildings that are less than 300 m² in floor space as well as buildings greater than 300 m² that have not recently undergone renovation or construction. Sunikka-Blank et al. (2011) point out that in Japan, where 50% of the stock consists of individual houses and the average floor area of a new dwelling is only 107 m², most residential buildings have a floor area less than 300 m² and are not required to comply with the building standards. In addition, between 1999 and 2003, 87% of residential buildings did not undergo any renovation (International Energy Agency, 2008b), suggesting that a significant proportion of Japan's building stock at any point in time will not be required to comply with the standards even if they exceed 300 m² in floor space. As such the compliance rate for these two classes of buildings, while unknown, is likely to be lower than for buildings that are required to comply with the standards.

As mentioned earlier, Japan has in the past targeted increasing the compliance rate for newly constructed residential and commercial buildings. The number of buildings complying with the building energy code can also be increased by making the energy savings plan submission mandatory for buildings with a floor area of less than 300 m², or by making the codes mandatory for existing buildings that have not undergone renovation or construction. Energy savings, however, are only one side of the equation, since energy efficiency measures in buildings also entail costs. If the goal of building energy efficiency policy is to maximize societal welfare, maximizing energy savings may be counter-productive if they are achieved at a very high cost.

Japan's building standards are not determined using life-cycle analysis that would take into account the economic costs and benefits of the standards over their lifetime. This means that regulations do not explicitly aim at ensuring that the standards are set at the optimal level. Ex-post cost-benefit analyses of Japan's building energy codes have not been made available to the authors of the report, at least publicly, though there do exist limited cost estimates. When the building standards for heat insulation were made stricter after the 2001 revision of the Long-Term Energy Policy, energy savings were estimated to be 20% for air-conditioning at a cost of around JPY 1 million (approximately US\$ 10,000) per house (Geller et al., 2006; International Energy Agency, 2010).²¹ However, it is not clear from this information alone whether the standards were optimally set.

To increase the effectiveness of the codes, therefore, incorporating life-cycle economic analysis into the process for designing building energy codes is recommended, so as to ensure that the process attempts to maximize net benefits. Ex-post analysis of the actual costs and benefits of the codes is also recommended in order to guide future revisions to the code.

In the absence of information on whether the standards were optimally set, it is not clear whether maximizing the number of buildings complying with the standards is necessarily a desirable policy goal. Coverage should be maximized only if the standards are optimally set and the implementation is not too costly.

²¹ IEA (2010), "IEA Energy Efficiency Policies and Measures Energy Efficiency Standards for Housing/Building," IEA Energy Efficiency Policies and Measures Database. <http://www.iea.org/textbase/pm/?mode=cc&id=675&action=detail>.

In considering costs and benefits of policies, it is also worthwhile comparing building energy codes to market-based alternatives such as a carbon/energy tax (or cap-and-trade) that attempt to price the environmental externality of energy use.²² On the one hand, market-based instruments give building owners the flexibility to decide where to incorporate energy efficiency improvements in the building, which could lead to energy efficiency improvements being achieved at a lower cost. On the other hand, unlike a tax/cap-and-trade, building energy codes also tackle informational and behavioral barriers, such as the low salience of energy efficiency at the point of purchase or rent of a building, and thus could well lead to greater net benefits in terms of energy savings.

Information programs

Labeling programs help evaluate a building's energy efficiency performance and thus provide homeowners and buyers with the information needed to make rational housing decisions. For such programs to be effective, therefore, clarity and simplicity in how the information is presented is essential, otherwise it is likely that consumers will simply ignore the information or process it incorrectly when making decisions. The labeling programs implemented in Japan prior to Comprehensive Assessment System for Building Environmental Efficiency (CASBEE) did not perform well according to this criterion, since they did not clearly distinguish between the building performance (which positively influences the consumer's decision) and the environmental impact (which negatively influences the consumer's decision). CASBEE, by clearly defining and distinguishing between the environmental quality of the building and its environmental load, clarifies and simplifies the assessment of building energy efficiency (Vare, 2010). While the environmental performance result of CASBEE is simple and clear, its detailed criteria limited its use in practice, since the evaluation could take between three to seven days (Sunikka-Blank et al., 2011). It includes both quantitative and qualitative assessments which have to be conducted by an engineer with expertise and knowledge in the area, which further adds to the costs of conducting the assessment.

To address this, the CASBEE Accredited Professional Registration System was established in 2005, and there are now over 10,000 professionals in Japan as of December 2011 (JSBC, 2012). In addition, brief versions of CASBEE are also available in which the assessment process is simplified and takes only around a couple of hours, barring the time required to prepare an Energy Saving Plan (Japan Sustainable Building Consortium, 2012).²³

The use of CASBEE has been growing, with submissions from more than 6,600 buildings for assessment as of December 2011. 24 local governments, representing 44% of the Japanese population, currently require building owners to report CASBEE assessment results prior to construction (Japan Sustainable Building Consortium, 2012). In addition, many local governments have provided incentives for buildings with a high rating on CASBEE, which include subsidies, access to lower interest mortgages, and permission to increase floor-area ratio (Vare, 2010). From a cost-benefit perspective, such policies would be justified if the benefits from the use of CASBEE – superior availability of information and energy saving benefits – outweigh the costs of performing the evaluation as well as the costs of associated incentives.

Among the other information programs used in Japan, the housing performance labeling system included under the Housing Quality Assurance Law categorizes residential buildings into four

²² Japan has been considering the introduction of a carbon tax for some time (Watanabe, 2011), though it has recently ruled out introducing a carbon price or a carbon tax in the near future (Shanahan, 2012).

²³ See <http://www.ibec.or.jp/CASBEE/english/overviewE.htm>

categories, based on whether they comply with the 1999 building standards, 1992 standards, the 1980 standards or none at all, and also provides comparisons to other buildings. The Environment and Energy Friendly Building Mark divides non-residential buildings into two categories based on their performance relative to the building energy standards. Thus, both these labeling programs perform well on criteria of clarity and simplicity. In addition, by providing information on whether buildings meet the building energy codes, they increase the incentive for homeowners to comply with the codes, enhancing the potential benefits of the codes. The 'Cool Biz' program is estimated to have saved 460,000 tons of CO₂ while public awareness of the program was reported to be 96% (Murakami et al., 2007), though it is unclear what the cost was.

Fiscal and Financial Incentives

The New Energy and Industrial Technology Development Organization (NEDO) subsidies for energy efficiency improvements in residential buildings led to energy savings that were close to 135 TJ between 1999 and 2006, at a total cost of US\$ 49.8 million (International Energy Agency, 2008b). Thus the NEDO subsidy program achieved savings of around 2.5 TJ of energy for every million US dollars spent on the subsidies. The cost-effectiveness of the NEDO program has increased over the years, from around 2 TJ of energy saved per million US\$ in 1999 to more than 3 TJ of energy saved per million US\$ in 2006 (International Energy Agency, 2008b).

As mentioned earlier, the NEDO subsidy project targeted achieving energy savings equivalent to 3 million liters of crude oil (=790 TJ) between 1999 and 2010. By 2006, hence, the project had achieved less than 20% of this target. It should also be noted that the energy savings achieved represent a very small proportion of Japan's overall energy consumption from residential buildings; for instance, in 2005, the energy savings from the NEDO subsidies of around 23 TJ (International Energy Agency, 2008b) amounted to approximately 0.001% of Japan's total energy consumption from the residential sector (=2,023,000 TJ) in that year (Asia Energy Efficiency and Conservation Collaboration Center, 2010).

The benefits from financial incentive programs, such as the low interest loans provided by the Japan Finance Corporation and the Japan Housing Finance Agency, include their promotion of green investments, in particular energy efficiency investments carried out by Energy Service Companies (ESCOs). The size of the ESCO market in Japan increased from US\$ 10 million in 1998 to US\$ 350 million in 2003 (Asia Energy Efficiency and Conservation Collaboration Center, 2010), an increase that can be attributed in part to the rising use of financial incentives during that period (as argued by, for instance, Geller et al., 2006). From 2003 onwards, however, the size of the ESCO market has fluctuated considerably, decreasing to US\$ 176 million in 2008 (Asia Energy Efficiency and Conservation Collaboration Center, 2010). This is in part because some restrictions have been imposed on the use of financial incentives since 2003. As mentioned earlier, direct loans for energy efficient houses were discontinued in 2003, while in 2008 the low-interest loans provided by the Japan Finance Corporation were restricted to cover only small and medium-sized enterprises. In the absence of cost-benefit analysis on these financial incentives, however, it is not possible to make a definitive judgment on whether the benefits from the increased size of the ESCO market are justified by the costs of the incentive programs.

(ii) Scientific Integrity

In general, Japan's policies appear to be based on scientific analyses and principles. Policies tend to be detailed and comprehensive in their design and have been formulated taking into account a number of relevant variables.

Scientific evidence and analyses have played a major part in the formulation of the building energy codes. For commercial buildings, energy standards are set for the building envelope as a whole and are also set separately for various specific components of the building envelope, including the heating, ventilation, and air-conditioning (HVAC) system, ventilation, lighting, hot water and lifting equipment. Moreover, these standards are differentiated based on relevant factors such as building type, building size, and climate zone (with standards varying depending on whether the building is located in the ordinary, cold or tropical climate zone). The two energy codes for residential buildings specify maximum allowable heating and cooling loads (for the building as a whole), set standards for insulation, HVAC, and water heating and are differentiated according to the building type and the climate zone (Evans et al., 2009).

A similar conclusion holds for CASBEE. By taking into account both the environmental load of the building and the environmental quality delivered by the building, CASBEE allows for a holistic assessment of a building's sustainability, improving upon evaluation systems used in Europe which only account for the load (Sunikka-Blank et al., 2011). CASBEE's assessment of environmental quality is detailed and takes into consideration a number of relevant variables such as the indoor environment, quality of service and the outdoor environment on site, while its assessment of the environmental load is similarly based on measuring a number of variables such as energy, resources and materials and the off-site environment (Japan Sustainable Building Consortium, 2012). However, a limitation of CASBEE is that biotopes are absent in its assessment, meaning that the assessment does not compensate for green spaces in the building environment (Sunikka-Blank et al., 2011).

(iii) Flexibility

Japan has shown a willingness to revise its policies in response to changing circumstances. The Energy Conservation Act, which forms the foundation for much of Japan's energy efficiency policies, has been revised several times (1983, 1993, 1998, 2002, 2005, and 2008) since it was passed in 1979, so as to better address the changing energy consumption of various sectors in Japan and concerns about global environmental issues (Asia Energy Efficiency and Conservation Collaboration Center, 2010). The earlier focus of the Act was on promoting the efficient use of energy in the manufacturing sector. As energy use in the building sector has increased more rapidly than energy use in the industrial and transport sectors since 1990, building standards have been gradually strengthened and the requirement to submit an energy savings plan was introduced in 2003. In 2008, moreover, the requirement was extended to cover small to medium buildings (between 300 m² and 2000 m²), which were previously exempted.

Regular revisions also underlie the "Basic Program for Housing." This program was issued by the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) in 2006 and sets targets for the life span of buildings and the number of buildings that have energy saving measures. By regularly analyzing and evaluating the effectiveness of the project using target assessment indicators, the MLIT

intends to reappraise and modify the plan in five years based on the effectiveness of these measures and changes in social conditions (International Energy Agency, 2010).²⁴

Since the earliest labeling programs provided no assessment of the environmental load of a building, Japan subsequently adopted labeling methods that considered both the environmental load and the environmental quality (or building performance) of the building. However, in the initial reforms, schemes did not clearly distinguish between these two assessment criteria. This restriction prompted the development of the Comprehensive Assessment System for Building Environmental Efficiency (CASBEE) labeling program in which the environmental load and environmental quality of the building are clearly defined and distinguished from each other. Finally, though CASBEE was initially designed only for large-scale buildings, its coverage was subsequently expanded, in 2007, to small-scale detached houses (International Energy Agency, 2008b), responding to the rapid growth in energy use in the buildings sector and the fact that detached houses account for about half of the total housing stock.

As discussed earlier, the building energy codes are as yet mandatory only for a limited proportion of the building stock. Instead, the policy approach towards encouraging compliance with the building energy standards has been through the use of financial incentives and labeling programs that reward energy-efficient buildings. This allows building owners the flexibility to decide whether their buildings should comply with the standards or not depending on whether the energy saving benefits outweigh the costs of implementing energy efficiency measures. Moreover, the building energy codes are differentiated according to factors such as regional and climatic differences, meaning that building codes, by default, are responsive to some dimensions of the varying environment faced by different building owners.

The CASBEE labeling program allows stakeholders some flexibility in their approach towards energy efficiency compliance. CASBEE is composed of four assessment tools corresponding to different stages in the lifecycle of buildings, including CASBEE for Pre-design, CASBEE for New Construction, CASBEE for Existing Building and CASBEE for Renovation. In addition, different versions of CASBEE have been developed that are tailored to specific applications, including CASBEE for Detached Houses, CASBEE for Temporary Construction, CASBEE brief versions, CASBEE local government versions, CASBEE for Heat Island Effect, CASBEE for Urban Development, and CASBEE for Cities.²⁵ CASBEE local government versions, for instance, allow local governments to set their own guidelines and local criteria, based on assessment standards and different weighting coefficients for certain items.²⁶ CASBEE for Urban Development and CASBEE for Cities allow assessment of the environmental performance of an entire metropolitan area or a city, not just individual buildings (Japan Sustainable Building Consortium, 2006).

When it comes to fiscal and financial incentives, the multiplicity of policies and regulations in place helps to enhance flexibility and responsiveness of the policy framework to varying circumstances and conditions. For instance, owners of houses that already meet energy conservation

²⁴ International Energy Agency (2010), "Basic Program for Housing: Energy Efficiency Standards, Japan," IEA Energy Efficiency Policies and Measures Database.

²⁵ Please see <http://www.ibec.or.jp/CASBEE/english/overviewE.htm>

²⁶ Please refer to "CASBEE for Japanese Local Government" Programs, available at http://www.climate-ig.jp/en/programs/id_003.html

standards can apply for low-interest loans from the Japan Housing Finance Agency (JHFA), whereas owners of houses that do not meet the standards can apply for low-interest loans from the Japan Finance Corporation to support energy conservation renovation of their buildings, or receive grants from the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) subsidizing one-third of the costs for surveys, planning, and installation of “environmentally symbiotic facilities” (Hong et al., 2010).

ADMINISTRATIVE AND POLITICAL VIABILITY

(iv) Transparency

Although building energy standards are the joint responsibility of the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) and the Ministry of Economy, Trade and Industry (METI), the Energy Conservation Center of Japan (ECCJ) is actively involved in the process, providing technical assistance in energy-efficient building construction and operations. The ECCJ is a non-governmental organization established in 1978 with numerous industrial partners (Hong et al., 2007), so the fact that they are involved in the process means there is stakeholder engagement and scope for the views of the owners of commercial buildings to be taken into account in standard-setting. However, owners of residential buildings are not directly represented in the ECCJ, meaning there is limited scope for their views to be accounted for in the standard-setting process.

Comprehensive Assessment System for Building Environmental Efficiency (CASBEE) was a joint project between various stakeholders. It was carried out between industry, government and academia with the assistance of the MLIT and is managed by the Japan Sustainable Building Consortium and its affiliated sub-committees (Japan Sustainable Building Consortium, 2006). It also features active involvement from local governments, with 24 local governments currently mandating the use of CASBEE. In that sense, CASBEE is transparent in terms of stakeholder engagement. Information on CASBEE is also easily available to interested stakeholders. Developers, builders, architects and others are enabled to download a program and assess any new building or renovation on their own. Alternatively, they can hire qualified architects to conduct the assessment (Hong et al., 2007). The results of the evaluation are verified by a third party, and then disclosed to the public in a graphic form from a score sheet.²⁷

Information about laws, regulations, and financial incentives for energy efficiency investments can be found on the websites of relevant ministries – the Ministry of Economy, Trade, and Industry (METI) and the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) as well as the websites of semi-governmental organizations – the New Energy and Industrial Technology Development Organization (NEDO) and the Energy Conservation Centre, Japan (ECCJ). In addition, the ECCJ is responsible for disseminating information on energy conservation and plays an active role in informing the general public as well as commercial and industrial stakeholders on energy efficiency programs and policies by subsidizing various promotional campaigns and advertising in the media (International Energy Agency, 2008b). This further enhances the transparency of Japan’s building energy efficiency policies.

²⁷ Please refer to "CASBEE for Japanese Local Government" Programs, available at http://www.climate-ig.jp/en/programs/id_003.html

(v) Alignment

The agencies governing laws and policies regarding energy efficiency in buildings include the Ministry of Economy, Trade and Industry (METI), Ministry of Land, Infrastructure, Transport and Tourism (MLIT), and the Ministry of Environment. Semi-governmental organizations such as the New Energy and Industrial Technology Development Organization (NEDO) and Energy Conservation Centre, Japan (ECCJ) are responsible for creating awareness regarding energy efficiency, promoting energy efficiency projects, and ensuring compliance to the Energy Conservation Laws. There is thus a distinct difference in the roles and responsibilities of the ministries, on the one hand, and the semi-governmental organizations, on the other, reducing the chances of coordination problems in policymaking.

Alignment among the authorities has been facilitated by the amendment of the Energy Conservation Law which was enforced in December 1983; the changes included the simplification, rationalization, and consolidation of clerical work, to cover 14 ministries and encompass 58 other laws (Asia Energy Efficiency and Conservation Collaboration Center, 2010). Moreover, the establishment of the Ministry of Land, Infrastructure and Transport (MLIT) in 2001, through the consolidation of the former Ministry of Construction, Ministry of Transportation, National Land Agency and the Hokkaido Development Agency (Hong et al., 2007), is also likely to have facilitated coordination and alignment by reducing the number of ministries involved in policymaking.

Many of the policies instituted by Japan are dictated by inter-ministerial committees or involve cooperation among different government arms and other stakeholders, indicating a good level of coordination and alignment in policymaking. In 2007, the “Inter-Ministerial Liaison Committee for the Promotion of Energy and Resource Conservation Measures,” consisting of vice-minister level officials, was held to further promote energy conservation efforts and implement, among others, “energy conservation contests” for households and an operating procedure on energy conservation for the commercial sector (as discussed earlier).

Comprehensive Assessment System for Building Environmental Efficiency (CASBEE) is a voluntary program implemented by local governments but encouraged in some central government policy documents like the MLIT Action Plan and the Kyoto Protocol Target Achievement Plan (Sunikka-Blank et al., 2011). Hence, with CASBEE, there appears to be alignment between local governments (which actually implement the program) and the central government (which encourages it). Moreover, the expansion of CASBEE’s coverage in 2007 was a joint initiative, with the MLIT overseeing and private, academic and government participants cooperating to bring about the policy change (International Energy Agency, 2008b).

In general, the different policies implemented by Japan to encourage energy efficiency improvements in buildings tend to be well-aligned with each other. The complementary role of fiscal and financial incentives in enhancing the effectiveness of both the building energy codes and labeling schemes (such as CASBEE) has already been highlighted. Similarly, labeling programs such as the housing performance labeling system included under the Housing Quality Assurance Law and the Environment and Energy Friendly Building Mark are directly aligned with the building energy codes as they provide information on the extent to which residential and commercial buildings comply with the codes. The assessment of a building under CASBEE does not indicate whether the building complies with the standards, but a building with a high Building Environmental Efficiency score under the CASBEE scheme is more likely to be compliant with the building energy codes.

2.1.2 Energy Efficiency in Buildings in Thailand

Key findings

- Increased energy efficiency in buildings is expected to form a key component of Thailand's efforts to reduce energy use, with the residential and commercial sectors together accounting for around one-fifth of total energy use.
- Thailand has targeted its building energy conservation efforts on commercial buildings, relying largely on building energy codes and fiscal and financial incentives.
- Thailand's building energy efficiency policies are expected to generate moderate energy savings, though it is unclear whether they can do so in a cost-effective manner. Policymaking is transparent and scientifically grounded, but problems of alignment and policy lags remain.

Costs, benefits and promotion

- Projected energy savings from full implementation of the new building energy code for commercial buildings are moderate, amounting to 1.4% of the total energy demand of the commercial sector in 2016. It is unclear, however, if the costs of the new energy code justify the energy saving benefits.
- Financial incentives are expected to generate energy savings and leverage private investment. However, the extent to which they maximize such benefits while minimizing costs varies. Tax incentives generate the highest energy saving benefits and leverage the greatest amount of private investment relative to the cost when compared with the Energy Efficiency Revolving Fund and the Energy Services Company Fund.

Scientific integrity

- Thailand's policies, in particular the building energy codes, are based on scientific analyses and principles.

Flexibility

- Regular updates are not the norm, as there was a gap of 14 years between the implementation of the original and new versions of the code. However, it is encouraging that lessons from the flaws found in the revision of earlier building codes have been considered in the design of the new building code.
- The new building energy code allows owners increased flexibility in how they wish to improve their building energy efficiency, enhancing the cost-effectiveness of the measures.

Transparency

- The process for the formulation of Thailand's building energy efficiency policies allows stakeholder views to be reflected.

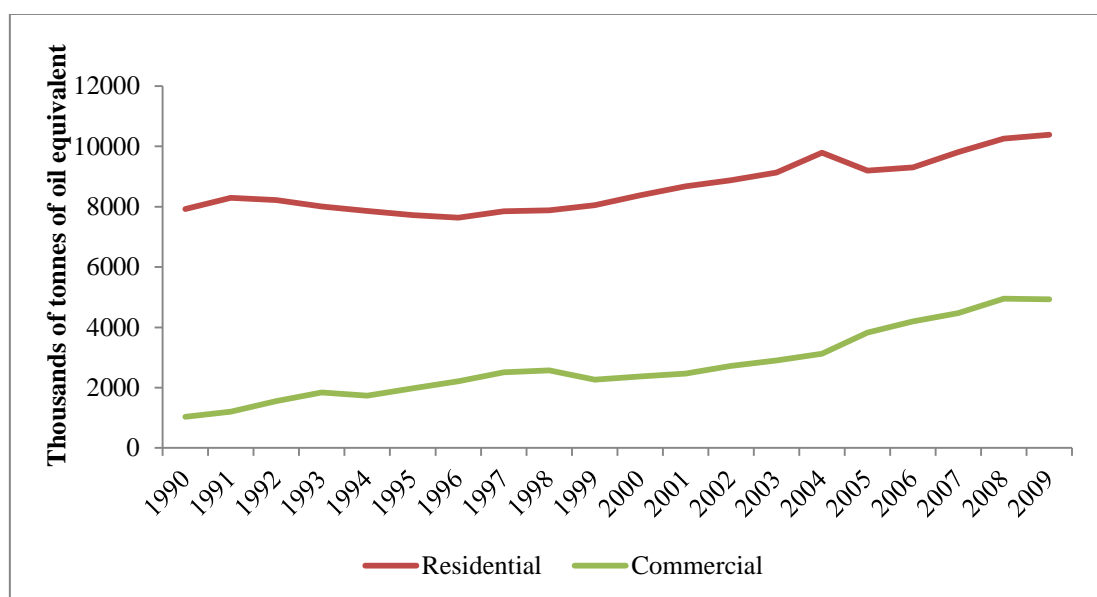
Alignment

- Alignment between the various government agencies has been a challenge and more coordination is needed to improve the effectiveness of the building energy code and energy audits. However, the formation of the Ministry of Energy, as the body overseeing most of the agencies involved, is likely to have assisted in improving alignment among government agencies.

A. Size and Significance

The buildings sector, which essentially consists of the commercial and residential sectors, is a significant user of energy in Thailand. It accounted for 20.2% of Thailand's total energy consumption in 2009. While the energy consumption of the residential sector was more than double that of the commercial sector in 2009 (International Energy Agency, 2011), commercial energy consumption has been growing more rapidly than residential energy consumption in recent years, as Figure 2.1.3 below illustrates. Commercial energy consumption has also been accounting for a rising proportion of Thailand's total energy consumption, from 4.5% in 1999 to 6.5% in 2009, whereas residential energy consumption in 2009 accounted for 13.7% of total energy use as opposed to 16.1% in 1999 (International Energy Agency, 2011).

Figure 2.1.3 Historical energy consumption in Thailand's residential and commercial sectors (1990 – 2009)



Source: International Energy Agency, 2011

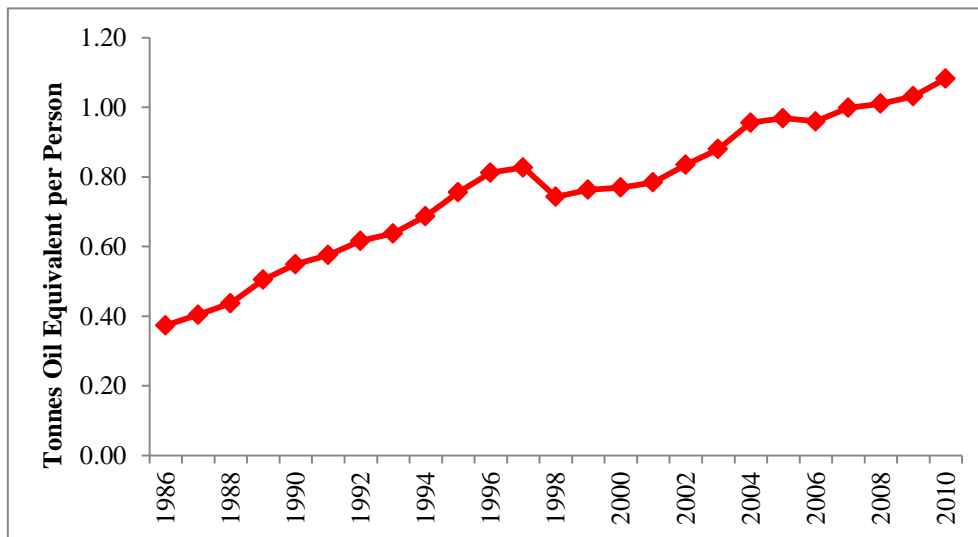
B. Policy Formulation

(i) History and Background

Thailand's energy intensity (final energy consumption per GDP at 1988 prices) has been increasing annually at an average rate of 0.1% while its energy consumption per capita has been increasing rapidly at an average rate of 4.3% annually (see Figure 2.1.4 below) (Energy Policy and Planning Office, 2011). As such, Thailand has laid considerable emphasis on energy efficiency and

conservation policy in order to reduce energy demand, while still ensuring sustainable economic growth and minimal adverse impact in the environment. Thailand’s goal of reducing its dependence on energy imports from foreign economies has provided further impetus to its energy efficiency and conservation efforts. Part of Thailand’s energy conservation efforts have been targeted at the buildings sector, though till now the focus has largely been on reducing energy consumption from commercial rather than residential buildings.

Figure 2.1.4 Historical final energy consumption per capita in Thailand



Source: Energy Policy and Planning Office, 2011

In 1992, Thailand launched the Energy Conservation Promotion Act (ENCON Act), which is the government legislation that underlies Thailand’s energy efficiency and conservation policies and comprises a mixture of mandatory regulations, incentives and penalty measures. The Energy Conservation Program (ENCON Program) and the Energy Conservation Promotion Fund Committee (ENCON Fund Committee) became operational after the Act was enacted. The ENCON Program includes 3 main programs, namely a *Compulsory Program* for “designated facilities” (DFs), which are large commercial buildings and factories, a *Voluntary Program* for small and medium-sized enterprises (SMEs), and a *Complementary Program* for human resource development, public awareness campaign and management and monitoring. It has three phases and covers the periods of 1995–1999, 2000–2004, and 2005–2011 respectively. The ENCON Program Phase 3 was revised in 2008 to include the Energy Efficiency Improvement Sub-Program’s target of reducing 10.8% of commercial energy consumption by the year 2011 (Asia Pacific Economic Cooperation, 2010).

Specific policies to improve energy efficiency and conservation in buildings fall under three categories: mandates (in particular, the building energy code), fiscal and financial incentives, and information programs.

(ii) Policy Description

MANDATES

Building Energy Codes

Thailand has a mandatory building energy code (BEC) in place for commercial and government buildings. The Department of Alternative Energy Development and Efficiency (DEDE), the Department of Public Works and Town & Country Planning, the Energy Policy and Planning Office (EPPO) and the Electricity Generating Authority of Thailand (EGAT) are the four government agencies responsible for developing and enforcing the energy-efficiency building codes (Hong et al., 2007). There are two versions of the code that are currently in operation. The first-generation code was introduced in 1995 as part of the ENCON Act (Hong et al., 2007). From December 2001 to March 2004, the DEDE and Danish International Development Assistance (DANIDA) collaborated in developing a new building energy code (Chirarattananon et al., 2010). In 2007, the new code was prepared for submission to the Thai cabinet for endorsement (Hong et al., 2007) and was eventually gazetted in 2009 under the Energy Ministerial Regulation (Prakobchat, 2011).

Since 1995, the first-generation code has been mandatory for both existing and new designated buildings with energy consumption rates above 1.0 MW.²⁸ In practice, the way designated buildings are defined ensures that most of them have air-conditioned floor areas greater than 10,000 m² (Hong et al., 2007). By 2010, it is estimated that more than 1,900 buildings and 3,500 factories have been registered as designated facilities and are required to comply with the code set out in the Energy Conservation Promotion Act (ENCON Act) (Asia Pacific Economic Cooperation, 2010).

The first-generation code specified minimum system performance requirements for the thermal performance of the building envelope as well as the efficiency of the lighting and air-conditioning systems. Existing buildings were given three years to comply with the code. They could achieve this by improving their building shells so that their rate of energy use was 55 watts or less per square meter for heating and cooling. New buildings were required to use no more than 45 watts per square meter. In addition the code specified maximum values for lighting power and minimum coefficient of performances for air-conditioning system (Energy Policy and Planning Office, 2000; Asia Pacific Energy Research Centre, 2003). Energy audits were required for existing designated buildings, and those did not meet the code requirements were required to undergo retrofit changes to comply with the standards set in the code (Hong et al., 2007). The penalties for non-compliance can be categorized into two types: 1) the surcharge for the electricity utilization and the suspension of financial support, and 2) a fine or imprisonment. The code also requires each Designated Facility (DF) to assign one qualified “Person Responsible for Energy” (PRE)²⁹ as an energy manager and to report “Target and Plan” for implementation of energy conservation measures every three years, in addition to complying

²⁸ Under the ENCON Act, the Royal Decree on Designated Building, B.E. 2538 was issued to define “Designated Facilities or Buildings” for energy conservation purposes. DFs are building and factories with an installed electrical demand more than 1.0 MW or an annual commercial energy consumption (electricity and steam) of more than 20 TJ.

²⁹ With the revision of ECP Act in 2007, stringent requirement necessitates each DF with an electrical demand from 3000 kW onwards to appoint two PREs who are responsible for energy auditing the facilities and reporting the results to Department of Alternative Energy Development and Efficiency (DEDE).

with other duties³⁰ defined in the Energy Conservation Promotion Act (ENCON Act) (Energy Policy and Planning Office, 2000).

By contrast, the new building energy code is meant to target only new and retrofitted commercial buildings that have a total floor area of at least 2,000 m² (United Nations Environment Program, 2011). Buildings are now categorized into three types: office and school; department store, hypermarket, and miscellaneous; and hotel, hospital, condominium and hostel, with the standards differentiated based on the building type. The standards embodied in the original code were updated in the new code using a life cycle costing principle, meaning that the life cycle costs associated with alternative standard levels were evaluated and compared in coming up with the final set of standards (Chirarattananon et al., 2010).

Like the original code, the new code continues to adopt system performance requirements for building envelopes, lighting, and air-conditioning. However, buildings that fail on the “system performance-based compliance” because their performance for one or more of the components does not meet the standard, can still be assessed to be energy-efficient if they satisfy the new “whole building compliance” criterion. This criterion is assessed by ensuring that the annual energy consumption of the proposed building is less than that of a reference building (Chirarattananon et al., 2010).³¹ In addition, the new code sets minimum efficiency requirements for boilers and water heaters and encourages the use of renewable energy by allowing both the use of solar energy via “daylighting” and the generation of electricity from solar PV systems to count towards the “whole building compliance” (Chirarattananon et al., 2010; Rakkwamsuk, 2010). Along with the new code, Thailand government has written a handbook to assist building professionals in building design and a computer program in code compliance.

Building Energy Audits and Retrofits

The ENCON Act (as described above) requires existing designated buildings to undergo energy audits and retrofitting to improve their energy conservation performance (Hong et al., 2007). After the 2007 revision to the ENCON Act, the energy audit requirement was strengthened and designated buildings are now required to carry out an annual energy audit and report the results to the Department of Energy Development and Efficiency. The audit costs are financed by ENCON Fund. By 2001, roughly 1,600 commercial buildings had received energy efficiency audits (United Nations Environment Program, 2011), which is estimated to have increased to more than 1,900 commercial buildings by 2010 (Asia Pacific Economic Cooperation, 2010). It was found that designated buildings that received retrofits did so primarily for their lighting systems (Hong et al., 2007).

Energy audits for commercial buildings also form part of the US\$ 189 million Demand Side Management (DSM) Program, and the Demand-Side Management Office (DMSO), which is in charge of the DSM program, offers energy audits for building lighting, cooling envelope, and load management systems. This program is coordinated with the energy audits required under the compulsory program of the ENCON Act. By 2000, 433 building owners applied to participate and the

³⁰ The duties stipulated by the Act include assigning one person as an “Energy Manager”, keeping records on monthly energy consumption data, submitting information of energy consumption, production and conservation to government agency, setting up energy conservation targets and plans and monitoring the achievement in implementing the targets and plans.

³¹ Reference building is hypothetically designed to have identical dimension, shape and functional areas as the proposed building and to comply with the requirements in “system performance-based compliance.”

Demand Side Management Office (DSMO) had conducted 252 energy efficiency audits, though only 34 projects were approved (Hong et al., 2007).

In addition, Thailand has implemented a Government Buildings Audit and Retrofit Program, financed by the ENCON Fund, encouraging all government offices to carry out an energy audit and a subsequent retrofit program for their buildings (United Nations Environment Program, 2011). Public buildings are an attractive target for energy efficiency improvements due to the possibility of a direct implementation of energy efficiency measures by the government and a short payback period which in turn implies a high rate of return on public expenditure (Asia Pacific Energy Research Center, 2003). Between 1997 and 2001, DEDE conducted energy audits and carried out retrofitting on 600 government buildings (Asia Pacific Energy Research Center, 2003).

INFORMATION PROGRAMS

The Department of Alternative Energy Development and Efficiency (DEDE) established a labeling program for Thai buildings in 2007, aimed at promoting energy-saving buildings (both residential and non-residential) in Thailand (United Nations Environment Program, 2011). The labeling program is voluntary and awards different scores for different levels of energy and environmental performance. The program has three levels of labels – Bronze, Silver and Gold – which are given for various residential and non-residential buildings after assessing their energy and environmental performances. The DEDE provides technical advice and recommendations for energy efficiency improvements to participants in the labeling program free of charge, to provide an incentive for the buildings sector to participate in the scheme (Asia Pacific Economic Cooperation, 2010).

Thai public buildings have also become living laboratories for state-of-the-art energy efficiency demonstrations. The Energy Demonstration Center and the Electricity Generating Authority of Thailand (EGAT) Headquarters Buildings are good examples on the matter (Asia Pacific Economic Cooperation, 2010). Other voluntary and non-regulatory initiatives include Thai Energy Efficient Building Award, Green Building Program, and regional energy efficiency activities. Starting from 2006, the Ministry of Energy has provided awards for different categories of energy-efficient buildings in Thailand. Thailand also has actively participated in the development of regional energy benchmarking of buildings and award programs for energy efficient buildings in ASEAN region (Hong et al., 2007).

FISCAL AND FINANCIAL INCENTIVES

The Thai government has also developed a number of financing mechanisms to reduce energy consumption in the buildings sector. Under the Energy Conservation Promotion Act (ECP Act), four financing mechanisms were established, namely an Energy Conservation Promotion Fund, an Energy Efficiency Revolving Fund, an Energy Service Company Fund, and tax incentives.

Energy Conservation Promotion (ENCON) Fund

The Energy Conservation Promotion (ENCON) Fund revenues are derived from a tax of THB 0.04 per liter collected from domestically sold petroleum products.³² The tax provided an initial Oil Fund of THB 1.5 billion (US\$ 50 million) (Wangskarn, 1997) and provides annual inflows of

³² The petroleum products include gasoline, diesel, kerosene and fuel oil. LPG is exempted (Asia Pacific Energy Research Centre, 2003).

approximately THB 2 billion (US\$ 70 million).³³ By 2005, the Fund had accumulated around THB 14 billion (US\$ 470 million) in 2005 (Hong et al., 2007). The ENCON Fund has been utilized for carrying out energy efficiency improvements in 10 building projects and 56 factory projects as well as for supporting other energy conservation activities, including RE projects, energy-related research and development, human resource development, public awareness campaign and Energy Conservation Program management and monitoring. The ENCON Fund also provides funding for other energy efficiency financing mechanisms such as the Energy Efficiency Revolving Fund and the Energy Service Companies (ESCO) Fund.

Energy Efficiency Revolving Fund (EERF)

In late 2002, the DEDE introduced a loan program to stimulate energy efficiency investments in designated facilities. The Energy Efficiency Revolving Loan Fund gives commercial banks capital at no cost (zero interest rate), enabling the banks to then provide loan opportunities for energy efficiency and renewable energy projects at a maximum interest rate of 4%. The banks manage all aspects of the loans and report on the status of individual projects regularly. The DEDE is responsible for ensuring that the energy savings are genuine, the targeted numbers are achieved, the lending and repayment are met, the performances are evaluated and the energy savings are measured. The Energy Conservation Promotion (ENCON) Fund provided an amount of THB 2 billion (US\$ 70 million) to Phase 1 (2003), Phase 2 (2006) and Phase 3 (2007) of the Revolving Fund.

In 2010, the Fund was in its third phase with a maximum loan of THB 50 million (US\$ 1.70 million) available per project and a maximum repayment period of 7 years. The loan funded 43 projects in the building sector out of 239 projects in commercial and industrial facilities (Asia Pacific Economic Cooperation, 2010). Between 2002 and 2008, 11 public and commercial banks extended US\$ 150 million in loans from the Revolving Fund in support of 250 projects with total investment of around US\$ 500 million (Asawutmangkul, 2010).

Energy Service Company (ESCO) Fund

Energy Service Companies (ESCOs) play a role in narrowing the energy efficiency gap in the building sector by helping building owners and operators implement EE measures and manage their energy use. In Thailand, ESCOs provides a range of energy management services including energy auditing, energy efficiency measures consultation, project development, project commissioning, financing and performance guarantees (Vechakij, 2010).³⁴ In 2008, the DEDE established the ESCO Fund as a source of venture capital to stimulate joint investments between public sectors and private investors in energy efficiency and renewable energy projects, through various channels – venture capital, equity investment, equipment leasing, carbon market, technical assistance and credit guarantee facility.

The Fund serves as a pilot initiative to provide capital up to 50% of total equity and hence address the issue of lack of equity capital for SMEs. The initial amount allocated from the Energy Conservation Promotion (ENCON) Fund to the ESCO Fund was THB 500 million (US\$ 16.7 million). The maximum loan size is US\$ 1.25 million per ESCO and the maximum repayment period is 5 years. The DEDE appointed the Energy Conservation Foundation of Thailand (ECFT) and Energy

³³ This is based on an assumed exchange rate of 1 USD = 30 baht.

³⁴ ESCOs offer risk management service by guaranteeing savings when incurring losses while sharing the benefits with the clients when generating profits.

for Environment Foundation (E for E) as ESCO Fund Managers. The two entities received THB 250 million (US\$ 8.3 million) each to evaluate proposals of energy efficiency and renewable energy projects from investors. By 2010, the Fund had already provided US\$ 8.8 million as supporting investment in 17 ESCO projects, including a solar firm, cogeneration power plants, biomass power plants, gasification projects, heat recovery system and energy management system (Asawutmangkul, 2010; Asia Pacific Energy Research Center, 2010).

Tax Incentives

The DEDE has introduced tax incentives to induce investments in energy efficient equipment or machinery. Three methods of corporate tax deduction have been put in place, namely *Cost-based*, *Performance-based* and *Board of Investment-based (BOI-based)*. The *Cost-based* method allows 25% credit on income tax of investment costs in energy efficiency projects. In 2008, 94 *Cost-based* projects were implemented (Asawutmangkul, 2010). The *Performance-based* method supported 200 projects by allowing an income tax deduction of 30% from project's actual energy savings value, but not exceeding THB 2 million (US\$ 70,000). Thailand's *BOI-based* method has also provided incentives for businesses to undertake EE investments through exemptions of import duties and corporate taxes for a maximum of eight years. In the 1st phase of the scheme, from 2006 to 2007, 193 projects were approved resulting in a total investment of THB 4836 million (US\$ 160 million); while in Phase 2 (2008-09), as of August 2008, there were 127 participating projects (Asia Pacific Energy Research Centre, 2010).

Research and Development (R&D) Assistance

While Thailand does not have any policies specifically targeting research and development for building sector energy efficiency, the government has continuously supported R&D to develop and demonstrate new energy efficient technologies as well as to improve and disseminate existing energy efficient technologies. R&D promotions which were a part of Energy Conservation Program received financial support from the Energy Conservation Promotion (ENCON) Fund. The Fund provided a total of THB 525 million (US\$ 17.5 million) in grants for 59 R&D projects (Asia Pacific Energy Research Center, 2003). Some examples of R&D projects funded include development of wall materials to reduce cooling loads in buildings, testing of fuel-saving equipment for vehicles, reduction of energy consumption on shrimp farms, energy efficient home designs and a handbook on efficiency characteristics of building materials. In addition, the government has also allocated research funds of THB 50 million (US\$ 1.7 million) per year for academic and research institutions and of THB 5 million (US\$ 170,000) per year for postgraduate and Ph.D. students to promote the study of energy efficiency and conservation (Asia Pacific Energy Research Center, 2010).

C. Regulatory Review

ECONOMIC EFFICIENCY AND EFFECTIVENESS

(i) Costs, Benefits and Promotion

There is evidence that social costs and benefits are taken into account in the regulatory process for the formulation of several of Thailand's building energy efficiency policies. As mentioned earlier, during the design of the new building energy code, an economic life cycle costing principle was used to determine the minimum energy performance requirement of each system in buildings (Chirattananon et al., 2007). The life cycle costing principle dictates that the total cost throughout

the life of a building should be the basis for the choice of building construction materials, systems and equipment. For any particular system, the lifetime costs arising from different performance levels are evaluated and compared while determining the minimum energy performance requirement for that system. The measurement of life cycle costs incorporates both the energy saving benefits of higher levels of energy efficiency as well as the possibly higher upfront costs. Thus, the building energy codes have a basis in economic cost-benefit analysis.

The same also holds true for many of the funding mechanisms as well. An Energy Efficiency Market Assessment study was conducted in 2001 to estimate the economic potential for energy efficiency projects in industries and buildings (Energy Futures Australia Pty Ltd & DMG Thailand, 2005). Only after the study was finalized did the DEDE decide on an initial allocation of THB 2 billion (US\$ 70 million) from the Energy Conservation Promotion Fund to the Revolving Fund. Subsequently, in 2003, the Energy Efficiency Revolving Fund commenced and the Energy Conservation Committee³⁵ gave approval for a pilot program (Phase 1) which would last for three years. In this case, the amount of funding to be allocated was determined based on analysis of the economic potential for the energy efficiency projects that were to be covered by the funding. In addition, before an energy efficiency project can receive funding from the Revolving Fund, the loan applicant will have to perform a detailed feasibility study in order estimate the likely energy savings from the project and determine whether the likely repayment commitments can be met, while the bank issuing the loan performs its own financial analysis of the project (Energy Futures Australia Pty Ltd & DMG Thailand, 2005). This process is likely to ensure that economic costs and benefits are taken into account when deciding whether to allocate funds from the Revolving Fund to an energy efficiency project.

The evidence is less clear on whether Thailand's building energy efficiency policies, once implemented, maximize benefits and minimize costs. While quantitative studies on the costs and benefits from Thailand's first-generation building energy code have not yet been conducted, qualitative evidence suggests that the code did not always maximize benefits while minimizing costs. The code placed a lot of emphasis on retrofitting existing buildings to improve their energy efficiency (Chirarattananon et al., 2007), whereas the more cost-effective way to achieve energy savings is to implement energy efficiency measures before the building is constructed. By contrast, the new building energy code is targeted at either new buildings (where energy efficiency can be incorporated directly into the design of the building) or at buildings that are going to be retrofitted in any case (so that the marginal cost of implementing energy efficiency measures is comparatively low). A further reason why focusing on new buildings makes more sense from a cost-benefit perspective is the relatively low life-span of Thai buildings. For instance, buildings in Bangkok typically last between 30-40 years.³⁶ In addition, the standards set out in the original code were often misconstrued by industry participants as target levels for energy efficiency performance, rather than as minimum requirements which could be exceeded if necessary. This was a sub-optimal outcome since improving energy efficiency beyond the minimum standards would typically lead to net benefits (Chirarattananon et al., 2007).

³⁵ Energy Conservation (ENCON) Committee chaired by Deputy Prime Minister includes members from various government agencies i.e. Ministry of Science and Technology, Ministry of Industry, Office of the Economic and Social Development Board, Thailand Industrial Standard Institute, Comptroller General's Department, DEDEM and Department of Public Works, Town and Country Planning.

³⁶ Personal Communication (19 Jan 2012), Prof Surapong Chirarattananon, Asian Institute of Technology, Thailand.

A study was conducted to assess the potential energy saving benefits from the mandatory implementation of the new building energy code (Chirarattananon et al., 2010). The assessment was conducted by developing three building models corresponding to three possible cases of buildings i.e. the “base” case (buildings that do not carry out energy efficiency improvements), the “code” case (buildings that exactly comply with the standards set in the new code), and the “economic” case (buildings in which building components reach higher performance levels and lower life cycle costs than in the “code” case). The model assumes that compliance with the new building energy code begins in the year 2010.

The study estimated that the initial energy savings from the new building energy code were likely to be small, amounting to only 0.13% of the total energy demand of the commercial sector in 2010. However, energy savings are expected to rise over the years, as more and more buildings “over-comply” with the standards and the proportion of new and existing buildings that correspond to the “economic” case increase. The energy savings expected in 2016 amount to 1.4% of the total energy demand of the commercial sector and 10% of the total energy demand of large commercial buildings, while the energy savings expected in 2021 amount to 2.6% of the total energy demand of the commercial sector and 20% of the total energy demand of large commercial buildings. The *cumulative* energy savings from the new code amount to 3.3% by 2016 (as a percentage of the total energy demand of the commercial sector in that year) and 26.7% by 2021.

In addition, the Asia Business Council (Hong et al., 2007) has projected that the new building energy code will produce an additional 8–9% of energy savings when compared to the original code. The aforementioned analyses only consider the benefits of the new building energy code and refrain from considering the costs of implementing it. It remains unclear, therefore, whether the standards set in the building energy code are optimally set.

According to the Asia Business Council (Hong et al., 2007), 60% of existing buildings complied with the envelope requirements, 75% complied with the lighting requirements while close to 50% complied with the air conditioning requirements. The level of compliance is thus only moderately high. More significantly, coverage of the code is limited. Although the residential sector accounts for around 14% of total energy use compared to just 7% by the commercial sector, only commercial buildings are covered at all by the code. Within the commercial sector, only large buildings (existing buildings with energy consumption rates above 1.0 MW and new or retrofitted buildings with floor areas above 2,000 m²) have to abide by one of the codes.

Building energy audits and retrofits complement the first-generation building energy code and increase the energy saving benefits from them, since audits allow identification of the buildings that comply or do not comply with the standards and retrofitting allows non-compliant buildings to improve their energy conservation performance. However, as already discussed, it is not clear whether the energy auditing and retrofitting approach is the most cost-effective way to constrain the energy consumption of the commercial sector. Energy audits and retrofitting for designated facilities under the Demand-Side Management (DSM) Program have had a limited impact. By 2000, although 433 building owners applied to participate in the program and the Demand Side Management Office (DSMO) had conducted 252 energy efficiency audits, only 34 projects were approved (Chirarattananon et al., 2007).

Financial incentives are expected to generate energy savings over their lifetime, though the extent to which they do so varies from fund to fund. For Energy Conservation Promotion Fund, a total of

THB 11.7 billion (US\$ 390 million) was spent during the fiscal year period of 1995-2001 to provide financial support to energy conservation programs that were expected to return a saving of THB 12.2 billion (US\$ 410 million) over their lifetimes (refer to Table 2.1.2). While this seems to indicate a positive rate of return on the energy efficiency investment, the energy savings accrue slowly over time whereas the costs are incurred initially (note from Table 2.1.2 that the savings per year have been outweighed by the average disbursement per year). Depending on the discount rate, therefore, net monetary benefits from the program may not necessarily be positive. On the other hand, the monetary calculation of energy saving benefits could underestimate the social benefits from such energy savings if the positive externalities from reduced energy use (e.g. environmental and energy security benefits) are substantial.

Table 2.1.2 Energy Conservation Promotion (ENCON) Fund budgets and savings potential

	Compulsory	Voluntary	Other	Total
ENCON Fund Budgets				
Average per year (million US\$)	15.5	14.9	18.3	48.6
Total disbursement (million US\$)	124	119	165	389
Electricity Savings Potential (million kWh)				
Savings per year (million kWh)	129	51		181
Savings over project life (million kWh)	1,938	771		2,709
Avoided capacity (MW)	48	15		63
Fuel Savings Potential				
Savings per year (million liters crude)		48		48
Savings over project life (million liters crude)		666		666
Monetary Savings				
Savings per year (million US\$)	8.7	18.4		27.1
Savings over project life (million US\$)	130	277		407
Avoided investment (million US\$)	73	22		95

Source: Asia Pacific Energy Research Center, 2003

Note: All figures in US\$ are converted from THB using an exchange rate of 1 US\$ = 30 THB.

Table 2.1.3 summarizes the costs and benefits from the other three financial mechanisms in operation, namely the Energy Efficiency Revolving Fund (EERF), the Energy Service Company (ESCO) Fund, and the tax incentives. Tax incentives provide the highest benefit (in terms of energy savings) relative to the initial cost, and have also leveraged the greatest total investment relative to the initial cost.³⁷

³⁷ In addition to the studies summarized in Table 2.1.3, an Asia Pacific Economic Cooperation case study (Energy Futures Australia Pty Ltd & DMG Thailand, 2005) found that each dollar of lending from the Energy Efficiency Revolving Fund (EERF) resulted in more than US\$ 10 in lifetime financial energy savings and leveraged around US\$ 0.60 in private sector lending.

Table 2.1.3 Financial incentives for buildings in Thailand

	EE Revolving Fund	ESCO Fund	Tax Incentive
Description	Low interest loan	Co-investment fund between public and private sectors	Income tax reduction
Number of EE and RE projects	250	17	327
Total investment	US\$ 500 million	US\$ 125 million	US\$ 189 million
Benefit per annum (energy savings)	US\$ 120 million	US\$ 14 million	US\$ 75 million
Cost (initial allocation from ENCON Fund or tax revenue reduction)	US\$ 150 million	US\$ 15 million	US\$ 6.2 million
Benefit per annum / Cost	0.80	0.93	12.10
Investment / Cost	3.33	8.33	30.48

Source: Asawutmangkul (2010), Sinsukprasert (2009)

The Department of Alternative Energy Development and Efficiency (DEDE) and the banks share the responsibility of promoting the Energy Efficiency Revolving Fund (EERF) and educating the public with the prospect of the Fund. The DEDE runs seminars for participating banks, which in turn proactively promote the Fund to their customers.

(ii) Scientific Integrity

A positive feature of Thailand's policies is that they are generally based on scientific analyses and principles. For the building energy code, the key variable used to gauge the energy performance of the building envelope is the Overall Thermal Transfer Value (OTTV), which measures the size of the average heat gain across building envelope of a commercial building as sensed by the cooling coil of the building's air-conditioning system. The OTTV formulation is generated by using computer code to simulate annual cooling load of a generic building; the data is then utilized for OTTV formulation regression. Background justification for the methodology is provided by Chirarattananon & Taveekun (2004), and Chirarattananon et al. (2010) point out that this formulation provides "an accurate measure of the thermal performance of the envelope of a building." The methodology is also conceptually identical to that used in the Singapore code and the Hong Kong code. In addition, the performance for lighting and the air-conditioning system are measured by the Lighting Power Density (LPD) and Coefficient of Performance (COP) respectively.

The original building energy code had some shortcomings from a scientific perspective, since many of the system requirements that it specified were based on old technologies and had become outdated, while there was no differentiation into categories for different building types (Chirarattananon et al., 2010). However, the development of the new code takes into account updated technologies used in new equipment, while the standards set in the new code are differentiated according to the building type.

The process for determining whether an energy efficiency project can receive funding from the Energy Efficiency Revolving Fund also takes into account scientific evidence and analyses. The

feasibility study carried out by the applicant requires an assessment of whether the proposed energy efficiency measures are technically feasible as well as the likely energy savings from the project, while some banks carry out their own technical analysis of the proposed measures (Energy Futures Australia Pty Ltd & DMG Thailand, 2005).

(iii) Flexibility

The Thai government decided to revise the first version of the building energy code due to its limited success in conserving energy in commercial buildings. Some limitations in the earlier code included the absence of any economic justification for the system performance requirement, excessive emphasis on retrofitting existing buildings, and outdated standard values. The new building energy code was designed so as to account for these problems, i.e. by targeting new commercial buildings only. The process by which flaws in the original code were identified and a new building energy code was formulated indicates that Thailand's building energy efficiency policy process is responsive to changing circumstances. However, although the development of the new code began as early as December 2001, the new code was finalized and gazetted only in 2009. The lengthy process for updating the building energy code means that flexibility in the policymaking process is constrained. An APEC Peer Review on Energy Efficiency in Thailand suggested that the commercial building energy code should be updated every 3 years, whereas in the case of Thailand there was a gap of 14 years between the implementation of the original and new versions of the code.³⁸

The new building energy code allows building owners greater flexibility in their choice of improving their building energy efficiency, compared to the original version. In the original code, a proposed building design would be accepted if it passed one or more of the three system performance-based requirements, i.e. building envelope, lighting, and air-conditioning. Revision of the code has introduced a new degree of flexibility, by allowing building designs which do not pass the three system performance-based requirements, to continue to be eligible for assessment under the whole building energy compliance option. The added flexibility of the new code is also likely to mean that energy savings under the new code will be achieved in a more cost-effective manner. If it is costly for building owner to satisfy the minimum requirements for one of the systems (e.g. air-conditioning), the new code gives the owner the option to "over-comply" in one of the other systems and thus achieve the same level of energy savings for the building as a whole at a lower cost.

The policy process for grants and other financial mechanism has been moderately flexible and responsive. For instance, when the Revolving Fund commenced in 2003, only owners of designated facilities were eligible to apply for funding for their energy efficiency projects. As such, the take-up of loans was slow in the first 18 months during which the Fund operated. This led to an extension of the eligibility criterion to include any commercial building and industrial facility, i.e., small and medium enterprises (SMEs) and third parties such as energy service companies (ESCOs). The main objective of the eligibility extension was to expand the Fund's target area and hence expedite the take up rate of loans. Since the eligibility criterion was extended in 2005, the take up has increased, but most banks are still reluctant to make loans to third parties due to lack of collateral. Still further adjustments to policy (for instance, provision of low-interest loans for energy efficiency improvements via channels other than through commercial banks) might be necessary to increase the take up rate.

³⁸ Asia Pacific Economic Cooperation (APEC) (2010), "Peer Review on Energy Efficiency in Thailand."

ADMINISTRATIVE AND POLITICAL VIABILITY

(iv) Transparency

In planning new policies, public hearings with relevant stakeholders are considered standard protocol for the responsible government agencies.³⁹ Stakeholders include specialists, academics, suppliers and users (public) and about three to four hearings are held. Before the policies/laws are imposed, they are announced one year in advance to allow for an adjustment period. Following the implementation of policies, the DEDE monitors and evaluates the policies. The Department obtains feedback by conducting focus group sessions. This allows for the fine-tuning of policies every three to five years if needed. This process is likely to enhance transparency and stakeholder engagement.

In particular, the development of the building energy code in Thailand can be said to be transparent with respect to involvement of relevant stakeholders in the standard-setting process. Similar to Japan, the development and implementation of the standards is the responsibility of government authorities. However, the process features involvement from stakeholders. In the development of the building energy code, after alternative building systems with different performance levels were developed and life cycle costs were evaluated, the results were then used in a series of consultations with expert groups to determine the value of minimum performance requirement for each system i.e. building envelope, lighting system, air-conditioning system, absorption chillers, hot water system, and renewable energy (Chirarattananon et al., 2010). It has been noted that an effective collaboration between government agencies and academic institutions has contributed to the development and refinement of codes and standards in the Thai building sector (Hong et al., 2007). In addition, a manual that contains the requirements of the building energy code was published and more than a thousand copies were distributed to building professionals, enhancing availability of information on the code.

The process via which the financial mechanisms are designed also allows stakeholder views to be reflected. For instance, the DEDE's allocation of an initial budget of US\$ 50 million (THB 2 billion) from the ENCON Fund to the Energy Efficiency Revolving Fund (EERF) was decided only after several discussions with Thai commercial banks, and the process for determining the policy took into account stakeholder views in a number of ways. The DEDE collected information about the value of loans which the banks were expected to make before issuing a credit line of US\$ 2.5 to 10 million (THB 100 to 400 million) to each of participating banks over Phase 1 (2003 – 2006) of the program. It also proposed a fixed maximum interest rate to help the banks to cover management fees and loan risks while still ensuring attractive loans to project proponents. As a result, the banks provide loans to proponents of EE projects at the maximum interest rate of 4% per annum. In 2002, the DEDE and participating banks negotiated a contract to reach a mutual agreement for requirements and conditions of loans. The contract took 12 months to negotiate and prescribed that the banks will be allowed to terminate a default contract and replace it with another commercial loan.

(v) Alignment

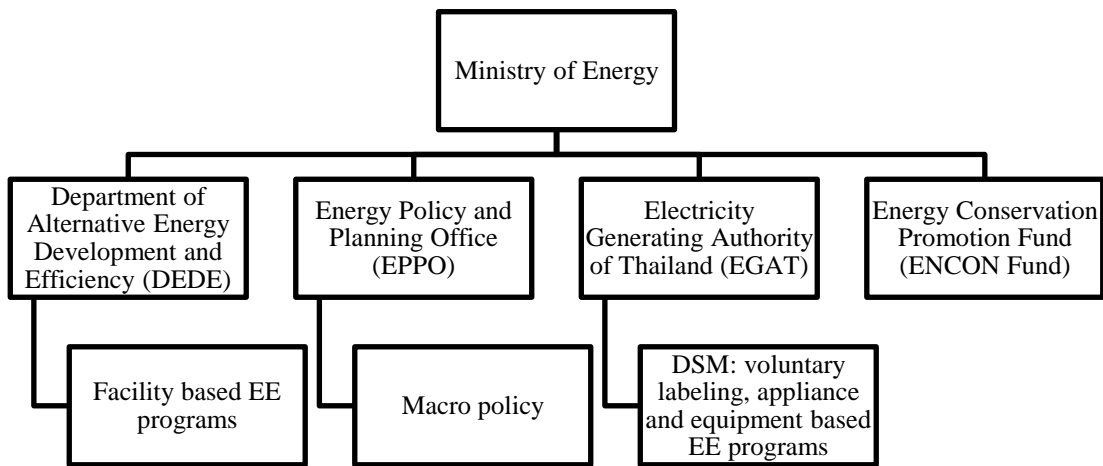
Energy policy in Thailand is decentralized, with multiple government agencies involved. Alignment between the various agencies can be a challenge, even though most of these agencies are

³⁹ This information was gleaned from interviews conducted with officials from the Department of Alternative Energy Development and Efficiency (DEDE), Ministry of Energy, Thailand (19 Jan 2012).

under the Ministry of Energy, which was formed in 2002 to assist alignment and coordination among them.

The building energy code is the main energy efficiency policy for the Thai building sector, and is also the policy for which the greatest number of government agencies is involved. The jurisdiction of each of the agencies involved is distinguished from one another. The Energy Policy and Planning Office (EPPO) is responsible for formulating overall energy policy, the Department of Alternative Energy Development and Efficiency (DEDE) formulates and determines building energy code requirements, and the Department of Public Works and Town & Country Planning (under the Ministry of Interior) administers and enforces the building energy codes. However, adequate coordination between the different agencies has often been lacking.⁴⁰

Figure 2.1.5 Thai government agencies responsible for energy efficiency activities



Source: Energy Futures Australia Pty Ltd, DMG Thailand, 2005

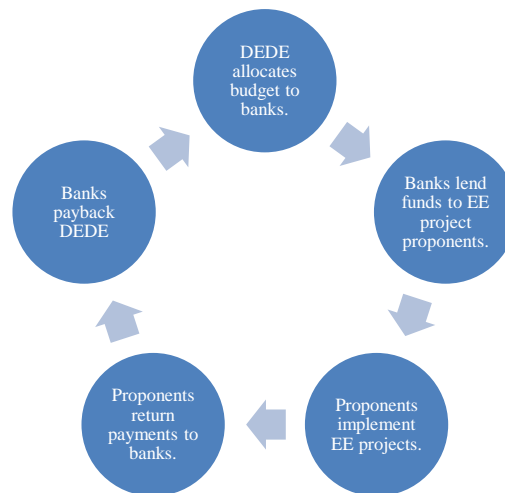
Alignment problems have limited the effectiveness of the energy audits conducted by the Demand Side Management Office (DSMO), which is an office within the Electricity Generating Authority of Thailand (EGAT), a state-owned electricity generating company (Hong et al., 2007). As noted earlier, although the DSMO carried out 252 preliminary energy efficiency audits, only 34 projects were approved. Since the energy audits are conducted only for designated facilities that do not meet the building energy code set by the DEDE, the successful implementation of energy audits requires collaboration between the DEDE and the DSMO. Chirarattananon et al. (2007) and the Asia Business Council (Hong et al., 2007) have both suggested that lack of effective collaboration and coordination between the DEDE and the DSMO is a significant reason why the energy audit program has not yet had a significant impact.

For other key policies, there is usually just a single authority involved, minimizing potential problems of a lack of coordination. The Energy Efficiency Revolving Fund (EERF), the Energy Service Company (ESCO) Fund and tax incentives are managed by the DEDE, while the Energy Conservation Promotion (ENCON) Fund is managed by its own Fund Committee.

⁴⁰ This information was gleaned from interviews conducted with academics from the Asian Institute of Technology, Thailand.

Thai commercial banks are responsible for most aspects of the lending process for the various funds. The lending process for the Energy Efficiency Revolving Fund (EERF) comprises of several stages: the DEDE allocates budget to banks, the banks give loans to project proponents, the proponents implement energy efficiency project, the proponents return payment to the banks, and finally the banks pay back the DEDE (see Figure 2.1.6). The decision to appoint the banks in processing the loans has helped expedite investments in EE projects.

Figure 2.1.6 Energy Efficiency Revolving Fund



Source: Energy Futures Australia Pty Ltd, DMG Thailand, 2005

Unlike Japan, in Thailand there is no direct link between building energy codes and financing mechanisms in the sense that provision of subsidies or loans is typically not contingent on the building meeting the standards. However, the various funds support energy efficiency projects, some of which go towards improving building energy efficiency, thus making it easier for buildings to meet the standards. Thus, the building energy codes and financial mechanisms are still aligned with each other, if in a different and more indirect way than in Japan.

The voluntary labeling program for buildings is, similarly, not aligned with the building energy code. The labels given by the labeling program for different levels of energy performance do not indicate (for large commercial buildings) the extent to which they comply with the building energy code. It should be noted that the labeling program is targeted at a much wider class of buildings than the building energy code, so the lack of alignment is unlikely to be a major drawback.

The Energy Efficiency Revolving Fund was established to overcome specific (largely informational and institutional) barriers to the implementation of energy efficiency measures. The barriers which hindered the progress of energy efficiency efforts included lack of awareness of energy efficiency improvement opportunities, the low priority given to energy costs in management decision-making due to limited access to capital, and excessive bureaucracy and paperwork associated with energy auditing and reporting. To overcome these barriers, the Revolving Fund was established to involve the Thai financial sector in providing low interest loans for energy efficiency improvements and renewable energy development. Thus, the Revolving Fund helps to complement measures such as energy auditing as well as policies such as building energy codes which are meant to encourage energy efficiency improvements in buildings and which become more effective if the barriers discussed above are removed.

2.1.3 Concluding Remarks

Japan and Thailand have utilized a similar mix of building energy efficiency policies that includes building energy codes, information programs, and fiscal and financial incentives. Information programs, in particular labeling programs, have been used to a greater extent in Japan. The policies in Japan target energy efficiency improvements in both commercial and residential buildings, whereas Thailand's policies are mostly targeted at large commercial buildings. In contrast to Japan, aggregate energy savings from Thailand's building policies are likely to be constrained by the fact that residential buildings are so far not included in most of the policies aiming to improve energy efficiency.

The formulation of building energy codes in Thailand takes into account economic cost-benefit analysis, with the choice of the standards based on an evaluation of expected lifetime costs. Such a procedure is more likely to ensure that the standards end up achieving an outcome that is socially optimal, and it is recommended that ex-ante economic cost-benefit analysis is incorporated into the formulation process for building energy codes in Japan as well. Ex-post analysis of the actual costs and benefits of the different policies is recommended for both economies in order to evaluate whether the policies are leading to socially optimal outcomes and to guide future revisions.

Japan has regularly revised its building policies in response to changing circumstances, for instance by strengthening energy standards for commercial and residential buildings in response to the rapid growth in energy use in the buildings sector since 1990. By contrast, regular revisions have not been a feature of Thailand's policies, with a gap of 14 years between the implementation of the original and new versions of the building energy code. Policymakers in Thailand should ensure that regular updates to its building energy efficiency policies are carried out to enhance their effectiveness and to ensure that policies are not outdated.

However, it is encouraging that Thailand's new building energy code allows building owners increased flexibility in how they wish to meet the targets. Even if a building does not satisfy the minimum requirements for a particular component (e.g. air-conditioning, lighting or building envelope), it can still comply with the code by ensuring that its overall energy consumption satisfies the standards. This is likely to enhance the cost-effectiveness of the standards and is an option that should be considered by Japanese policymakers in the implementation of their building energy codes.

Alignment between the various government agencies has been more of a challenge in Thailand than in Japan, even though Thailand has improved alignment by setting up a Ministry of Energy in 2002. Japan has implemented a series of measures to improve alignment, including consolidation of a number of government agencies into the Ministry of Land, Infrastructure and Transport (MLIT), simplification and consolidation of clerical work, and utilization of inter-ministerial committees to carry out changes to its energy conservation policy. In attempting to address issues of inter-agency alignment and coordination, Thailand should consider drawing from Japan's experience in the area.

Overall, Japan's building energy efficiency policies are comprehensive in their design, flexible and well-aligned. Thailand's policies are transparent and scientifically grounded and are expected to generate moderate energy savings, though problems of alignment and policy lags remain. In both economies, however, the extent to which the policies have cost-effectively met their respective energy efficiency objectives remains unclear.

2.1.4 References

- Asawutmangkul, A. (2010, September 17). "Energy Efficiency, Standard and Labeling Policies in Thailand." Retrieved January 13, 2012, from <http://www.unep.org/ClimateChange/LinkClick.aspx?fileticket=nWsIFrg1sK4%3D&tabid=4845&language=en-US>.
- Asia Energy Efficiency and Conservation Collaboration Center (AEECC) (2010). "Energy Conservation Policies and Laws in Japan." *Japan Energy Conservation Handbook 2010*, Retrieved from http://www.asiaeec-col.eccj.or.jp/databook/2010/pdf/handbook10_2.pdf.
- Asia Pacific Economic Cooperation (APEC) (2010). "Peer Review On Energy Efficiency in Thailand." Asia-Pacific Economic Cooperation.
- Asia Pacific Energy Research Center (APERCC) (2003). "Energy Efficiency Programmes in Developing and Transitional APEC Economies." Japan: Asia Pacific Energy Research Center.
- Asia Pacific Energy Research Center (APERCC) (2010). "Compendium of Energy Efficiency Policies of APEC Economies." Tokyo: Institute for Energy Economics, Japan (IEEJ).
- Berkeley, L. (2006). "Energy Consumption, Efficiency, Conservation, and Greenhouse Gas Mitigation in Japan's Building Sector."
- Chirarattananon, S., & Taweekun, J. (2003). "A technical review of energy conservation programs for commercial and government buildings in Thailand." *Energy Conversion and Management*, 743–762.
- Chirarattananon, S., & Taweekun, J. (2004). "An OTTV-based energy estimation model for commercial buildings in Thailand." *Energy and Buildings*, 680-689.
- Chirarattananon, S., Chaiwiwatworakul, P., Hien, V., Rakkwamsuk, P., & Kubaha, K., Chaiwiwatworakul, V., Chirarattananon, S., & Rugkwamsuk, H. P. (2007). "Revised Building Energy Code of Thailand : Potential Energy and Power Demand Savings." *Proceedings of sustainable building SouthEast Asia* , 1-10.
- Chirarattananon, S., Chaiwiwatworakul, P., Hien, V., Rakkwamsuk, P., & Kubaha, K. (2010). "Assessment of energy savings from the revised building energy code of Thailand." *Energy*, 1741-1753.
- Chirarattananon S. (2012). "Energy Efficiency in Buildings, Thailand. Bangkok." The Joint Graduate School of Energy & Environment (Personal Communication, 20 January 2012).
- Energy Conservation Center, Japan (2011). *Japan Energy Conservation Handbook 2011*.
- Energy Futures Australia Pty Ltd, & DMG Thailand. (2005). "Thailand's Energy Efficiency Revolving Fund: A Case Study." Asia-Pacific Economic Cooperation.
- Energy Policy and Planning Office (EPPO) (2000, June 9). "Energy Conservation Program and Guidelines, Criteria, Conditions and Expenditures Priorities of the Energy Conservation Promotion Fund." Retrieved January 05, 2012, from *Energy Conservation Promotion Fund*: <http://www.eppo.go.th/encon/encon-fund00.html>.
- Energy Policy and Planning Office (EPPO) (2011, December 26). "Energy Statistics, Economic Data and Analysis." Retrieved January 03, 2012, from Energy Policy and Planning Office, Ministry of Energy, Thailand: http://www.eppo.go.th/info/stat/T07_02_04.xls.

Evans, M., Shui, B., & Takagi, T. (2009). "Country Report on Building Energy Codes in Japan." Pacific Northwest National Laboratory.

Geller, Howard; Harrington, Philip; Rosenfeld, Arthur H.; Tanishima, Satoshi and Unander, Fridtjof (2006). "Policies for Increasing Energy Efficiency: Thirty Years of Experience in OECD Economies." *Energy Policy*, 34, 556-573.

Hong, Wen; Chiang, Madelaine Steller; Shapiro, Ruth A., and Clifford, Mark L. (2007). "Building Energy Efficiency- Why Green Buildings are Key to Asia's Future." Hong Kong: Asia Business Council.

Institute for Building Environment and Energy Conservation (IBEC) (1999). "Environment and Energy Friendly Building Mark." Retrieved from www.ibec.or.jp/nintei/hyouji/index.html.

International Energy Agency (IEA) (2008a). "Energy Efficiency Requirements in Building Codes, Energy Efficiency Policies for New Buildings." Paris: OECD/IEA.

International Energy Agency (IEA) (2008b). "Promoting Energy Efficiency Investments, Case Studies in the Residential Sector." IEA-OECD-AFD: Paris. Retrieved from <http://www.iea.org/textbase/nppdf/free/2008/PromotingEE2008.pdf>.

International Energy Agency (IEA) (2010). "IEA Energy Efficiency Policies and Measures Database." Retrieved from <http://www.iea.org/textbase/pm/?mode=pm>.

International Energy Agency (IEA) (2011). Energy Balances of Non-OECD Economies 2011 Edition.

Japan for Sustainability (2007). "'Energy Bank', a New Fund for Energy Efficiency and CO2 Reduction." Retrieved from <http://www.japanfs.org/en/pages/026854.html>.

Japan Sustainable Building Consortium (JSBC) (2005). "The background of CASBEE development." Retrieved from <http://www.ibec.or.jp/CASBEE/english/backgroundE.htm>.

Japan Sustainable Building Consortium (JSBC) (2006). "An overview of CASBEE." Retrieved from <http://www.ibec.or.jp/CASBEE/english/overviewE.htm>.

Japan Sustainable Building Consortium (JSBC) (2012). "Dissemination of CASBEE in Japan." Retrieved from <http://www.ibec.or.jp/CASBEE/english/statistics.htm>.

McKinsey & Company (2010). "Impact of the financial crisis on carbon economics- Version 2.1 of the Global Greenhouse Gas Abatement Cost Curve."

Ministry of Economy, Trade and Industry, Japan (METI) (2002). "Financial or Tax Incentives for Energy Efficient Houses and Buildings." Retrieved from <http://www.enecho.meti.go.jp/topics/hakusho/2009energyhtml/p3-2-1-2.htm>.

Ministry of Economy, Trade and Industry, Japan (METI) (2007). "National Energy Conservation Promotion - New 2007 Campaigns for Further Energy Efficiency." Retrieved from www.meti.go.jp/english/newtopics/data/nBackIssue20071129_02.html.

Ministry of Economy, Trade and Industry, Japan (METI) (2008). "Energy Demand and Supply Prospect from 2010 to 2030 (Formulation and Revision)."

Ministry of Economy, Trade and Industry, Japan (METI) (2010). "The Strategic Energy Plan of Japan." Retrieved from http://www.meti.go.jp/english/press/data/pdf/20100618_08a.pdf.

Ministry of Land, Infrastructure, and Transportation, Japan (MLIT) (2006). “Environmental Load Reduction Program on Government Facilities (Government Buildings Green Program).” Retrieved from http://www.mlit.go.jp/english/2006/p_g_b_department/04_environment/01_chapter1.html#2.

Ministry of Land, Infrastructure, and Transportation, Japan (MLIT) (2007). “White Paper on Land, Infrastructure, Transport and Tourism in Japan, 2007.”

Murakami S, Levine MD, Yoshino H, Inoue T, Ikaga T, Shimoda Y, Miura S, Sera S, Nishio M, Sakamoto, Y, Fujisaki, W (2007). “Energy consumption and mitigation technologies of the building sector in Japan.” *The 6th International conference on Indoor Air Quality, Ventilation & Energy Conservation in Buildings*. October 2007, article Nr.89.

NEDO (2011). “NEDO's Role.” Retrieved from http://www.nedo.go.jp/english/introducing_mis_poli.html.

Phumaraphand, N. (2008, June 4). “Thailand DSM Programs: Financial Mechanisms and Program Design the Key to Success.” Retrieved January 10, 2012, from *Asia Clean Energy Forum*.

Prakobchat, S. (2011). “Implementing Energy Efficiency Building Code in Thailand.” Bangkok, Thailand: Department of Alternative Energy Development and Efficiency.

Rakkwamsuk, P. (2010). “New Building Energy Code and Government Policies of Thailand.” School of Energy, Environment and Materials.

Shanahan, L. (2012). “Japan’s energy crisis puts ETS launch on ice.” *The Australian* (29 February 2012).

Sinsukprasert, P. (2009, March 27). “Thailand Clean Energy Policy and Programs.” Retrieved January 9, 2011, from *Asian Development Bank*: <http://www.adb.org/documents/events/2009/Climate-Change-Energy-Workshop/THA.pdf>.

Smith, C. (2008). “Greening a giant: Shrinking the footprint of Japan’s building sector.” *United Nations University: Our World 2.0*.

Sunikka-Blank, M., Iwafune, Y. (2011). “Sustainable Building in Japan – Observations on a Market Transformation Policy.” *Environmental Policy and Governance*.

Talangsari, V. (2011, April 20). “Green SME Support Policies in Thailand.” Retrieved January 15, 2012, from *APEC SME Green Innovation Conference*: apecsmeic.org/data/20/Thailand.pdf.

United Nations Environment Program (UNEP) (2011). “Sustainable Building Policies on Energy Efficiency- Thailand.”

United Nations. (2002). “Thailand Country Profile.” Johannesburg: Commission on Sustainable Development .

Vare, R. (2010). “Japanese Green Building Technologies: New Innovations and Policy.” *JETRO Green Building Report*.

Vechakij, A. (2010, March 04). “Experience from an ESCO to developing Energy Efficiency Projects in Thailand.” Retrieved January 05, 2012, from *Sustainable Energy Technology at Work*: http://www.setatwork.eu/events/thailand/1002Day1Pres3-3/1.11%20-%20Session%201%20-%20Mr.%20Arthit,%20EEI_rev.pdf.

Wangskarn, D. P. (1997). "Success of Energy Efficiency and Energy Conservation in Thailand." *Thai Energy Day: Energy for Tomorrow*. Bangkok: National Energy Policy Office.

Watanabe, Chisaki (2011, December 8). "Japan may introduce carbon tax to curb emissions as nuclear reactors shut." *Bloomberg*.