The Need for Energy Efficiency Legislation in Malaysian Building Sector. A Comparative Study of South East Asian Policies

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Abstract:
The Malaysian building sector approximately consumes 53% of national electricity generated, and emits 5,301 ktons of greenhouse gases (GHG) with an annual growth rate of 6.4%. While voluntary codes of practice for energy efficiency and use or renewable energy exist for non-residential buildings, Malaysia has yet to adopt mandatory energy efficiency legislation for its building sector. Mandatory building energy performance codes have been shown to be the most cost-efficient and effective policy instruments for reducing building energy-related greenhouse gas emissions. Therefore, without mandatory and comprehensive energy efficiency policy, Malaysia faces locking in substantial inefficiencies, and higher than necessary climate change impacts from its building sector. A comparison of energy efficiency policies from other South East Asian countries with similar climatic characteristics will be a valuable insight for Malaysia.

Keywords:
Building control, developing country, energy efficiency, policy development.

1 Introduction

Developing countries in Asia and Africa are rapidly urbanizing, which consequently caused a swift increase of GHG emissions as housing and energy demand escalates (Fujita et al., 2009). South East Asia (SEA) is one of the world's most dynamic regions with progressive economic developments in the past decades (ADB, 2009). The region mainly experiences tropical climate and has a large coastline (173,251 kilometres), which makes it one of the world's most vulnerable regions to the impacts of climate change (ADB, 2009). Already, the region is affected by climate change with rising temperature, rising sea level, and more frequent and extreme weather events that leads to massive flooding and landslides (ADB, 2009).

It is a pressing issue for SEA countries to take action in adapting to climate change, and reduce the environmental impact of energy consumption and GHG emissions that are already locked into the climate system (ADB, 2009). The building sector has been identified by the Intergovernmental Panel on Climate Change (IPCC) as the single largest sector for GHG mitigation potential in all countries (IPCC, 2007; UNEP-SBCI, 2010). A cost-effective global potential up to 80% reduction, of the projected baseline emissions by 2020, has been identified in the building sector (Levine et al., 2007; UNEP-SBCI, 2010; UNEP, 2009). Furthermore, the projected reduction are made available for new and existing buildings with proven and commercially available technologies (UNEP-SBCI, 2010; UNEP, 2009).

Buildings worldwide consume approximately 45% of primary energy sources, making it the single largest energy consumption sector (Iwaro & Mwasha, 2010; Yang et al., 2008). The building sector also globally generates approximately 40% wastes and consumes 16% of water (du Plessis, 2002; WBCSD, 2009). In Malaysia, electricity is the predominant form of energy consumed in buildings (90%), and approximately 53% of the total electricity generated is consumed in the building sector (Energy Commission, 2009). This is further broken down to 18% for residential buildings, and 28% for commercial or non-residential buildings (Shafii, 2008). Currently there is lack of published data for energy performance and actual energy consumption of buildings, especially for residential buildings in Malaysia (Shafii, 2008). Annually the Malaysian building sector emits approximately 5,301 ktons of GHG emissions, with an annual growth rate of 6.4% (UNDP, 2009).

Energy efficiency (EE) legislation exists in almost all developed countries while the developing countries are currently introducing such guidelines on a voluntary basis first to raise awareness among professionals (Iwaro & Mwasha, 2010; UNEP, 2007a, 2009). Energy efficiency legislation such as building energy codes and standards primarily set minimum requirements for energy efficient design and construction (Department for Communities and Local Government, 2007; Iwaro & Mwasha, 2010). Building energy codes are mandatory requirements, enforced to ensure building are constructed and perform according to the minimum energy requirements (Iwaro & Mwasha, 2010). These standards are used to “address energy use of an entire building or building systems such as heating, ventilation and air conditioning” (Birner & Martinot, 2002 p.44), which is also a popular instrument to expedite energy efficiency in the building sector (OECD, 2003; UNEP, 2007a). Conversely, energy standards are used as voluntary guidelines for building construction to promote energy efficiency and save energy cost-effectively (Iwaro & Mwasha, 2010).

2 Effectiveness of Energy Performance-Related Building Codes

It is argued that enforcing energy performance requirements in building codes is the most effective and cost-effective strategy in reducing GHG emissions from both existing and new buildings (UNEP-SBCI, 2009). Regulatory strategies are taken by governments to intervene in the market to achieve and assert changes within the sector (Lee & Yik, 2004). Enforcement of energy efficient building standards through regulatory control can potentially ensure a minimum level of performance is achieved across the building sector (Huovila et al., 2009; Lee & Yik, 2004; UNEP, 2007b). In Asia, energy efficiency initiatives is seen to be largely dependent on governmental efforts (Hong et al., 2007). Countries in Scandinavia generally implement national building codes that regulates the physical, thermal and electrical requirements of building components, service systems and equipments to help promote energy efficiency (UNEP, 2007b). Building codes have also introduced energy performance standards to limit the amount of energy consumption according to building type (UNEP, 2007b).

Additionally, the effectiveness of these building codes and standards are dependent on level of enforcement and implementation (Birner & Martinot, 2002; Deringer et al., 2004; UNEP, 2007a). Moreover, in order to stay effective, building codes need to be regularly revised as technology advances and costs less (Birner & Martinot, 2002; UNEP, 2007a, 2009). This consequently leads to more efficiency, with the removal of least efficient products and encourage higher efficient product purchase in the market (Birner & Martinot, 2002).

Therefore, unless the criteria levels are easily achieved and does not impose heavy financial burden, the building sector would strongly oppose the legislation, or likely to encounter numerous violations rendering enforcement (Lee & Yik, 2004). Some suggest the voluntary-based environmental approach is more effective, whereby it offers greater flexibility for stakeholders to achieve its target (Lee & Yik, 2002, 2004). Voluntary initiatives are also aimed at influencing behavioural characteristics of individuals and companies, by providing examples of successful implementations (IEA, 2005; UNEP, 2007a). Voluntary agreements usually consist of negotiated energy use reduction targets, quantifying energy consumption and baselines, technical assistance services, sanctions for noncompliance, and incentives for compliance (IEA, 2005).

However, based on experience in public sector buildings with mandatory energy reduction programme have shown significant cost-effective energy savings. Federal agencies in the U.S. were obliged to reduce their energy consumption by 35% by 2010 compared to 1990 levels, which led to energy savings of 4.8 GWh annually (equivalent to 2.3 ktCO2e.) and cost savings of USD$ 5.2 billion (U.S. DOE, 2006 cited in UNEP, 2009). Mandatory energy efficiency building codes also provides an incentive for the private sector to invest in new technologies (UNEP, 2009).

3 Energy Efficiency Building Codes in South East Asia (SEA)

In many developing countries, energy efficiency building codes (EEBCs) exist only on paper and have failed to impact significant energy savings (Deringer et al., 2004; UNEP, 2007a). This is due to lack of enforcement, corruption, and different levels of rigor implementation (Birner & Martinot, 2002; Deringer et al., 2004; UNEP, 2007a). Additionally the United Nations 'Assessment report on energy efficiency institutional arrangements in Asia' (UNESCAP, 2010), countries in SEA share common barriers in promoting energy efficiency, i.e. lack of industrial awareness, lack of financial capacities, and lack of confidence in technology (UNESCAP, 2010).

For example, EEBCs are strictly enforced in Singapore, while EEBCs in the Philippines National Building Code only considers energy efficiency a voluntary requirement (OCEAN, 2009). Similarly, Thailand's Building Energy Code is mandatory for all commercial and government buildings, while Vietnam's mandatory Energy Efficiency Commercial Code hasn't been widely disseminated and not strictly enforced (OCEAN, 2009). Brunei, Cambodia, Lao PDR, Malaysia and Myanmar have yet to implement any mandatory EEBC, but some have introduced voluntary EE guidelines, conservation programmes, or codes for non-residential buildings (OCEAN, 2009; UNEP & BCA, 2011; UNESCAP, 2010). This reflects the lack of awareness, the different levels of implementation and enforcement of EEBCs across SEA. Brief comparison of existing EEBCs in SEA is presented in Table 1, thus presenting the current state of play.

Table 1. Energy Efficiency Policies in Building Sector for South East Asian Countries

(Source: APERC, 2011; UNEP & BCA, 2011)

Country	**Energy Efficiency Policies and Building Codes in SEA**	
	Mandatory	**Voluntary**
Brunei Darussalam	N/A	Energy audits, EE Building Guidelines, EE and Conservation Initiative Awards Scheme, EE Labelling Scheme.
Cambodia	N/A	Energy Audits in Commercial Buildings, Promotion of EE and Conservation (PROMEEC)
Indonesia	Building Codes-Energy Provision, Mandatory energy conservation for government buildings, Energy Building Standards (SNI), Minimum Energy Performance Standards and Labelling, Presidential Instruction No.9/1982-Energy Conservation; No.10/2005-EE and energy saving; No.13/2010-Energy Manager; No.14/2010-Building Managers.	EE Labelling Systems, GREENSHIP Building Rating Tool, Public-Private Partnership Programme on Energy Conservation, Energy Conservation Clearinghouse, Energy Benchmark and Best Practice Guide (for commercial buildings).
Lao PDR	N/A	Promotion of EE and Conservation (PROMEEC)
Malaysia	N/A	Energy Rating and Labelling Programme, Malaysian Standard-Code of Practice on the Use of Renewable Energy and EE in Non-Residential Buildings (MS1525:2007), Green Building Index (GBI), Energy Performance Management Systems (EPMS)– energy audits on government buildings
Myanmar	N/A	N/A *only a general Energy Policy and Strategy, Energy Conservation Model Project.
The Philippines	Building Codes-Guidelines for Energy Conservation Design of	Building for Ecologically Responsive Design Excellence

	Buildings and Utility Systems, Mandatory EE Labelling, Government Energy Management Programme (GEMP) – energy audits, Malacanang Administrative Order (OA) No. 103, 183, 228.	(BERDE) Building Rating System, Green Building Initiative (GBI) Rating System, EE Standard and Labelling Programme, Energy Audits by Dept. Of Energy under National EE Conservative Programme (NEECP), GEMP Award.
Singapore	Minimum Energy Performance Standards (MEPS), Building Control (Environmental Sustainability) Regulations, Code on Envelope Thermal Performance for Buildings, Code of Practice for EE Standard for Building Services and Equipment, and Code of Practice for Air-Conditioning and Mechanical Ventilation in Buildings, Mandatory Energy Labelling Scheme (MELS).	Green Mark Schemes, Singapore Green Building Product Certification Scheme, Eco-Office Label, Singapore Green Labelling Scheme (SGLS), EE Building Benchmarking Programme, online benchmarking system (Energy Smart Tool), Built Environment Leadership Award, Green Mark Champion Award.
Thailand	Building Energy Code, Minimum Energy Performance Standards (MEPS), Designated Buildings/Factories under Energy Conservation Promotion Act, Mandatory Audits under Building Energy Code (for designated buildings).	Green Leaf Programme, Thai Green Label Scheme, EE Labelling (No.5), High Energy Performance Standards (HEPS), EE Building Labelling Scheme, Government Buildings Audit and Retrofit Programme, Private Building Energy Audits.
Vietnam	EE Building Code, EE Standards and Labels, EE Commercial Building Code, Public Procurement of Works and Constructions–Law on Construction (No.16/2003/QH11), Law on Environmental Protection (No. 52/2005/QH11).	LOTUS VN Green Rating Tool, ASEAN Energy Management Scheme, Promotion on EE and Conservation (PROMEEC).

This energy efficiency policies comparative study for South East Asian building sector is mainly compiled from the Sustainable Building Policies on Energy Efficiency reports (UNEP & BCA, 2011) and the Compendium of Energy Efficiency Policies of APEC Economies (APERC, 2011). The comparison mainly focuses on policies related directly with the building sector, such as building codes, EE standards, and energy labelling schemes. It can be concluded that most countries in SEA has already implement mandatory EE policies related to the building sector. However, even if these policies were in place, the more pressing question now is to what extent is its effectiveness in addressing environmental issues. Presented below are excerpts of each South East Asia's EEBC.

3.1 Brunei

Brunei is in the midst of introducing its own Energy Efficient Building Guidelines, that is expected to become a mandatory legislation and in supplementing the existing National Building Code (APEC, 2011a; UNEP & BCA, 2011). The guideline is set to cover building envelope, cooling and ventilation, lighting, heating, insulation, site orientation, and building design (UNEP & BCA, 2011). Albeit any mandatory guideline, there has been some voluntary initiative taken by the government and industry.

Voluntary energy audits were conducted to both government and industrial buildings to help determine the consumption pattern of Brunei's building stock (UNEP & BCA, 2011). This initiative was in collaboration with the Energy Division of the Prime Minister's Office, the Conservation Centre of Japan and the ASEAN Centre for Energy (UNEP & BCA, 2011). An Energy Efficiency and Conservation Initiative Awards Scheme was initiated in 2007, by the government and private organizations, in hopes to exemplify energy efficiency and conservation efforts (UNEP & BCA, 2011). The government also launched a voluntary Energy Efficiency Labelling Scheme targeting commercial, residential and government buildings, to raise awareness on more energy efficient product (at present only air-conditioners are being labelled as it represents the bulk of electricity consumption) (UNEP & BCA, 2011).

3.2 Cambodia

Cambodia has taken steps in promoting energy efficiency through voluntary programmes such as Promotion of Energy Efficiency and Conservation (PROMEEC) with the Energy Conservation Centre of Japan (ECCJ) (UNEP & BCA, 2011). PROMEEC aims to establish a standardized evaluation criteria for energy conservation, introduce energy conservation technologies, encourage and award best practices for buildings and other major industries (UNEP & BCA, 2011). Another example is through series of activities for capacity building and technical assistance, conducted by a French Agency for the Environment and Energy Management together with the Energy Conservation Research and Development Centre (ENERTEAM) (UNEP & BCA, 2011).

Cambodia also participates in the ASEAN Energy Awards, which promotes regional cooperation and partnerships between the private and public sectors (UNEP & BCA, 2011). Voluntary energy audits are also carried out on commercial buildings in efforts to promote more energy efficiency measures (UNEP & BCA, 2011). However, there is currently no mandatory regulation, no building rating scheme and is yet to develop any fiscal instruments to widely disseminate energy efficiency within the building sector (UNEP & BCA, 2011). Therefore, Cambodia needs to play catch up with its other SEA counterparts, in preventing potentially high inefficiency lock-in effect.

3.3 Indonesia

Indonesia applies mandatory energy conservation best practice measures for all its government office buildings, which is expected to submit monthly energy consumption report every six months (APEC, 2011a; UNEP & BCA, 2011). Other mandatory frameworks are such as Law No.28/2002 regarding Buildings, which requires all buildings to comply with existing energy standards (SNI) that applies to building envelope, air-conditioning, lighting, and energy auditing (APEC, 2011a; UNEP & BCA, 2011). The Presidential Instruction No.10/2005 on Energy Efficiency requires government officials to implement EE measures such as lighting, air-conditioning, electrical appliances and office vehicles, within its institutions (UNEP & BCA, 2011). A Minimum Energy Performance Standards (MEPS) is also being developed to encourage energy efficiency through energy labelling for appliances (UNEP & BCA, 2011).

The Green Building Council of Indonesia introduced a voluntary green building rating tool, the GREENSHIP in 2008 (UNEP & BCA, 2011). GREENSHIP rates the environmental design and construction of buildings through six criteria; appropriate site development; energy efficiency & refrigerants; water conservation; materials & cycle resources; water, indoor health & comfort; and buildings & environment management (UNEP & BCA, 2011). A Public-Private Partnership Programme on Energy Conservation was introduced, by the government, to improve energy efficiency for industries and buildings with intense energy consumption (UNEP & BCA, 2011).

3.4 Lao People's Democratic Republic (PDR)

Currently, no legal framework for improvement of energy efficiency and conservation exists within the building sector in Lao PDR (ECCJ, 2011). The Ministry of Energy and Mines (MEM) is in the process of drafting a decree on Energy Efficiency and Conservation to encourage conservation measures in public buildings (ECCJ, 2011). Nevertheless, Lao PDR has taken steps to introduce energy efficiency by participating in the Promotion of Energy Efficiency and Conservation Project (PROMEEC) since 2001, similar to Cambodia and Vietnam (ECCJ, 2011). This project is aimed to provide capacity building on energy efficiency and conservation, in disseminating best practices and experiences from Japan to other ASEAN member countries (ECCJ, 2011).

3.5 Myanmar

Similar to Brunei, Cambodia and Lao PDR, Myanmar has yet to implement any mandatory energy efficiency legislation within its building sector (UNEP & BCA, 2011). Incidentally, available energy efficiency and conservation voluntary actions has so far only appear in the energy production industry (UNEP & BCA, 2011). However, energy conservation seminars have been conducted to raise awareness and promote for more energy efficient equipments in commercial buildings and electrical appliances in households (UNEP & BCA, 2011).

An Energy Policy and Strategy exits for the energy production sector, to encourage renewable sources and conservation of non-renewable energy sources (UNEP & BCA, 2011). The Ministry of Energy has also introduced the Energy Conservation Model Project, to conduct a feasibility study of energy demand and consumption of the industry sector, in efforts to develop energy efficiency and conservation policies that is unique to the current energy trends (UNEP & BCA, 2011). Myanmar also engages in a regional energy corporation between Bangladesh, India, Sri-Lanka and Thailand-Economic Corporation (BIMST-EC), for capacity building and technology transfer programmes and activities (UNEP & BCA, 2011). These initiatives are encouraging, however more effort and focus must trickle down to the building sector in preventing a future lock-in of an inefficient building sector.

3.6 The Philippines

The Philippines introduced the Guidelines for Energy Conservation Design of Buildings and Utility Systems into its National Building Code (Republic Act No. 6541) (OCEAN, 2009; UNEP & BCA, 2011). However, the particular energy efficiency section of this building code is presently only as a voluntary basis, an only concerns building envelope, lighting, HVAC (heating, ventilation, and air conditioning), and water heating (OCEAN, 2009). A mandatory Energy Efficiency Labelling scheme was introduced to label energy efficient refrigerators, window-type air-conditioners, compact fluorescent lamps and linear fluorescent lamps; targeted at all types of building (UNEP & BCA, 2011).

Other regulatory instruments such as Malacanang Administrative Order (AO) No. 103, No. 183 and No. 228 has set requirements for public buildings facilities to achieve a 10% reduction in cost for consumption of fuel, water, office supplies, electricity (UNEP & BCA, 2011). The AO also requires public buildings to use energy efficient lighting systems, to turn off air-conditions at 4.30pm except those operate 24 hours daily, convert 20% of vehicles to liquefied petroleum gas, and to apply energy saving technologies (UNEP & BCA, 2011). Energy audits are also conducted for government buildings, under the Government Energy Management Programme (GEMP) (UNEP & BCA, 2011). Tax exemptions/reductions, grants and capital subsidies are also available via the government and other public institutions as fiscal instruments to promote energy efficiency (UNEP & BCA, 2011).

There are voluntary rating systems such as the Building for Ecologically Responsive Design Excellence (BERDE) and the Green Building Initiative (GBI), where one measures a building's environmental impact and performance throughout life cycle analysis (LCA), and the other focuses on green building design criteria (UNEP & BCA, 2011). Many building awards based on best practice of eco-friendliness, energy efficiency, and energy management are both voluntary instruments and market-lead to help promote a more energy efficient built environment (UNEP & BCA, 2011).

3.7 Thailand

Thailand's Energy Conservation Promotion Act (No. 2 B.E. 2550) enforces energy conservation practices for industrial, commercial and government building sectors (OCEAN, 2009). Additionally the Building Energy Code was introduced in 1994 and enforced in 1995, which covers building envelope, HVAC and lighting requirements (OCEAN, 2009). The mandatory code is applicable to all new and existing commercial and government buildings, in complying with the maximum standard of 55 watts per square meter (m^2) of gross floor area (g.f.a) (OCEAN, 2009).

Under the Building Energy Code, two specific decrees are imposed; Royal Decrees on Designated Buildings (B.E. 2538) and Royal Decree on Designated Factories (B.E. 2540). The B.E. 2538 prescribes "a) the standards, criteria, and procedures for energy conservation in designated buildings; b) the forms and schedule for submission of information on energy consumption and conservation; and c) the criteria, procedures and schedule for owners of designated buildings to establish and submit energy conservation targets and plans" (APERC, 2011 p.208). Meanwhile the B.E. 2540 imposes "a) the forms and schedule for submission of information on energy production, consumption and conservation, including the criteria on and methods of recoding information on energy consumption and installation or modification of machinery or equipment that affects the level of energy consumption and conservation; and b) the criteria, procedures and schedule for owners of designated factories to establish and submit energy conservation targets and plans" (APERC, 2011 p.208).

Other regulatory instruments implemented as like the Minimum Energy Performance Standards (MEPS) and mandatory energy efficient refrigerator/air-conditioner programme (UNEP & BCA, 2011). The MEPS standard defines an energy efficiency performance threshold for six electrical appliances, such as refrigerators, air-conditioners, motors (three phase), fluorescent lighting ballast, fluorescent lighting tubes, and compact fluorescent lamps (UNEP & BCA, 2011). The Energy Efficient Air-Conditioner Programme (EEAP) and Energy Efficient Refrigerator Programme (EERP) are mandatory energy labelling for air-conditioners and residential-use refrigerators (UNEP & BCA, 2011).

Fiscal instruments aimed at providing tax exemption, corporate funds, and household energy credits are exemplary initiatives by the Thailand government and public sectors to highlight energy efficiency issues (UNEP & BCA, 2011). There are also a variety of voluntary initiatives done by both the public sector and the industry to push for energy efficiency, such as the Green Leaf Programme, the Thai Green Label Scheme, High Energy Performance Standards (HEPS), Government and Private Buildings Audit and Retrofit Programmes, and the Building Energy Awards of Thailand (BEAT) (UNEP & BCA, 2011).

3.8 Vietnam

Vietnam introduced its Energy Efficiency Building Code (No.40/2005/QD-BXD) and consequently the Energy Commercial Building Code (No.40/2005/QB-BXD) in 2005 (OCEAN, 2009; Pham, 2011). These mandatory codes cover building envelope, lighting, air-conditioning and ventilation, and are applicable to public, residential and non-residential buildings (APEC, 2011a; UNEP & BCA, 2011). Additionally, the Public Procurement of Works and Constructions, via Law on Construction (No.16/2003/QH11) and Law on Environmental Protection (No.52/2005/QH11), requires construction projects in Vietnam to submit an Environmental Impact Assessment (IEA) documentation (UNEP & BCA, 2011).

A Pilot Commercial Energy Efficiency Programme (CEEP) was introduced from receiving the Global Environment Facility (GEF) grant from the World Bank (UNEP & BCA, 2011). The CEEP (2004 to 2009) was aimed to increase capacity building in energy efficiency and conservation for organizations, and provided financial support for the private sector (UNEP & BCA, 2011). Other voluntary instruments are such as the LOTUS Green Rating Tool, ASEAN Energy Management Scheme and the Promotion on Energy Efficiency and Conservation (PROMEEC) programme (UNEP & BCA, 2011). The LOTUS Green Rating Tool was developed in 2010 by Vietnam's Green Building Council (VGBC) (UNEP & BCA, 2011). Currently, LOTUS is available in three categories, i.e. residential, non-residential and existing buildings (VGBC, 2011). LOTUS rates a building through nine criteria, i.e. energy, water, material, ecology, waste and pollution, health and comfort, adaptation and mitigation, community, and management (VGBC, 2011).

3.9 Singapore

In comparison, Singapore's extensive sustainable building and energy efficiency commitment is reflected in its various initiatives that range from regulatory legislation, fiscal instruments, market-driven initiatives and voluntary schemes. Singapore introduced its Building Control (Environmental Sustainability) Regulations in 2008 (BCA, 2008; UNESCAP, 2010). This legislation requires all new buildings (residential and non-residential) and additions/extensions to existing buildings, with gross floor area of 2,000 square metres or more, to comply with a minimum Green Mark Score of 50 points (BCA, 2008; UNESCAP, 2010). The Green Mark assesses buildings by its energy efficiency (minimum 30 points), and other green requirements (minimum 20 points) such as water efficiency; environmental protection; indoor environmental quality; and other green features (BCA, 2012).

Aside from that, other relevant building codes implemented in Singapore are Code on Envelope Thermal Performance for Buildings, Code of Practice for Energy Efficiency Standard for Building Services and Equipment, Code of Practice for Air-Conditioning and Mechanical Ventilation in Buildings, Code of Practice for Artificial Lighting in Buildings, and Code of Practice for Lighting of Work Places-Indoor (UNEP & BCA, 2011; UNESCAP, 2010). The Code on Envelope Thermal Performance for buildings focuses on thermal transfer value of building envelope and roofs for air-conditioned non-residential buildings, envelope transmittance value for residential buildings, and roof insulation for air-conditioned buildings (APEC, 2011a; UNEP & BCA, 2011).

Additionally, under the Mandatory Energy Labelling Scheme (MELS), selected household appliances such as air-conditioners, refrigerators and clothes dryer sold in Singapore must include energy labelling (APEC, 2011a; UNEP & BCA, 2011). This is tied together with the Minimum Energy Performance Standards (MEPS), which requires air-conditioners and refrigerators sold to comply with a minimum level of energy efficiency (APEC, 2011a; UNEP & BCA, 2011). Singapore has also introduced the Energy Efficiency Building Benchmarking Programme to "promote energy efficiency in the building sector by recognizing energy efficient buildings (UNESCAP, 2010 p.85). The programme uses an online benchmarking system, the Energy Smart Tool, to evaluate energy performance based on air quality, thermal comfort, ventilation and lighting (National Environment Agency, 2011).

Fiscal instruments were also introduced by the government, in terms of tax exemptions/reduction, and various energy efficiency financial schemes and grants provided by the public sector (UNEP & BCA, 2011). A One-Year Accelerated Tax Depreciation Allowance for Energy Efficiency Equipment and Technology (One-Year ADAS) is an initiative by the government to encourage companies to invest in energy-saving equipment by providing tax allowance when replacing old and less efficient equipments (UNEP & BCA, 2011). Other fiscal support are such as Energy Efficiency Improvement Assistance Scheme (EASe), Grant for Energy Efficiency Technologies (GREET), Design for Efficiency (DfE) Scheme, and Green Mark Incentive Schemes (GMIS) (APEC, 2011a; UNEP & BCA, 2011).

4 The Need for Energy Efficiency Legislation in Malaysia

Using an energy index (total energy used in a building divided by gross floor area), estimation of the average energy consumption for a standard non-residential Malaysian building is between 250-300 kWh/m^2/year (Shafii, 2008; Zain-Ahmed, 2008b). In comparison, Singapore's average non-residential building energy consumption is at 220 kWh/m^2/year, while South East Asia's region average is at 230 kWh/m^2/year (Shafii, 2008; Zain-Ahmed, 2008b). The Malaysian building stock in approximately at 38 million m^2 floor area, and of which 11% of the buildings can be considered as energy efficient (consumes less than 136 kWh/m^2/year) (UNDP, 2009).

This clearly indicates that the Malaysian building sector is an energy intensive sector of the economy, and energy efficient strategies and guidelines is needed in order to reduce its overal energy consumption. The sustainable construction approach is still at its infancy phase for the Malaysian industry (Hezri, 2004). Additionally, Malaysia still lacks a consistent GHG emissions database (Fong et al., 2008) to further monitor its progress in the presented strategies. This is a key issue that needs to be addressed if Malaysia aims to achieve its voluntary 40% GHG reduction from the 1990 baseline, by year 2020 (Department of Environment, 2010).

Nevertheless, efforts by professional bodies like Architect Association Malaysia (PAM) and Association of Consulting Engineers Malaysia (ACEM) in Malaysia have served as a catalyst in addressing environmental issues in the building sector. The Green Building Index (GBI) Malaysia, created in collaboration by PAM and ACEM, rates building based on energy efficiency, indoor environmental quality, sustainable site planning and management, materials and resources, water efficiency and innovation (Greenbuildingindex, 2009). The GBI currently only applies for non-residential (existing and new), residential (new only) and townships (Greenbuildingindex, 2009). However, there is currently no reference for measuring GHG emission during building operational phase in the GBI assessment criteria, which reflects the lack of research and development into operational emission of buildings in Malaysia.

Also recently introduced in 2009 were tax exemptions and financial incentives by Ministry of Energy Green Technology and Water in attempts to generate interest for more green construction (Ministry of Energy Green Technology and Water, 2009). Such financial incentives are designated for energy efficiency, production and consumption of renewable resources, and green buildings (Ministry of Energy Green Technology and Water, 2009).

4.1 Lack of Energy Efficiency Building Codes in Malaysia

The Malaysian Standard Code of Practice on Energy Efficiency and Use of Renewable Energy for Non-residential Buildings (MS 1525:2007) was introduced in 2001, and revised in 2007, to guide the effective use of energy (including renewable energy) in new and existing non-residential buildings (SIRIM, 2004; Zain-Ahmed, 2008a). Also according to the MS 1525, the recommended amount of energy consumption for non-residential buildings is 135 kWh/m^2/year (Shafii, 2008; SIRIM, 2007; Zain-Ahmed, 2008b). As the average non-residential building in Malaysia consumes between 250-300 kWh/m^2/year, it noticeably implies that more drastic strategies are needed to comply with the energy efficiency guideline.

The Malaysian building sector is regulated by the Uniform Building By-Law (UBBL) that governs the minimum specifications that includes ventilation, structural and constructional requirements, fire safety (APEC, 2011b; Ministry of Finance, 2006). The by-law however does not include energy performance or energy efficiency guidelines, and the voluntary MS 1525:2007 is being used by the government as efforts to promote energy efficiency for the commercial sector (APEC, 2011b). However, the MS 1525:2007 is planned to be incorporated in the UBBL by 2015, under the National Energy Efficiency Master Plan (NEEMP), an initiative by the Ministry of Energy, Green Technology and Water (MEGTW) (APEC, 2011b).

The MEGTW has also been promoting energy efficiency to government-owned buildings. The Ministry's headquarters implemented a Low Energy Office (LEO) strategy, in efforts to reduce its energy consumption (MEGTW, 2009; Shafii, 2007). In 2006, an energy audit conducted to the LEO building and calculated its energy consumption was 104 kWh/m^2/year, which subsequently won ASEAN Building Energy Award (MEGTW, 2009; Shafii, 2007). Other non-residential buildings that have adapted energy efficiency strategies are like the Malaysian Energy Centre's Zero Energy Building in Bangi (ZERO building), the Energy Commission's Diamond Building in Putrajaya, and the Securities Commission Building in Kuala Lumpur (Shafii, 2007; Zain-Ahmed, 2008b). The ZERO and Diamond buildings were designed to reduce energy consumption to 50 kWh/m^2/year and 85 kWh/m^2/year, respectively (Zain-Ahmed, 2008b).

Albeit these incentives, and more significantly, a similar energy efficiency standard for the residential sector does not exist (SIRIM, 2004; Zain-Ahmed, 2008a). Residential buildings are not regulated nor promoted for energy efficiency, which is likely to have a significant implication on its energy end-use performance (APEC, 2011b). Without such legislation, the residential sector in Malaysia is locking itself for a predicted growth of GHG emission through building operation as purchasing power increases.

5 Conclusion

Malaysia falls behind in terms of implementing energy efficiency building codes compared to its other SEA counterparts. From the listed SEA energy efficiency policy and initiatives, Malaysia has a wide variety of examples to help design its own energy efficiency building code. These examples are furthermore applicable to the Malaysian context, as most of the countries share the same climatic conditions. Energy efficiency standard and guideline in the building sector has proven to reduce energy consumption and consequently help reduce total GHG emissions. The apparent gap for the residential sector in energy-efficiency research and legislation, coupled with rising trend of GHG emission, is set to put Malaysia at high risk of locking in high consumption and low-efficiency building. Therefore, to negate this lock-in effect, both residential and commercial sectors need to develop baselines for monitoring and mitigating GHG emissions from building operations. It is also crucial for stakeholders in the building industry to promote existing guidelines to reduce its overall environmental impact.

6 References

ADB (2009). The Economics of Climate Change in Southeast Asia: A Regional Review Jakarta: Asian Development Bank (ADB)

APEC (2011a). Compendium of Energy Efficiency Policies of APEC Economies. Tokyo, Japan: Asia Pacific Energy Research Centre, Institute of Energy Economics Japan.

APEC (2011b). Peer Review on Energy Efficiency in Malaysia: Asia-Pacific Economic Cooperation (APEC).

APERC (2011). Compendium of Energy Efficiency Policies of APEC Economies. Tokyo, Japan: Asia Pacific Energy Research Centre, Institute of Energy Economics Japan.

BCA (2008). Building Control Act *Building Control (Environmental Sustainability) Regulations 2008*. Singapore: Building and Construction Authority (BCA) Singapore.

BCA (2012). 'About BCA Green Mark Scheme'. *Building & Construction Authority (BCA) Singapore*, http://www.bca.gov.sg/greenmark/green_mark_buildings.html, viewed: 27th January 2012.

Birner, S., & Martinot, E. (2002). The GEF Energy-Efficient Product Portfolio: Emerging Experience and Lessons, *Monitoring and Evaluation Working Paper 9*. Washington, DC Global Environment Facility (GEF) Corporate Monitoring and Evaluation Team.

Department for Communities and Local Government (2007). Building Regulations: Energy efficiency requirements for new dwellings. London: Crown Copyright

Department of Environment (2010). COP 15: The Copenhagen Accord. In C. M. Chun (Ed.), *Quarterly DOE Update on Environment, Development and Sustainability*. Putrajaya: Department of Environment (DOE), Ministry of Natural Resources and Environment.

Deringer, J., Iyer, M., & Huang, Y. J. (2004). Transferred Just on Paper? Why Doesn’t the Reality of Transferring/Adapting Energy Efficiency Codes and Standards Come Close to the Potential?, *Proc. 2000 ACEEE Summer Study on Energy Efficiency in Buildings*. Pacific Grove, CA.

du Plessis, C. (2002). *Agenda 21 for Sustainable Construction in Developing Countries, A discussion document* (WSSD ed.). South Africa: International Council for Research and Innovation in Building and Construction (CIB); United Nations Environment Programme, International Environmental Technology Centre (UNEP-IETC).

ECCJ (2011). 'Asia Energy Efficiency and Conservation Collaboration Centre'. *The Energy Conservation Centre, Japan (ECCJ)*, http://www.asiaeec-col.eccj.or.jp/st-takes/countries.html, viewed: 5th July 2012.

Energy Commission (2009). Electricity Supply in Malaysia: Performance and Statistical Information, *Electricity Supply Industry in Malaysia*. Putrajaya: Energy Commission Malaysia (Suruhanjaya Tenaga Malaysia).

Fong, W.-K., Matsumoto, H., & Lu, Y.-F. (2008). 'Establishment of City Level Carbon Dioxide Emission Baseline Database and Carbon Budgets for Developing Countries with Data Constraint'. *Journal of Asian Architecture and Building Engineering/,* 7(2), 403-410.

Fujita, Y., Matsumoto, H., & Siong, H. C. (2009). 'Assessment of CO2 emissions and resource sustainability for housing construction in Malaysia'. *International Journal of Low Carbon Technologies,* 4, 16-26.

Greenbuildingindex (2009). 'The Green Building Index'. *Greenbuildingindex Sdn Bhd*, http://www.greenbuildingindex.org/green_building_index.htm, viewed: 13 October 2009.

Hezri, A. A. (2004). 'Sustainability indicator system and policy processes in Malaysia: a framework for utilisation and learning', [doi: DOI: 10.1016/j.jenvman.2004.07.010]. *Journal of Environmental Management,* 73(4), 357-371.

Hong, W., et al. (2007). *Building Energy Efficiency: Why Green Buildings Are Key to Asia's Future*, ABC, Asia Business Council, Hong Kong

Huovila, P., et al. (2009). Buildings and Climate Change: Summary for Decision-Makers. In J. Yamamoto & P. Graham (Eds.). Paris: United Nations Environment Programme - Sustainable Buildings and Climate Change Initiative (UNEP-SBCI).

IPCC (2007). Climate Change 2007: Synthesis Report. In Abdelkader Allali, Roxana Bojariu, Sandra Diaz, Ismail Elgizouli, Dave Griggs, David Hawkins, Olav Hohmeyer, Bubu Pateh Jallow, Lucka Kajfez-Bogataj, Neil Leary, Hoesung Lee & D. Wratt (Eds.), *An Assessment of the Intergovernmental Panel on Climate Change*. Valencia, Spain: Intergovernmental Panel on Climate Change (IPCC).

Iwaro, J., & Mwasha, A. (2010). 'A review of building energy regulation and policy for energy conservation in developing countries', [doi: DOI: 10.1016/j.enpol.2010.08.027]. *Energy Policy,* 38(12), 7744-7755.

Lee, W. L., & Yik, F. W. H. (2004). 'Regulatory and voluntary approaches for enhancing building energy efficiency', [doi: DOI: 10.1016/j.pecs.2004.03.002]. *Progress in Energy and Combustion Science,* 30(5), 477-499.

Levine, M., et al. (2007). Residential and Commercial Buildings. In B. Metz, O. R. Davidson, P. R. Bosch, R. Dave & L. A. Meyers (Eds.), *Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge: Cambridge University Press, Cambridge, United Kingdom

MEGTW (2009). 'Energy Efficiency in Building Projects'. *Ministry of Energy Green Technology and Water*, http://www.kettha.gov.my/en/content/energy-efficiency, viewed: 27 May 2010.

Ministry of Finance (2006). Uniform Building By-Laws. In L. o. Malaysia (Ed.), *ACT 133*. Kuala Lumpur: MDC Publishers Sdn Bhd.

National Environment Agency (2011). 'Energy Efficiency Building Benchmarking Programme'. *Government of Singapore*, http://www.e2singapore.gov.sg/buildings/Energy%20Efficiency%20Building%20Benchmarking%20Programme.html, viewed: 4th May 2012.

OCEAN (2009). 'Code Status: International Non-Residential and Residential '. *Online Code Environment & Advocacy Network (OCEAN)*, http://energycodesocean.org/code-status, viewed: 9th May 2012.

OECD (2003). Environmentally Sustainable Buildings: Challenges and Policies, *The OECD Environment Programme*: OECD, Organization for Economic Co-operation and Development.

Pham, H.-L. (2011). 'Promoting Energy Efficiency - An Option for Development of Low Carbon Society in Vietnam'. *16th Asian Pacific Integrated Model Workshop*, http://www-iam.nies.go.jp/aim/AIM_workshop/16thAIM/presentation/6-4_Pham.pdf, viewed: 9th May 2012.

Shafii, F. (2007). Building as Energy Producers - A Case from Kuala Lumpur. Paper presented at the *UNFCC Framework Convention on Climate Change COP13 and CMP1*. Bali, Indonesia

Shafii, F. (2008). Status of Sustainable Building in South-East Asia, *Report prepared for SB08 Melbourne*. Johor, Malaysia: Institute Sultan Iskandar of Urban Habitat & Highrise, Universiti Teknologi Malaysia.

SIRIM (2004). 'Malaysian Standards Catalogue 2004: Construction Materials and Building'. *Department of Standards Malaysia (SIRIM), Ministry of Science, Technology & Innovations*, http://www.msonline.gov.my/default.php, viewed: 3rd May 2012.

SIRIM (2007). *Revised Malaysian Standard. MS 1525:2007 Code of Practice on Energy Efficient and use of Renewable Energy for Non-Residential Buildings (First Revision)* Retrieved 16 January 2011, from http://www.sirim.my/std_dev/ms_approved/MSApproved190607.htm

UNDP (2009). Malaysia: Buildings Sector Energy Efficiency Project (BSEEP). Washington DC: United Nations Development Programme (UNDP), Global Environment Facility (GEF).

UNEP-SBCI (2009). Buildings and Climate Change: Summary for Decision-Makers. In J. Yamamoto & P. Graham (Eds.). Paris: United Nations Environment Programme - Sustainable Buildings and Climate Change Initiative (UNEP-SBCI).

UNEP-SBCI (2010). Common Carbon Metric: Protocol for Measuring Energy Use and Reporting Greenhouse Gas Emissions from Building Operations, *Draft for Pilot Testing*: United Nations Environment Programme-Sustainable Buildings & Climate Initiative (UNEP-SBCI); World Resource Institute (WRI).

UNEP (2007a). Assessment of Policy Instruments for Reducing Greenhouse Gas Emissions from Buildings. In S. Koeppel & D. Urge-Vorstaz (Eds.), *Report for the UNEP-Sustainable Buildings and Construction Initiative*. Budapest: United Nations Environment Programme (UNEP), Central European University (CEU).

UNEP (2007b). Buildings and Climate Change: Status, Challenges and Opportunities: United Nations Environment Programme (UNEP)

UNEP (2009). Buildings and Climate Change: Summary for Decision-Makers. In J. Yamamoto & P. Graham (Eds.). Paris: United Nations Environment Programme - Sustainable Buildings and Climate Change Initiative (UNEP-SBCI).

UNEP & BCA (2011). Sustainable Building Policies on Energy Efficiency, *Country Report on Sustainable Building Policies on Energy Efficiency in Brunei Darussalam, Cambodia, Indonesia, Malaysia, Myanmar, Philippines, Singapore, Thailand, Vietnam.* Singapore: United Nations Environment Programme (UNEP), Building and Construction Authority Singapore (BCA).

UNESCAP (2010). Assessment Report on Energy Efficiency Institutional Arrangements in Asia, *Policy Discussion Paper*. Thailand: United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP).

VGBC (2011). LOTUS Residential Rating Tool (Pilot). Vietnam: Vietnam Green Building Council (VGBC).

WBCSD (2009). Energy Efficiency in Buildings: Transforming the Market. Switzerland: World Business Council for Sustainable Development.

Yang, L., Lam, J. C., & Tsang, C. L. (2008). 'Energy performance of building envelopes in different climate zones in China', [doi: DOI: 10.1016/j.apenergy.2007.11.002]. *Applied Energy,* 85(9), 800-817.

Zain-Ahmed, A. (2008a). 'Contemporary Issues in Energy and Buildings in Malaysia: Focus on R&D and Policies'*SENVAR + ISESEE 2008: Humanity + Technology,* Universiti Teknologi Mara, Universiti Teknologi Mara, Malaysia

Zain-Ahmed, A. (2008b). 'Integrating Sustainable Energy in Buildings: A Case Study in Malaysia'*FAU Conference*, Copenhagen, Denmark,