

Singapore

Building Code Implementation - Country Summary

Prepared for the IPEEC Building Energy Efficiency Taskgroup – Project 3: International Collaboration for Building Energy Code Implementation

Section I: Code Development

History

Starting year

The Singapore government adopted its first building energy standards in 1979 as part of the nationwide energy conservation efforts to tackle the energy crisis then. The standards addressed thermal performance of the building facade and envelope as well as building equipment such as ventilation, cooling and lighting. Singapore has periodically revised and added new requirements to these standards. In 1999, the government introduced major updates to the three codes of practice for buildings: (1) Code of Practice for Energy Efficiency Standard for Building Services and Equipment, Singapore Standard, CP24 (now known as Singapore Standard 530 or SS530); (2) Code of Practice for Mechanical Ventilation and Air-Conditioning in Buildings, CP13 (now known as Singapore Standard 553 or SS553); and (3) Code of Practice for Artificial Lighting in Buildings, CP38 (now known as SS531). These standards along with the Code on Envelope Thermal Performance for Buildings formed part of the prescriptive compliance that had been in effect since 1979 to ensure that buildings are designed with an acceptable level of energy efficiency under the Building Control Act and Regulations.

Timeline/ road map

In 2008, the Singapore government put in place the Building Control (Environmental Sustainability) Regulations. This regulation requires all new and existing buildings that undergoing major retrofitting with a gross floor area of 2000m² or more to meet the compliance standard which was modelled after the basic certified level under the Singapore's voluntary green building rating system, the BCA Green Mark Scheme. In support of this regulation, the Code for Environmental Sustainability of Buildings was published in 2008. The Code covered performance-based requirements and encompassed a number of measures to improve overall environmental performance of buildings. It was reviewed and revised to keep abreast with advancement in technology and global trends. The most recent revision requires building design to meet at least 28% energy efficiency improvement from 2005 energy standards. There is also pre-requisite requirement in the Code on the minimum prescribed system efficiency of the building cooling system as well as requirements for energy efficiency monitoring of building cooling systems in commercial and industrial buildings.

In 2009, the Singapore government mandated that all public buildings would be required to meet the Green Mark Platinum (for new buildings) and GoldPLUS (for existing buildings) standards by the year 2020. In 2010, the Singapore government mandated higher Green Mark standards under the Government Land Sales programme of key development areas. New building developments in these areas are required to meet the Green Mark Platinum or GoldPlus standards as stipulated in the land sale tender conditions. With the 2nd Green Building Masterplan released in 2009 placing more emphasis on existing buildings, Building Control (Amendment) Act 2012 listed 3 legislative requirements¹ for existing buildings to continue operating efficiently throughout their life cycle. Two other Codes for existing buildings were introduced in January 2014 to specify the minimum standards, namely the Code for Environmental Sustainability Measures for Existing Buildings and the Code on Periodic Energy Audit of Building Cooling Systems with a focus on the improvement of minimum sustainability standards and the auditing of cooling systems, respectively.

In addition to regulatory controls, the Singapore government has initiated a range of policies and measures since 2006 under the Public Sector Taking the Lead in Environmental Sustainability (PSTLES) initiatives. Under the PSTLES framework, all public sector agencies are required to submit an annual environmental scorecard to update their environmental performance for each of their buildings.² These initiatives have helped to reduce carbon emissions as well as create demands for energy efficient buildings and related services.

Existing codes

Structural coverage

	Scale (National, regional, local, etc.)	Building size threshold
<i>Residential buildings</i>		
New buildings	National (Code for Environmental Sustainability of Buildings)	None
Existing buildings for retrofits	National (Code for Environmental Sustainability of Buildings)	Major retrofits of above 2,000 m ²

¹ The requirements are 1) comply with the minimum environmental sustainability standard (Green Mark Standard) for existing buildings when a cooling system is installed or retrofitted; 2) submit 3-yearly periodic energy audits of building cooling systems; 3) submit building information and energy consumption data annually.

² New buildings with more than 5000 square metres air-conditioned spaces are required to be designed and constructed to attain the Green Mark Platinum rating; Existing buildings with more than 10,000 square metres air-conditioned spaces will have to make progress in improving the building performance by way of energy efficient retrofitting when appropriate, to attain the Green Mark GoldPlus rating by 2020. Smaller existing public sector buildings (with GFA of 5000 square metre or more) are required to attain the Green Mark Gold rating by 2020.

Commercial buildings		
New buildings	National (Code for Environmental Sustainability of Buildings)	None
Existing buildings for retrofits	National (Code for Environmental Sustainability of Buildings)	<ul style="list-style-type: none"> • Major retrofits involving the air-conditioned systems and façade, GFA of above 2,000 m² • Retrofit to Chiller only, GFA of above 15,000 m²

The most recent mandatory national building energy code is the Code for Environmental Sustainability of Buildings, which adopted a green building rating scheme. The code uses a point system in which the numerical scores achieved by a building represent its degree of compliance. Buildings are required to achieve the minimum scores for different groupings of criteria. In addition, the buildings have to meet certain (prescriptive) prerequisite requirements specified in the code. The Singapore government is responsible for design review and code enforcement with the support from third parties.

Measures covered

- Building envelope
- HVAC
- Service water heating
- Lighting
- Electric power driven systems such as lift and escalator, mechanical fans
- Renewable energy
- Maintenance practices
- Option for trade-off approach

Correction/new codes

Motivation/policies for improving existing building energy codes

The success of mandatory enforcement has given the Singapore government confidence and scope to strengthen building code requirements. Singapore has emphasized strong enforcement of the energy code since its first version, and the country has gained a reputation for strong and effective enforcement of the energy code. The Building and Construction Authority (BCA) of Singapore is administers the energy code.

The BCA has developed a green building master plan that aims to bring 80% of the buildings in Singapore up to the Green Buildings Mark standard by 2030. Strong leadership from industry and robust national

support (which includes subsidies for buildings and high standards for public buildings) are important drivers for energy efficiency in Singapore buildings.

Revision schedule

Singapore has no clear revision schedule for building energy codes, but would review and revise the energy efficiency standards to keep abreast with advancement in technology and global trends. Since the first adoption of energy standard in 1979, there had been revisions in place as a form of regulatory controls to provide the necessary impetus on the desired reduction in energy consumption and carbon emissions.

Involvement of stakeholders in the development of codes

Key stakeholders participate in drafting of the energy standards, revising and finalizing revisions as well as in other activities after the release of each revision to the code. The SPRING Singapore (an agency under the Ministry of Trade and Industry responsible for standards accreditation, and quality assurance infrastructure) or the relevant statutory board coordinates input from the industry.

Key methods used to engage stakeholders in the code development process

Stakeholders are engaged through training and capacity building activities. Industry associations, like the Institution of Engineers Singapore (IES), Professional Engineers Board, Singapore, Sustainable Energy Association of Singapore (SEAS), Singapore Green Building Council (SGBC), and academic institutions, like Singapore Environment Institute, the Building and Construction Authority (BCA) Academy and technical universities, run courses and briefings to help industry practitioners keep abreast with the new code developments and amendments.

Section II: Code Implementation

Administration

Administrative/enforcement structures

Government agency

The roles of stakeholders (what do they do at each stage)

	Design	Construction	Pre-occupancy check
The role of federal/central government	Review and approve building plans. Compliance with	N/A	Site Audits conducted to ensure compliance with the

	energy standards and the Code for Environmental Sustainability of Buildings are required before plan approval.		code requirement before the issuance of temporary occupation permit or certificate of statutory completion.
The role of state/provincial and local government	N/A	N/A	N/A
Involvement of third parties and their role	<p>For new building construction and existing building undergoing major retrofitting, the professional architect and engineers would have to be appointed by the developers to do the plan submission and to ensure that the building design meet the code requirement</p> <p>For installation or replacement of water building cooling system in existing commercial buildings, the building owners have to engage a licensed mechanical engineer to ensure that the overall building design meets the requirements specified in the code, including if there are chiller upgrades and other energy improvements.</p>		

Requirements for commissioning before occupancy

Yes.

Requirements for energy audits after occupancy

Owners of new buildings must conduct their first energy audit within the first year of operation and then regular energy audits every three years. Owners need to engage a Professional Engineer (Mechanical) or an Energy Auditor registered with BCA to carry out an energy audit on their chiller system in accordance with the 'Code for Periodic Energy Audit for Building Cooling System' and make the necessary documentary submission to BCA.

Requirements for Installing and Replacement of water-cooled or air-cooled Chiller(s) in existing commercial buildings (i.e. office, hotel, retails and mixed development with GFA of more than 15000 square metres)

The building owners will have to engage a Mechanical Engineer (a Professional Engineer registered with the Professional Engineers Board in the branch of mechanical engineering) to ensure that the overall building design achieves the BCA Green Mark Standards for existing buildings at the Certified level, taking into account the chiller upgrade and other energy improvement works. The chiller upgrading and other energy improvement works must be completed within three years from the date BCA approves the designs of the retrofits.

Tools used for compliance checking

Software used for compliance checking

Software-based tools, such as the Green Mark e-filing portal, Green Mark calculator, are made available to facilitate regulatory submission and compliance to the regulatory codes.

Capacity building and education

Education and capacity building programs that support code implementation

Singapore has a number of programs to build the capacity of stakeholders (government professionals, inspectors, designers, construction engineers) on building energy efficiency:

- Green Mark Specialist certification programmes. The BCA offers certification courses for Green Mark Managers, Green Mark Facilities Managers and Green Mark Professionals and Green Mark Facilities Professionals.
- A grant for training and certification to become Singapore Certified Energy Manager (SCEM). The grant covers 80% of the tuition and targets engineers that manage manufacturing facilities and buildings and provide energy services or engineering consulting services.
- An accreditation scheme for energy services companies (ESCOs). The scheme was introduced to enhance the professionalism and quality of energy services offered. Currently there are 19 accredited ESCOs operating in Singapore and 27 accredited energy services specialists.

- The government and the BCA Academy has partnered with a number of universities worldwide to offer professional degrees on sustainable design and operations. This incentive is known as the “Executive Development and Degree Programmes on Sustainable Design and Operations”:
 - Partnership with the University of Nottingham to roll out a Master of Science in Sustainable Building Design programme in 2009. The two-year part-time is the first of its kind in Singapore, focusing on developing cross-disciplinary professional skills as well as analysis and decision-making skills.
 - Partnership with the University College London (UCL) to launch the Master of Science degree in Facility and Environment Management earlier this year. This two-year part-time MSc programme will equip the building professionals with the skills, knowledge and tools to operate, maintain, manage and improve the performance of green buildings over their economic lifespan.
 - Partnership with the Singapore Institute of Management University and Singapore Polytechnic to jointly offer the Bachelor of Science in Facility and Events Management Programme. This is a four-year part-time honours degree programme launched in 2010 targeted to train working adults in the facilities and events management field who wish to upgrade from a diploma to a degree.
- The BCA Academy also offers a number of special courses on energy efficiency in buildings for participants of the Executive Development and Degree Programmes on Sustainable Design and Operations:
 - A six-day course at Carnegie Mellon University, launched in 2009, aims to accelerate professional development of executives in green stewardship roles, which will steer Singapore’s built environment towards the next level of environmental sustainability. About 540 executives have attended the course.
 - Training at the Stuttgart University of Applied Sciences in Germany, launched in 2010, to provide a strategic platform for leading building professionals in the area of green building design and technology.

Annually, BCA organizes the Singapore Green Building Week (SGBW) which serves as a platform for international organizations, government and industry leaders, professionals, solutions providers, academia and students; and community at large to explore opportunities and address challenges on environmental sustainability for the built environment. It also facilitates exchange through networks and partnerships. The anchor event during SGBW is the International Green Building Conference (IGBC). Apart from the conference tracks that share on global policies, and design and technology trends, specialist workshops are also conducted to deepen the building professionals’ knowledge in areas such as indoor environment quality, energy efficient lighting and high performance air-conditioning. Additionally, updates for Green Mark criteria are also shared during the conference, to keep the industry abreast with the latest environmental sustainability standards.

Section III: Compliance & Enforcement

Penalties, incentives and other mechanisms for improving compliance

Penalties for non-compliance with energy provisions in codes

- Fine
- Rejection of construction permit
- Refusal of permission to occupy

Incentives/rewards to go beyond minimum required performance level

The following incentives exist in Singapore:

- Subsidies for building upgrades:
 - Energy Efficiency Improvement Assistance Scheme (EASe) (up to S\$200,000, or about US \$150,000 per facility or building)
 - Grant for Energy Efficient Technologies
 - Design for Efficiency (DfE) Scheme
 - Innovation for Environmental Sustainability (IES) Fund.
- The Building Retrofit Energy Efficiency Financing (BREEF) scheme. The scheme provides financing for commercial building owners, building management corporations and energy service companies to carry out energy efficiency retrofits under an energy performance contract. This will help building owners with the high upfront capital required for energy efficiency retrofits.
- Green Mark incentive schemes including Green Mark Incentive Scheme for New Buildings (GMIS-NB), Green Mark Gross Floor Area Incentive Scheme (GM-GFA), Green Mark Incentive Scheme - Design Prototype (GMIS-DP), Green Mark Incentive Scheme for Existing Buildings (GMIS-EB) and Green Mark Incentive Scheme for Existing Buildings & Premises (GMIS-EBP). The schemes will help nudge private developers and building owners to achieve higher Green Mark rating and energy efficiency standards.

Other mechanisms to encourage compliance

- Commissioning requirements for public defense buildings (shelters)
- Mandatory computer modeling when submitting architectural and structural design plans
- Training of inspectors
- Requirements under the PSTLES framework for public buildings to achieve higher Green Mark rating

Compliance assessment

Airtightness testing required prior to compliance

Yes.

Section IV: Building Materials & Energy Performance Certificates

Building materials (e.g., windows, insulation, HVAC, lighting)

Rating of building materials

In Singapore, there are two local product certification bodies namely the Singapore Green Building Council (SGBC) and the Singapore Environmental Council (SEC). These non-government agencies provide third party assessment on the extent of environmentally friendliness of the products and materials. The Singapore Green Building Product (SGBP) Certification scheme³ administered by SGBC in partnership with a Germany-based company TÜV SÜD PSB Pte Ltd takes into consideration the product life cycle and impact on the environment. The product assessment covers various environmental aspects which include energy efficiency, water efficiency, resource efficiency, health consideration and environmental protection. The Ministry of Environment launched the Singapore Green Labelling Scheme (SGLS)⁴ in 1992, which is now administered by SEC. SGLS labels bricks, tiles, insulation, windows and many types of other materials.

Energy Performance Certificates

Building codes and energy performance certificates

Singapore has adopted a green building certification scheme, BCA Green Mark. It is a green building rating system to evaluate a building for its environmental impact and performance. It provides a comprehensive framework for assessing the overall environmental performance of new and existing buildings to promote sustainable design, construction and operations practices in buildings. The scheme works in tandem with our various green building initiatives to ensure that buildings continue to operate efficiently throughout their life cycle.

³ <http://www.sgbc.sg/green-certifications/product-certification/>.

⁴ http://sgls.sec.org.sg/cms.php?cms_id=3.

Enforcement of codes and energy performance certificates

The Code for Environmental Sustainability of Buildings was introduced at 2008 and 2013 for new and existing buildings respectively, the standard of which was modelled after the basic certified level under the BCA Green Mark Scheme.

Existence of national database for energy performance certificates

There is a national database for the building information and energy consumption data collected through the Green Mark scheme, and the legislative requirement of Annual Mandatory Submission under the Building Control (Amendment) Act 2012. However, this database is not used for any form of energy performance certification due to the absence of an energy disclosure law.

Useful Links:

http://aperc.ieej.or.jp/file/2014/6/10/Singapore_s_Compndium_14-May-2014.pdf

http://www.climateworks.org/imo/media/doc/07_0710F_10_countries_code_review.pdf

<http://www.gbpn.org/databases-tools/bc-detail-pages/singapore#Supporting%20Measures>