Industry Perspective

Construction & Infrastructure | December 2020

Improving buildings' energy efficiency to reduce CO_2 emissions

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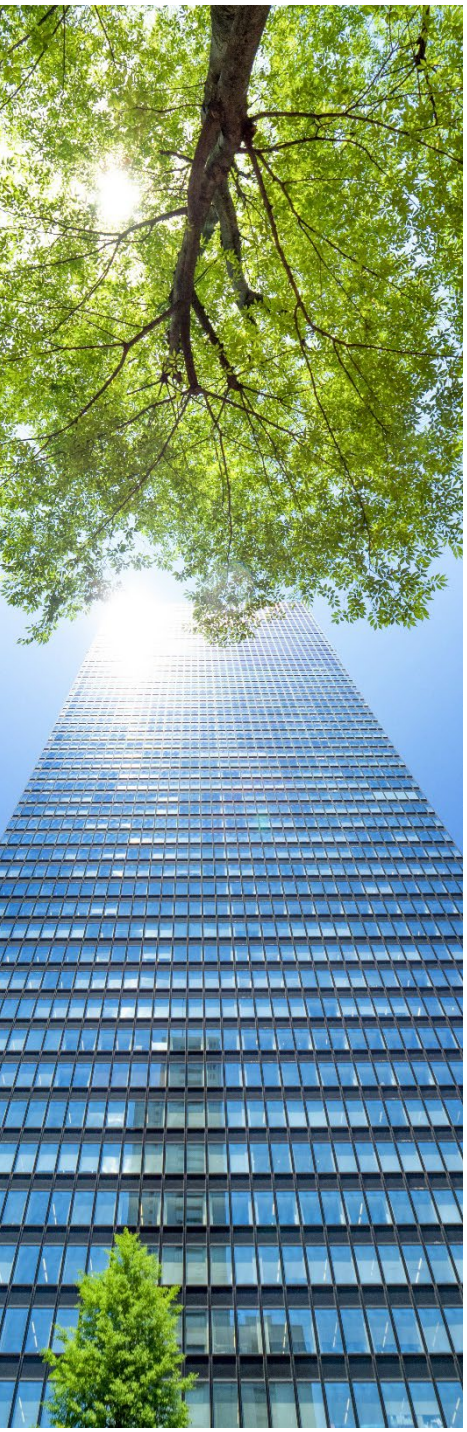
Content

December 2020



Executive Summary

December 2020

Buildings are a key contributor to CO_2 emissions. Research indicates that buildings and construction projects are a key contributor to global CO_2 emissions, accounting for 39 per cent of total emissions. In view of this, and to address issues of sustainability and meet government targets to reduce pollution, there needs to be a refocus on buildings' energy efficiency.

Energy efficiency is a first step to being a green building. Green building certification will be granted by a recognised body (such as Building and Construction Authority), taking into account areas like energy efficiency, water efficiency, green practices and innovation (including recycling and the use of sensors to manage energy use). Companies could also consider the use of solar energy to power buildings to enjoy costs savings and a lower carbon footprint.

Benefits of going green. Other than being more environmentally friendly and meeting Environmental, Social and Corporate Governance (ESG) aspirations, green buildings also enjoy lower operating costs, higher capital value and provide a better environment for people working or living within them. Studies indicate potential cost savings of up to 37 per cent for office properties and 17 per cent for retail properties. Correspondingly, there could also be a rise in capital value of the green building by over 2 per cent based on higher net income.

Government incentives. In view of the push towards sustainability, regional governments have offered incentives for building owners to go green. These range from co-funding incentives, green investment tax allowances to import duty exemptions for companies in renewable energy and energy efficiency business.

For more information on the insights and banking solutions, please email: SG.C&I@UOBgroup.com

Companies that wishes to embark on a journey to transition their buildings to a green building status or to improve the energy efficiency of their buildings can email us at SG.C&I@UOBgroup.com for more information.

Buildings are a key contributor to CO_2 Emissions

Buildings and construction projects account for 39% of CO_2 emissions worldwide

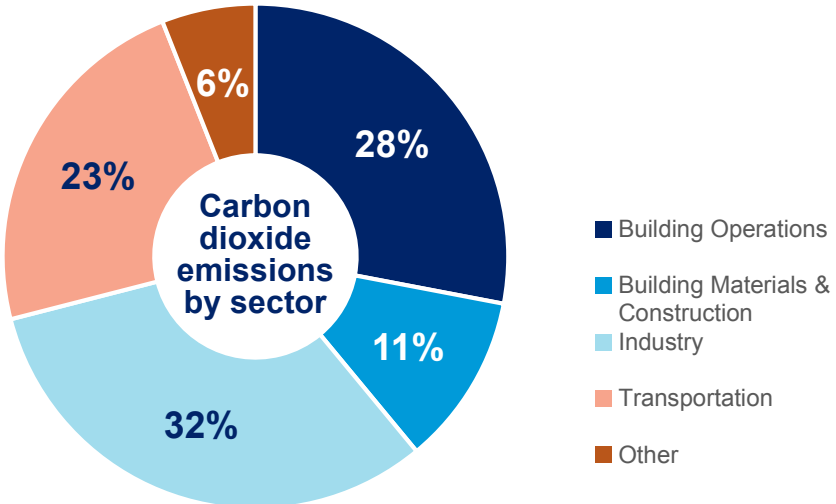
Energy efficiency for buildings is increasingly becoming more important to reduce carbon footprint as buildings and construction projects account for 39 per cent of global CO_2 emissions. Other than ESG considerations, building owners may also enjoy financial benefits in terms of energy cost savings and potential uplift in capital values by improving the energy efficiency of their buildings. The regulatory outlook is favourable with incentives in selected ASEAN countries.

Energy efficient buildings to reduce CO_2 footprint

Buildings and construction projects are a large CO_2 contributor

Buildings and construction are estimated to be responsible for 39 per cent of energy-related carbon dioxide (CO_2) emissions worldwide. This is because all buildings release CO_2 when they use equipment that relies on combustion energy sources such as boilers, furnaces and onsite power generation. The Global Alliance for Buildings and Construction highlights that global building sector CO_2 emissions have been rising, up three per cent since 2010.

Figure 1: Carbon dioxide emissions by sector



Source: Global Alliance for Buildings and Construction, UOB Analysis

LED lights offer energy savings of about 80% as compared to traditional commercial technologies.

Hence, the reduction in CO_2 from buildings is seen as a possible solution to the climate crisis. Rather than being a major contributor to greenhouse gas emissions by relying on fossil fuels, buildings could not only cut their energy demand but could also generate clean, renewable energy that could be sold back to the national grid.

With energy consumption expected to rise with the growing population rate and economic sector, the need for energy-efficient buildings is essential and the focus of building initiatives in many countries.

Energy efficiency in buildings to help the environment

Areas in a building that could be more energy efficient include:

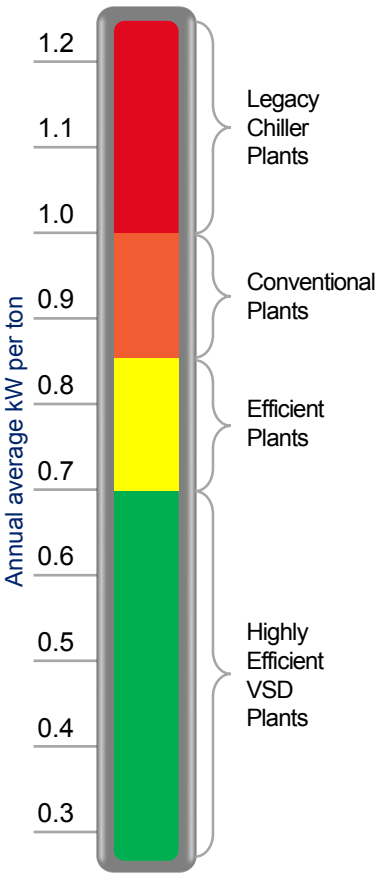
1) **Lighting**

   Lighting accounts for 18 per cent of energy used in commercial buildings. New lighting technologies such as light-emitting diode (LEDs) are many times more efficient than traditional technologies such as incandescent bulbs, and switching to newer technologies can result in substantial net energy use reduction, and associated reductions in greenhouse gas emissions. The output of LEDs is energy savings of about 80 per cent as compared to traditional commercial technologies such as halogen lamps.

   At the same time LED prices have been tumbling, declining 20 per cent for three consecutive years. Lighting products that were quite expensive are now much more affordable.

   Furthermore, since an LED light bulb can last from 20,000 to 50,000 hours i.e. 5-8 times longer than any other bulb, its cost of operation is lower than other bulb types. The global energy-efficient lighting market is projected to expand at a CAGR of 3.5 per cent during the forecast period and reach value of US$29.7 billion by 2026.

Figure 2: Rating systems for efficiency in kW/RT for chilled water plants.



Source: UOB Analysis

Source: Shutterstock

2) Air-Conditioning System

The Air Conditioning and Mechanical Ventilation (ACMV) system can account for more than 50 per cent of total building energy consumption. Incorporating energy efficient measures into a building's heating and cooling systems are essential to creating an energy-efficient structure.

An example of savings from improving the efficiency of air-conditioning systems is Shangri-La Hotel in Singapore. It had operated an air-conditioning system of 3,252 refrigeration tonnes (RT) capacity at an average efficiency of 1.22 kW/RT. After the retrofit, the installed capacity reduced to 2,600 RT with an average system efficiency of 0.68 kW/RT. The project has resulted in savings of 14,400 kWh of electricity per day. Without energy efficiency improvements to cooling equipment, electricity demand for cooling in buildings could increase by as much as 60 per cent globally by 2030.

Another example is the Singapore Post Centre that undertook a retrofit of its chiller plant. This helped to improve the efficiency from 1.1kW/RT to 0.6kW/RT. The resultant annual energy savings amounted to 5,000MWh and a 45 per cent reduction in annual energy cost usage to S$1.44 million (mn). The payback period was an attractive 1.7 years.

The global cool roof market size is expected to reach US$27.1bn by 2025

3) **Refrigerators**

Refrigerators are used in offices and households across the world to store food at a temperature of about 3 to 5°C in order to prevent it from spoiling. Although refrigerators have become considerably more energy efficient over the past two decades, they still account for a large share of electricity use in a building. For instance, energy star refrigerators use 15 per cent less energy than non-qualified models. Also, refrigerators with top-mounted freezers use 10-25 per cent less energy than side-by-side or bottom-mount units. Most energy efficient refrigerators are more expensive than less energy efficient models but the price differences are often not large. Due to lower energy costs, operational costs over the life-time of an energy-efficient refrigerator are lower than that of a less efficient model.

4) **Cool Roof**

An energy efficient roof (cool roof) is designed to reflect sunlight and absorb less heat than a standard roof. Cool roofs can be made using highly reflective paint, a sheet covering, or highly reflective tiles or shingles. Cool roofs reduce energy bills, improve indoor comfort, and may extend the service life of the roof. The warmer the climate, the greater the number of cooling days and the higher cost savings. A cool roof can benefit a building by reducing energy bills by decreasing air conditioning needs and improving indoor comfort for spaces that are not air conditioned. For commercial buildings, the estimated net annual savings of a cool roof vary between US$0.10 and $0.20 per square foot of roof area, depending on domestic electricity tariffs and other localised factors. The global cool roof market size is expected to reach US$27.1 billion by 2025, accelerating at a CAGR of 5.7 per cent.

5) **Glazing System**

Energy efficient glazing is a term used to describe glazing consisting of two or more glass panes within a sealed unit. Unlike the original single glazing or old double glazing, energy-efficient glazing incorporates low-emissivity coated glass to prevent heat escaping through the windows. It helps keep the office warmer in winter and cooler in summer, thereby increasing the overall energy efficiency of the entire building. Other benefits include reduced carbon footprint and noise reduction. The air or gas gap between the panes of glass in a sealed unit provides an extra layer of insulation. Installing energy efficient windows can save money over the long term by reducing the amount of energy required to heat/cool the offices. It is possible to lower the energy demand of a total glazed building up to 15 per cent compared to a normal building.

6) **Solar Photovoltaics (PV) System**

Another area to consider improving a building's energy efficiency is the use of solar PV systems for buildings. There are two kinds of solar PV for buildings.

Building-integrated photovoltaics (BIPV)

BIPV is one of the most promising and visually attractive ways of producing on-site electricity directly from the sun. In BIPV, the PV modules are integrated within the building structures mainly into roof or façade. The BIPV is installed considering the local weather conditions and the building architecture.

Thus, the BIPV system will have some impact on the building structure and its functionality. The PV modules serve a dual purpose: they replace conventional building envelope materials and generate power. BIPV systems can provide savings in materials and electricity costs, reduce use of fossil fuels and emission of ozone depleting gases, and add architectural interest to the building.

The initial cost of BIPV is offset by reducing the amount spent on conventional building materials and labour that would normally be used to construct that part of the building. Once the building is in operation, there are additional savings as the sunlight generates electricity energy. These advantages make BIPV one of the fastest growing segments of the solar PV industry.

Figure 3: Use of BIPV for a commercial building

Source: Shutterstock

Building-applied photovoltaic (BAPV)

BAPV is a photovoltaic technology retrofitted on different building structures primarily during the construction stage. It is fairly less detrimental to the environment and enables energy generation at a lower cost than conventional power generating sources. In BAPV, the PV modules are directly attached to the buildings using additional mounting structure and moving rails.

The PV modules do not have any direct effect on the building structures and the way they function. The PV modules are installed at certain tilt angles either on roof or façade based on local weather conditions. BAPV can also be installed on either a horizontal roof or a vertical wall. BAPV is gaining popularity, as they help in reducing the uncontrollable use of fossil fuels and, offers weather protection, without affecting building aesthetics where they are installed.

Figure 4: Use of BAPV for a commercial building

Source: Shutterstock

While the upfront costs of making a building energy efficient may seem high, building owners could recoup the extra cost through reduced utility and maintenance expenses. Also, incorporating energy efficient features into a building could improve the capital value of buildings and attract tenants due to the potential savings on utility bills.

Energy efficiency is a step towards being a green building

Improving the energy efficiency of a building is also a gradual move towards becoming a green building. The classification of a green building will require certification from a recognised body and will have characteristics and features such as:

1) Energy efficiency (powered by renewable energy such as solar power, energy efficient air-condition and lighting system, etc),
2) Water efficiency (system to harvest rainwater for irrigation, recycled condensate water for cooling tower system); and
3) Green innovations. These could include sustainable operations and maintenance, advocating a healthy indoor environment (good lighting, air quality, etc) and other green features (integrated paper recycling).

Figure 5: BCA Green Mark (Ratings and Criteria)

Groups	Components	Total Max Points	Intent
Energy Efficiency	**Part 1** – Building Energy Performance	30	Usage of energy efficient system (for e.g. Air Conditioning, Usage of Renewable Energy and other energy efficient features)
Other Green Requirements	**Part 2** – Climatic Responsive Design	30	Advocates strong leadership, Urban Harmony and Topicality (Façade, Spatial Organization, Ventilation)
	Part 3 – Resource Stewardship	30	Usage of water efficient fittings and features (reduction of water for building operations), construction materials and proper waste management systems.
	Part 4 – Smart and Healthy Building	30	Advocates healthy indoor environment (for e.g. Good air quality, thermal comfort, minimal noise level, good lighting) and monitoring capabilities.
	Part 5 – Advanced Green Efforts	20	Exceptional green performance beyond the above.

Green Mark Rating	Green Mark Score
GM Platinum	70 and above
GM Gold (Plus)	60 to <70
GM Gold	>50 to <60

Source: BCA Green Mark Non-Residential Buildings NRB : 2015 Revision Log*, UOB Analysis*

Green buildings for sustainability

Regulations and industry trends favour green buildings.

80%

of buildings in Singapore are targeted for BCA Green Mark certification by 2030

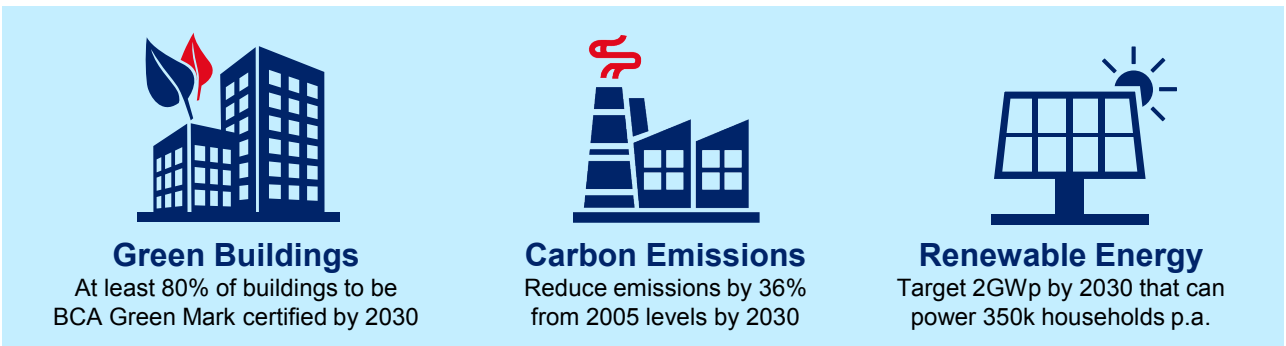
Regulations and industry-led initiatives have been put in place over the past few years to drive the development or the repurposing of existing buildings into green standard buildings ("green buildings"). Recent research from the Global Commission on the Economy and Climate finds that bold climate action could deliver at least $26 trillion in economic benefits through 2030.

Renewable energy has the potential to reduce the impact of fossil fuel on the environment while providing a range of economic opportunities for businesses and communities to thrive. The strong push for sustainability has not only become a part of many businesses' corporate social responsibility but is also an aspect of remaining relevant in the future business environment as various stakeholders and other relevant partners in the company's eco-system push for higher sustainability.

Singapore, together with 30 other countries, has committed to the Paris Climate Agreement which was ratified on 21 September 2016. Since the Paris Agreement came into force on 4 November 2016, Singapore has implemented a range of mitigation measures across various sectors, including industrials and real estate.

In terms of targets for green buildings, Singapore plans to have at least 80 per cent of buildings to be Building and Construction Authority (BCA) Green Mark certified by 2030. Complementing this effort is also the target to reduce carbon emissions by 36 per cent from 2005 levels by 2030 and have a renewable energy capacity of 2 gigawatt-peak by 2030.

Figure 6: Snapshot of Singapore's green building and related targets



Source: Straits Times, Business Times, UOB Annual Report 2018

Green buildings offer lower energy usage, positive social impact, cost savings and potentially higher capital value

Benefits of a green building

The benefits of a green building range from positive environmental impact to direct uplift in financials. These include:

Lower energy usage

Based on research by Singapore's BCA covering a nine year period, BCA observed that the overall energy use intensity (EUI) for green buildings has been steadily improving. The average EUI has improved by 11 per cent since 2008. This could be attributed to energy efficiency improvements as: circa 27 per cent of commercial buildings are BCA Green Mark buildings in Singapore and an additional 9 per cent are non-BCA Green Mark buildings have undergone upgrading and retro-fitting of their air-conditioning (chillers; split-units) and lighting systems. Some of the upgrades have also included the use of solar energy equipment.

Positive social impact

Green buildings can also deliver positive social impacts too. People spend about 90 per cent of their time indoors, and buildings have a unique ability to positively or negatively influence their health. A 2016 study by the Harvard School of Public Health and the State University of New York Upstate Medical University (backed by United Technologies) found that workers in green, well-ventilated offices recorded an increase in cognitive scores (brain function). Research suggests that better indoor air quality (low concentrations of CO_2 and pollutants, and high ventilation rates) can lead to improvements in performance of up to 8 per cent.

Cost savings

Buildings can significantly reduce their operating expenses by undergoing energy efficiency retrofits. For retail properties, the savings can range from about 9 per cent to 17 per cent of the total annual operating expenses, based on 15 per cent of the gross rental income. A 13.5 per cent saving in operating expenses translates to about 2.7 per cent higher net income. As for office properties, the savings ranged from 7 per cent to 37 per cent.

Prospects for green building and energy efficiency look promising given government incentives, cost savings and potential capital value upside

After a building upgrade where outgoings were lowered (assuming rental growth remains constant), based on the capitalisation rate of 6.75 per cent, the real estate valuation would increase by 1.7 per cent to S$180mn.

When measuring the return on retrofit based on the ratio of the change in valuation to the total retrofit cost, the ratio ranges from two to seven times for office buildings and one to nine times for retail properties. This demonstrates that the increase in the value of green properties far exceeds their total retrofit cost.

The green building landscape in Singapore continues to evolve and grow, underpinned by a supportive regulatory framework and government incentives. The incentives include a S$50mn Green Mark incentive scheme for existing buildings and premises (GMIS-EBP). The government will co-fund up to 50 per cent of the retrofitting cost for energy improvements, or up to S$3mn for building owners (up to S$20,000 for tenants) who are existing small and medium enterprises.

Another government incentive is the building retrofit energy efficiency financing (BREEF) scheme. This will help building owners to fund the upfront costs of energy efficiency retrofits and in adopting Green Mark standards for existing buildings. Furthermore, the authorities will also offer an increased risk share of 60 per cent for any loan default with participating financial institutions.

In summary, prospects for green building and energy efficiency in Singapore looks promising and we expect the growth of the green building trend to be mirrored in the other geographies in Asia.

Conclusion

Sustainability trends are here to stay. Building owners should consider going green to reduce carbon footprint and to save costs.

The trend towards sustainability and the green movement will pick up momentum. Given that globally, buildings and construction projects account for close to 40 per cent of global CO_2 emissions, we believe that the focus on energy efficiency of buildings will intensify. Other than reducing CO_2 emissions, an energy efficient building will also yield cost savings and is a move towards being classified a green building.

Looking ahead, we expect the development of green buildings will accelerate. In addition, building owners may consider retrofitting existing buildings or assets to reap the benefits that include lower CO_2 emissions and financial uplift in terms of lower operating expenses and potential higher capital values. Other than energy efficiency initiatives, building owners can also consider the switch to solar energy that is economically viable due to the accelerated decline in the cost of solar energy systems and savings from lower energy costs.

Figure 7: Benefits of green buildings

Environmental Benefits	Economic Benefits	Social Benefits
Green buildings are built to leverage on the best use of natural resources and to be environmentally friendly and sustainable.	The operating cost of a green buildings is generally lower compared to a normal building due to lower consumption of energy and water. This could increase the value of the building.	Research indicates green buildings enhance health and wellbeing of those living and working in them.

Source: UOB Analysis

ASEAN governments' green incentives

To encourage developers to adopt green practices or to gravitate toward developing/upgrading to green buildings, selected ASEAN governments offer a range of incentives. This is usually based on achievable outcomes or the uptake of green financing products.

UOB Key Markets	
Singapore	• **S$50mn Green Mark incentive scheme for existing buildings and premises (GMIS-EBP).** Co-funds up to 50 per cent of the retrofitting cost for energy improvements, or up to S$3mn for building owners (up to S$20,000 for tenants) who are existing small and medium enterprises. • **Building retrofit energy efficiency financing (BREEF) scheme**. Aids building owners in overcoming upfront costs of energy efficiency retrofits and in adopting Green Mark standards for existing buildings. Increased risk share of 60 per cent for any loan default with participating financial institutions.
Hong Kong	• **Electrical and Mechanical Services Department's Energy Efficiency Registration Scheme.** New or existing buildings/premises that achieve a "Final Bronze" rating under BEAM Plus are eligible for accelerated deduction under profits tax on capital expenditure incurred in the installation/construction of energy efficient building installations registered under HKEERSB. • **CLP Eco Building Fund.** Provides subsidies to carry out energy efficiency enhancement works on buildings and nearby ancillary facilities.
Mainland China	• **Wuxi City High-Tech Industrial Development Zone.** Buildings that achieve the highest green building ratings (in either LEED or China's three-star rating system) receive up to RMB500,000 – similar incentives are provided for the use of heat pumps, solar photovoltaic systems, and other clean energy technologies. • **Changning District.** Subsidies given to building managers have encouraged an additional RMB140mn of efficiency improvement to buildings.
Indonesia	• The Indonesian government raked in US$1.25bn from issuing a **"Green" Islamic compliant bond.** The funds raised will go to finance government projects that are both environmentally friendly and compliant with Islamic financing laws. • **Indonesia Sustainable Finance Initiative** aims to strengthen organisational capacity, particularly environmental, social and governance risk management.
Malaysia	• **Green Technology Financing Scheme (GTFS)** will provide the 60 per cent government guarantee on the green component cost by Participating Financial Institutions (PFIs) as well as 2 per cent per annum rebate on interest and profit for seven years. • **Green Investment Tax Allowance** provides investment tax allowance for the purchase of green technology equipment and income tax exemption on the use of green technology services, which has been extended to 2023.
Thailand	• **The Thai Board of Investment (BoI)** also exempts energy efficiency and renewable energy businesses from import duties for eight years. • **Thai tax code** offers incentives for the nascent green building sector. The government has approved 350 energy efficiency projects for its five-year, 25 per cent corporate tax credit, which backs investments up to US$1.25mn.

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