THAILAND TAXONOMY

Construction & Real Estate Sector

May 2025

THAILAND TAXONOMY BOARD

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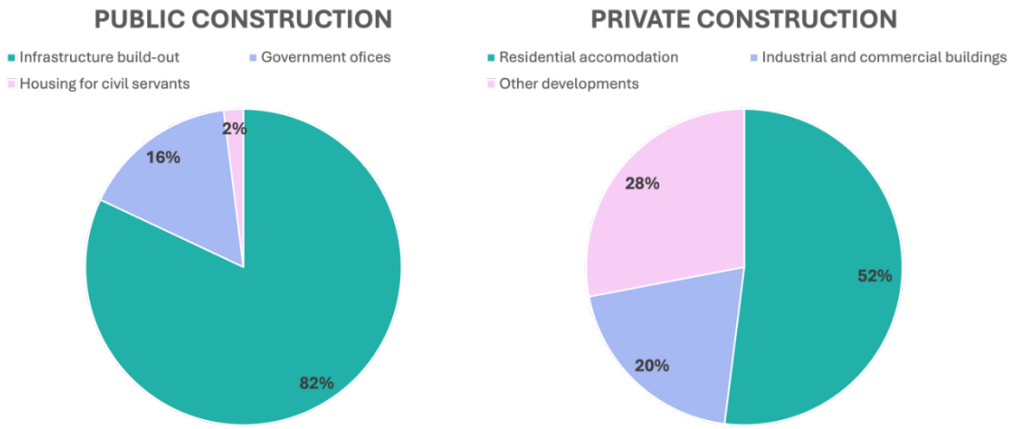
Local Consultant TDRI Thailand Development Research Institute

Construction and real estate sector background

Construction and real estate are a major sector of the Thai economy. Between 2012 to 2021, Between 2012 to 2021, the construction investment value averaged a 2.64% share of GDP[1]. In 2021, the construction industry employed 2.1 million workers or roughly 5.4% of the total labour force.[2] The sector can be split into two major segments: public and private buildings. In 2021, construction spending was split into 59% public construction and 41% private construction. The largest share (82%) of public sector construction is accounted for by the build-out of infrastructure, while the other 16% is accounted for by the building of offices for government agencies, and the remaining 2% by housing for civil servants.[3] Residential accommodation contributes to 52% of private construction investment, while the remainder is split between other developments (28%), a category that includes facilities such as hotels and hospitals, and industrial and commercial buildings (20%).[4]

Figure 1 Compositions of public and private construction investment in Thailand



Source: Data from NESDC[5]

[1] Office of the National Economic and Social Development Council (NESDC), "Database on National Accounts of Thailand 2022," https://www.nesdc.go.th/nesdb_en/main.php?filename=national_account

[2] National Statistical Office, "The Labor Force Survey Whole Kingdom Quarter 4: October-December 2021," Ministry of Digital Economy and Society of Thailand, https://webapps.ilo.org/surveyLib/index.php/catalog/8045/related-materials

[3] Lumkam, Puttachard , "Industry Outlook 2022-2024: Construction Contractor," krungsri Research, n.d., https://www.krungsri.com/en/research/industry/industry-outlook/construction-construction-materials/construction-contractors/io/construction-contractor-2022.

[4] Ibid.

[5] Data from the Office of the National Economic and Social Development Council (NESDC) summarised in Lumkam, Puttachard , "Industry Outlook 2022-2024: Construction Contractor," krungsri Research, n.d.,

While overall construction activities slightly decreased in recent years, there are trends that suggest the likely expansion of construction of new buildings in Thailand. The state enterprise construction had expanded with an annual average growth rate of 1.3% from 2021-2023, while further annual growth in public construction spending of 3.5-4% is expected from 2024-2026. Similarly, private construction had also increased in both dwelling and non-dwelling categories with an annual average growth rate of 2.0% from 2021-2023, and further annual growth of 3-3.5% expected from 2024-2026[6]. Moreover, industrial plant construction accelerated in line with an increase in permitted construction areas in industrial zones.[7] In addition, Thailand is undergoing accelerating urbanisation, which is associated with urban population growth and the expansion of cities. According to the UN Department of Economic and Social Affairs Population Dynamics estimates, the level of urbanisation in Thailand will grow from 52% today to 58% in 2030 and 69% in 2050[8], suggesting a likely expansion in the construction of new buildings.

1. Major climate and environment-related issues

The construction and real estate sector have a key role to play in climate change mitigation due to its emission profile. According to the World Green Buildings Council data, the largest emissions in this sector are associated with the production of building materials (cement, plastic, and steel, which will be discussed in detail in the Manufacturing section) and the consumption of major resources during buildings' lifetime, especially water and electricity.

In Thailand, for Q1 2024, residential and commercial building sectors combined account for 21% of the final energy consumption of Thailand, including 12% in the residential building sector and 9% in the commercial building sector[9]. The construction activities themselves

https://www.krungsri.com/en/research/industry/industry-outlook/construction-construction-materials/construction-contractors/io/construction-contractor-2022.

[6] Lumkam, Puttachard , "Industry Outlook 2022-2024: Construction Contractor," krungsri Research, n.d., https://www.krungsri.com/en/research/industry/industry-outlook/construction-construction-materials/construction-contractors/io/construction-contractor-2022.

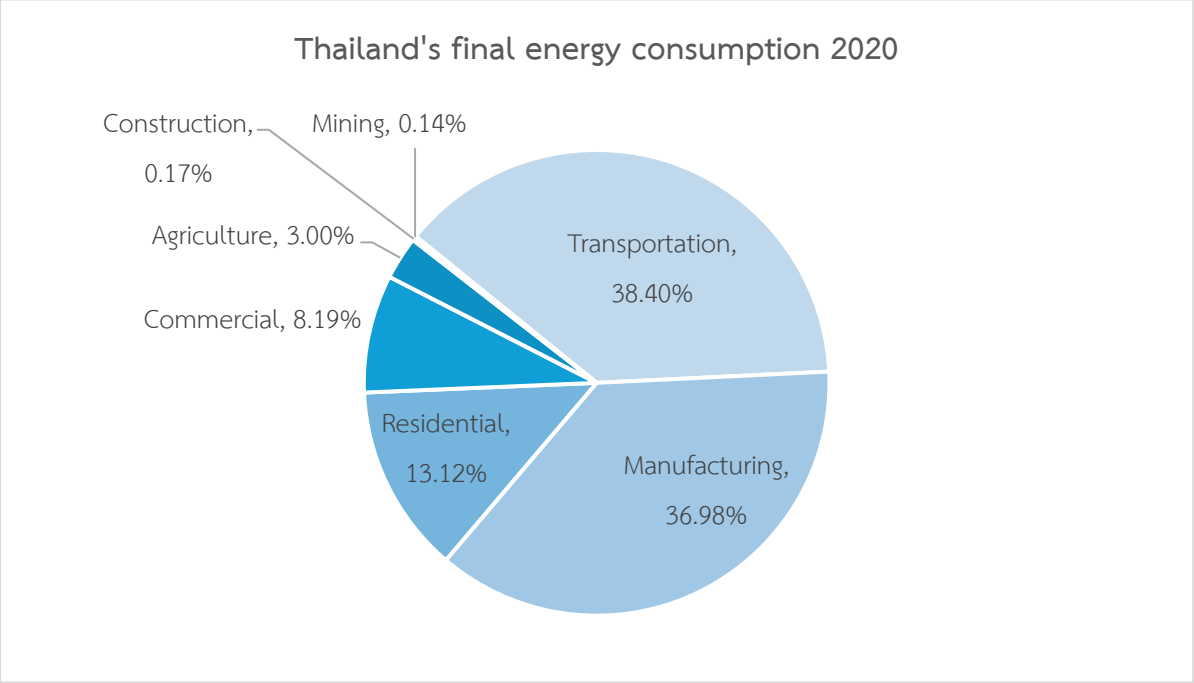
[7] Office of the National Economic and Social Development Council, "Gross Domestic Product:Q4/2023," 2024, https://www.nesdc.go.th/nesdb_en/article_attach/บทวิเคราะห์ภาษาอังกฤษ%20Q4-2566.pdf

[8] United Nations-Department of Economic and Social Affairs Population Dynamics, "World Urbanization Prospects - Population Division - United Nations," n.d., https://population.un.org/wup/Country-Profiles/.

[9] United Nations Framework Convention on Climate Change, "Thailand LT-LEDS (Revised Version)," November, 2022, https://unfccc.int/sites/default/files/resource/Thailand%20LT-LEDS%20%28Revised%20Version%29_08Nov2022.pdf.

(erection, demolition, and refurbishment of buildings) account for another 0.17% of the final energy consumption.[10]

Figure 2 Shares of different sectors in Thailand's final energy consumption, 2020



Source: DEDE (2024)[11]

With rapid urbanisation and development, there is a substantial demand for infrastructure and housing, leading to increased energy consumption and GHG emissions. Additionally, Thailand experiences seasonal variations of high temperatures, humidity, and monsoon rains and has a diverse topography, whereby buildings in mountainous regions may experience colder temperatures. Therefore, there is a need for more energy-efficient building designs that can maintain comfortable indoor conditions without heavily relying on energy-intensive cooling systems. The construction and real estate sector will reach USD 26.68 billion in size in 2024 and is expected to grow as much as 5% a year between 2024 and 2029.[12] This means that substantial opportunities exist for new investment in the sector to be channelled into low-carbon construction. This taxonomy can help guide more users to choose low-carbon building

[10] Ibid.

[11] United Nations Framework Convention on Climate Change, "Thailand LT-LEDS (Revised Version)," November, 2022, https://unfccc.int/sites/default/files/resource/Thailand%20LT-LEDS%20%28Revised%20Version%29_08Nov2022.pdf.

[12] Mordor Intelligence, "Thailand Construction Market Insights," n.d., https://www.mordorintelligence.com/industry-reports/thailand-construction-market.

construction options that are consistent with Thailand's climate change mitigation objectives and international commitments.

To reduce the construction and real estate sector's contribution to climate change, the main efforts of government agencies and relevant associations are thus aimed at reducing the consumption of resources by buildings through the introduction of minimum mandatory standards, for example, through the introduction of the Building Energy Code (BEC)[13], implementation and dissemination of certification systems such as TREES, LEED and EDGE. In the residential sector, major energy efficiency efforts in the past three decades have been focusing on promoting energy-efficient electrical appliances, while efforts to promote the design and construction of better envelopes for residential buildings have been relatively less coordinated[14].

While there is high awareness of energy efficiency appliances among residential end-users, especially those affixed with the No.5 Energy Labels and Minimum Energy Performance Standard (MEPS), awareness of a better building envelope and its associated benefits among Thai households appears to be limited, with homeowners usually leaving choices of construction materials with developers and builders. However, there has been increasing efforts to promote awareness of sustainable construction practices, promoting energy-efficient buildings, green infrastructure, and urban planning that considers climate resilience in the sector today[15].

Apart from contributing to climate change, the construction and real estate sector itself is highly vulnerable to the impacts of climate change, including extreme heat, frequent floods, and rising sea levels. The biggest climate-related threat to the construction and real estate sector in the country is flooding, which causes an average of around USD 2.6 billion in damage to the country every year. In addition to the loss of life and economic problems, these disasters systematically increase the cost of housing in certain parts of the country,

[13] การอนุญาตก่อสร้างอาคารเพื่อการอนุรักษ์พลังงาน, "การอนุญาตก่อสร้างอาคาร เพื่อการอนุรักษ์พลังงาน," การอนุญาตก่อสร้างอาคาร เพื่อการอนุรักษ์พลังงาน Building Energy Code (BEC), April 27, 2023, https://bec.dede.go.th/.

[14] Global Environment Facility, "Accelerating Construction of Energy Efficient Green Housing Units in Thailand," UNEP, 2021, https://www.thegef.org/projects-operations/projects/10189.

[15] Ibid.

disproportionately affecting the poor[16]. Thailand is also vulnerable to climate change-exacerbated sea level rise, which, when combined with land subsidence, affects land and properties in Bangkok and coastal zones. Large amounts of critical public infrastructure, including buildings, are located in areas which are likely to be further exposed under future climate change scenarios.[17]

The construction of climate-resilient buildings and the selection of non-precarious sites can, therefore, play a major role in supporting Thailand's national adaptation priorities, which include adaptation measures in the human settlements and security sector. These measures aim to enhance the capacity of individuals, communities, and cities to adapt to climate change impacts in accordance with the local context by developing mechanisms to manage climate risks and impacts.[18] Key investments to enhance climate resilience in buildings and construction include urban forests and green spaces to reduce heatwaves, structural designs (such as green roofs and reflective surfaces, etc.) to reduce heat inside buildings, rainwater harvesting and recharge systems that capture water on the roofs of buildings, etc.[19]

Moreover, a key aspect of Thailand's National Adaptation Plan is the integration of climate-resilient building approaches into existing standards and regulations, specifically updating the Building Control Act of 1979. This integration aims to ensure that building codes reflect current and future climatic conditions and disaster risks, thereby promoting the construction of structures capable of withstanding severe weather events.

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[16] Sawangnate, Chandhit, Benjawan Chaisri, and Suthirat Kittipongvises. 2022. "Flood Hazard Mapping and Flood Preparedness Literacy of the Elderly Population Residing in Bangkok, Thailand" Water 14, no. 8: 1268. https://doi.org/10.3390/w14081268

[17] Asian Development Bank, "Climate Risk Country Profile: Thailand," 2021, https://www.adb.org/sites/default/files/publication/722251/climate-risk-country-profile-thailand.pdf.

[18] United Nations Framework Convention on Climate Change, "Thailand Second Updated Nationally Determined Contribution (NDC)," 2022, https://unfccc.int/sites/default/files/NDC/2022-11/Thailand%202nd%20Updated%20NDC.pdf.

[19] United Nations Environment Programme, "5 Ways to Make Buildings Climate Change Resilient," UNEP, n.d., https://www.unep.org/news-and-stories/story/5-ways-make-buildings-climate-change-resilient.

2. Key sectoral climate policies

Thailand's Climate Change Master Plan (2015-2050)[20] focuses in this sector on reducing energy consumption through energy conservation and efficiency measures. Specifically, the CCMP Strategy 2 outlines the following climate mitigation-related measures:

- Progressively raise the energy efficiency requirements in commercial building codes, taking into account the applicability of relevant technology;
- Mandate the display and labelling of energy efficiency in residential, small, and large commercial buildings to facilitate the decision-making of consumers;
- Promote R&D in energy efficiency architecture and engineering practices to be in compliance with and prepared for more stringent standards and become the regional leader in energy-saving innovation for buildings;
- Mandate minimum energy efficiency standards for equipment and appliances that consume electricity in buildings;
- Promote the use of technology and intelligent management systems to achieve energy efficiency gains in cooling, lighting, and water heating systems, along with the promotion of complementary renewable power usage in all types of residential and commercial developments;
- Create a database of electrical appliance lifecycles to accurately inform the setting of ecological and carbon footprint standards;
- Collaborate with industry to encourage consumers to opt for energy-saving electric and electronic equipment (e.g., trade-up programmes) to increase energy efficiency and facilitate systematic electronic waste management;
- Increase the proportion of green procurement in commercial buildings, focusing on the shift to energy-saving equipment;
- Promote green building with emphasis on green design and the sourcing of energy-efficient and eco-friendly materials;

[20] Office of Natural Resources and Environmental Policy and Planning, "Climate Change Master Plan (CCMP) 58-93 (TH),"n.d., https://climate.onep.go.th/wp-content/uploads/2019/07/CCMP_58-93_TH.pdf.

- Initiate long-term campaigns to raise awareness for energy conservation to be promulgated via school curricula and media outlets;
- Mandate monitoring and reporting systems in the energy management systems of buildings and commercial facilities;
- Promote voluntary agreements on energy efficiency between the government and business/industrial sectors, especially with business associations and large corporations.

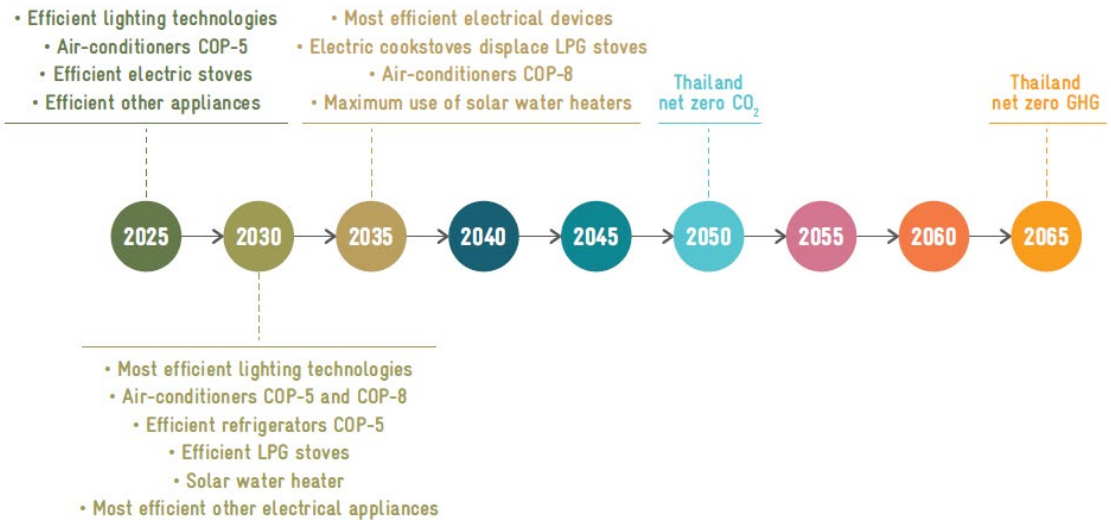
Consistent with the CCMP and LT-LEDS further elaborates a clear net-zero timeline for implementing mitigation actions related to buildings.

2.1. Residential buildings

According to the LT-LEDS, energy uses in the residential sector mainly depend on electricity, liquefied petroleum gas (LPG), and biomass. Most of the decarbonisation opportunities include improving the energy efficiency of end-use technologies in the residential sector. Efficiency improvement of cooling technologies such as air-conditioners and refrigeration, cooking technologies, electrical devices, and lighting technologies will have a major role in decarbonisation in this sector. Electrification of end-use technologies, for instance, shifting from LPG cooking to electric cooking, would also contribute to the decarbonisation efforts. Solar energy for water heating is also considered.[21] The timeline of GHG mitigation measures in the residential building sector to reach net zero emission is presented below.

[21] United Nations Framework Convention on Climate Change, "Thailand LT-LEDS (Revised Version)," November 8, 2022, https://unfccc.int/sites/default/files/resource/Thailand%20LT-LEDS%20%28Revised%20Version%29_08Nov2022.pdf.

Figure 3 Emission reduction timeline for the residential buildings sector



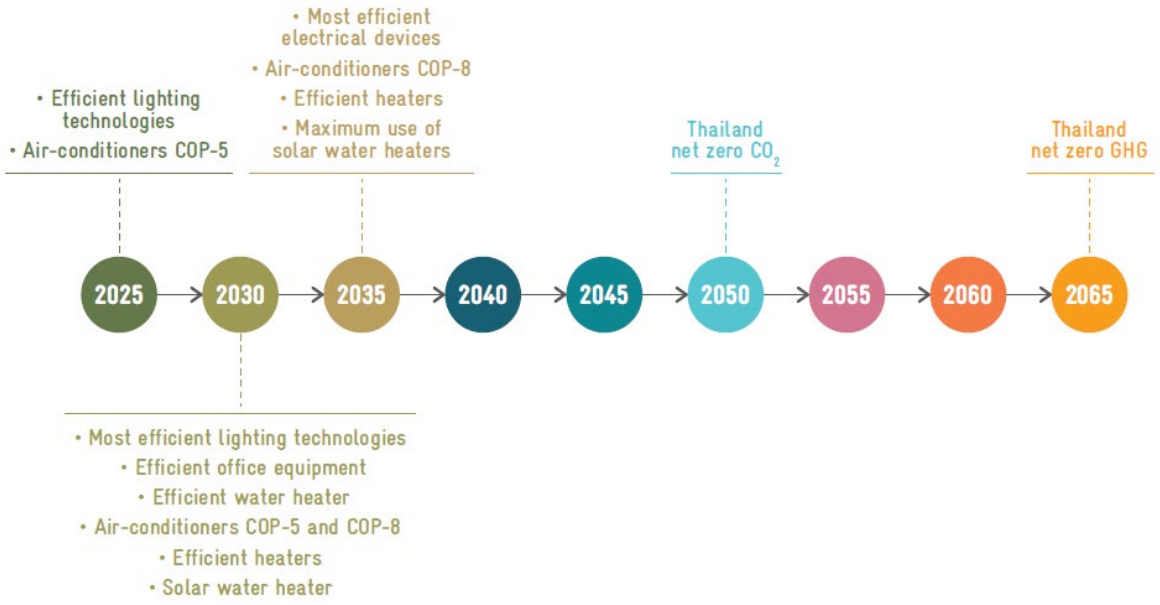
Source: ONEP (2022)[22]

2.2. Commercial buildings

According to the LT-LEDS, the commercial building sector in Thailand is mainly dependent on electricity and LPG for energy. Similar to the residential sector, most of the opportunities for decarbonisation in the commercial sector lie in improving the energy efficiency of end-use technologies. Efficiency improvement of cooling technologies such as air-conditioners and refrigeration will have a major role in this sector. Electrification of end-use technologies, for instance, shifting from LPG to electricity-based technologies, would also contribute to decarbonisation efforts. Solar water heating systems are also considered as an option for water heating in commercial buildings, particularly hotels and hospitals. The timeline of GHG mitigation measures in the commercial building sector to reach net zero emission is presented below.

[22]United Nations Framework Convention on Climate Change, "Thailand LT-LEDS (Revised Version)," November 8, 2022, https://unfccc.int/sites/default/files/resource/Thailand%20LT-LEDS%20%28Revised%20Version%29_08Nov2022.pdf.

Figure 4 Emission reduction timeline for the commercial buildings sector



Source: ONEP (2022)[23]

Energy Conservation Promotion Act (ENCON Act) of Thailand was promulgated in 1992 (amended in 2007). Under the ENCON Act, the Building Energy Code (BEC) was established for large commercial buildings under the Ministerial Regulations of the Ministry of Energy (MOE) in 1995[24] but it was not put into effect until 2021 due to the enforcement must be issued from both Ministry of Energy and Ministry of Interior.

BEC is the key tool assuring buildings will be designed to conserve energy, increase energy efficiency in new or renovated buildings, and reduce energy consumption and GHG emissions.[25] BEC is the standard-setting minimum energy efficiency requirements for buildings that request permission for construction or modification

Under the new revision of Ministerial Regulations of Building Energy Code 2021 (B.E 2563), new or retrofitted buildings being constructed or renovated which have a total area of all stories equal to or exceeding 2,000 square meters must be designed to comply with the energy

[23] United Nations Framework Convention on Climate Change, "Thailand LT-LEDS (Revised Version)," November 8, 2022, https://unfccc.int/sites/default/files/resource/Thailand%20LT-LEDS%20%28Revised%20Version%29_08Nov2022.pdf.

[24]Climate Technology Centre and Network, "Handbook-1: Enforcement Guidelines of BEC," https://www.ctc-n.org/system/files/dossier/3b/CTCN%20Project_Handbook-1%20Regulation_Rev.02_2021.12.30%20Eng%20New.pdf.

[25] Climate Technology Centre and Network, "Handbook-1: Enforcement Guidelines of BEC," https://www.ctc-n.org/system/files/dossier/3b/CTCN%20Project_Handbook-1%20Regulation_Rev.02_2021.12.30%20Eng%20New.pdf.

conservation requirements. Key components of the building design standards under the BEC include the following six systems:

1. Building Envelope (OTTV, RTTV)
2. Lighting System (LPD)
3. Air Conditioning System
4. Water Heating Equipment
5. Overall Building Energy Consumption
6. Renewable Energy Usage

There are nine types of targeted buildings for BEC: exhibition buildings, hotels, entertainment services, hospitals, schools, offices, department stores, condominiums, and theatres.[26]

BEC initially applied to buildings with a gross floor area (GFA) exceeding 10,000 sq. m., with a provision for a phase-step compliance strategy over three years. Starting in 2021, BEC enforcement extended to buildings with a GFA of over 5,000 sq.m, and from 2023 onwards, to a GFA of 2,000 sq.m. The code assesses compliance across six key aspects: building envelope, lighting system, air conditioning system, water heating system, renewable energy system, and overall energy consumption. The MOE has also successfully developed a software program for building energy efficiency assessment called the "BEC Building Energy Code Software" (BEC System WEB-BASED), which aims to facilitate the evaluation of BEC buildings' efficiency. BEC is considered to be one of these strategic mitigation measures according to Thailand's Nationally Determined Contribution Roadmap on Mitigation 2021-2030.[27]

Construction and real estate activities climate materiality

The construction and real estate sector are one of the most complex to assess in terms of emissions. In the ISIC classification system, it is called "Construction," but for the purpose of this Taxonomy, it has been named "Construction and real estate." The main reason is to provide clarity on the scope of the Taxonomy criteria and not to misguide the potential users

[26] Climate Technology Centre and Network, "Handbook-1: Enforcement Guidelines of BEC," https://www.ctc-n.org/system/files/dossier/3b/CTCN%20Project_Handbook-1%20Regulation_Rev.02_2021.12.30%20Eng%20New.pdf.

[27] United Nations Framework Convention on Climate Change, Thailand's Updated Nationally Determined Contribution (NDC), 2020, https://unfccc.int/sites/default/files/NDC/2022-06/Thailand%20Updated%20NDC.pdf.

because the Taxonomy criteria do not cover the very process of construction of infrastructure due to its relatively low climate materiality and scope 1 emissions consisting mostly of fuel burning by machinery.

The emissions associated with buildings are subdivided into two parts: embodied emissions related to building materials and components (embodied carbon) and operational emissions related to the operation of the building (energy consumption from electricity and gas consumed by the building during its lifetime). The emissions associated with the very process of building construction itself only emit carbon by burning fuel by construction machines and are not covered separately by the IPCC2006 classification or national GHG inventories as they are generally included in different transportation and professional activities subcategories. This taxonomy addresses only operational emissions, as there is currently a serious problem with data collection regarding existing embodied emissions, and the construction of reliable criteria in this area is not yet possible.

More specifically, in Thailand, according to the Ministry of Natural Resources and Environment data for 2020, the building sector contributed 21.3% of Thailand's operational energy consumption, of which 13.1% was in the residential sector and 8.2% in the commercial sector[28]. If carved out of the energy industry emissions (1A1(a+b)), this is equivalent to 21820,64 tonnes of GgCO2eq emitted yearly. This figure does not cover emissions associated with waste and water consumption but it still makes construction and real estate the fifth most emitting sector of the country.

The proposed list of activities below includes all activities that are material for the climate change mitigation and climate change adaptation objective:

- **Construction of new buildings:** the operational emissions of new buildings will need to achieve ambitious levels of GHG emissions in line with best practices based on international and Thai certification systems.

[28] Ravisara Lertpunyaroj, "How to Drive Thailand Developers Toward Net Zero: Lessons Learned From the Developer's Perspective and the Global Studies," by MIT Center for Real Estate, ed. Zhengzhen Tan and Siqi Zheng, MIT Center for Real Estate (2023), https://dspace.mit.edu/bitstream/handle/1721.1/150169/Lertpunyaroj-rlertpun-msred-cre-2023-thesis.pdf?sequence=1&isAllowed=y.

- **Renovation of the existing buildings**: operational emissions of existing buildings will need to be reduced and ultimately aligned with requirements for new buildings, or through a reduction the primary energy demand of the building by a certain value. This can be achieved by bringing down the level of consumption of key resources (energy, water, and gas) as a result of renovation.

- **Acquisition or ownership of buildings**: emission reductions will be carried out by incentivising financial transactions related to the purchase or rental of dwellings that comply with this Taxonomy. Financial institutions will be able to verify their portfolios and financial products related to real estate as compliant with the Taxonomy, increasing their attractiveness for a certain category of customers (green investors) compared to similar products that include non-green buildings.

- **Installation, maintenance, and repair of special-purpose building equipment**: emission reductions will be realised through the installation, repair and maintenance of equipment that helps to reduce the building's consumption of basic resources or encourages the adoption of taxonomy-appropriate technologies from other sectors (e.g. installation of electric car chargers).

- **Early warning systems**: Individual renovation measures consisting in installation, maintenance, testing, and repair of instruments and devices for providing early warning for climate related hazards. This activity is very important for climate change adaptation objective.

- **Demolition and site preparation**: activities of preparing a site for subsequent construction activities, including the removal of previously existing structures. This activity is not climate material but was added due to its importance to the Buildings

Construction and real estate criteria scope

In assessing the eligibility of related activities against their respective activity cards and mitigation criteria (see Section 5.2.6), the scope of emissions refers to the operational emissions of the building(s) and/ or of the built environment project, depending on the focus of the Taxonomy user. The following buildings, including from the public or private sector, fall into the scope of the criteria:

- **Residential buildings**. A building or portfolio of buildings where more than half of the floor area is used or suitable for use for dwelling purposes, including but not limited to the following subcategories of residential buildings:
    - Single house;
    - Semi-detached house;
    - Townhouse;
    - Condominiums;
    - Shophouses;
    - Dormitories (for construction workers and others).
- **Commercial buildings**. A building or portfolio of buildings where more than half of the floor area is used for commercial purposes and is intended to generate a profit, either from capital gain or rental income. There are sub-categories of commercial buildings, including but not limited to:
    - Offices;
    - Public buildings;
    - Schools and campuses;
    - Shopping centres, retail, warehouses;
    - Hotels;
    - Hospitals.
- **Renovation projects**. Activities here refer help residential or commercial buildings to achieve energy performance improvements through the application of energy efficiency measures and components that relate to the built environment, as well as the installation of renewable energies.
- **Demolition of buildings**. Activities of preparing a site for subsequent construction activities, including the removal of previously existing structures. Note that this is a separate activity from construction and renovation works.

- **Construction works themselves if they result in buildings and structures that meet the criteria of the Taxonomy**. Construction works and associated financial flows are not eligible per se but may be recognised as eligible if they result in the construction or renovation of taxonomy-aligned buildings.

For projects where the demolition works and the construction or renovation works are procured under the same contract, the criteria for new and renovated buildings have to be met for the construction and renovation works, while the criteria for demolition have to be met for demolition works.

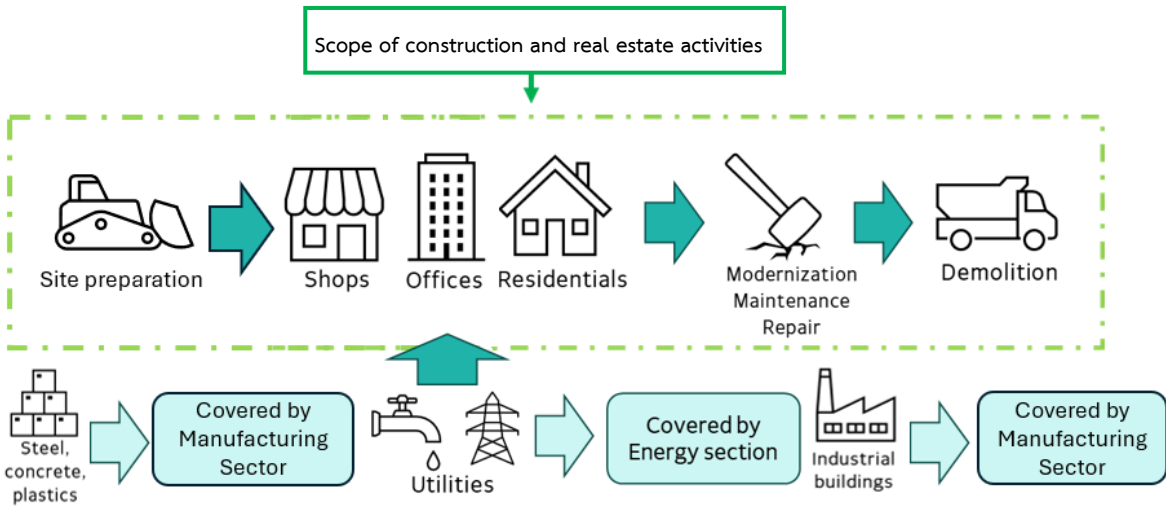
The following objects, projects and activities are outside of the scope of the present criteria:

- **Industrial buildings**. A building or facility dedicated to the manufacturing, altering, repairing, cleaning, washing, breaking up, adapting, or processing various articles, including special-purpose manufacturing and energy-related facilities. The activity of building industrial buildings is included into manufacturing or energy section criteria and is tied to manufacturing or energy generation activities indicated in this section.

- **Embodied carbon of buildings**. While this Taxonomy includes emissions from the operation of new buildings constructed, embodied carbon emissions are excluded. There is little information on existing buildings regarding embedded carbon, and emissions associated with steel and cement production are covered in the production section of the Taxonomy of Thailand.

- **Construction process itself if not leading to the construction or renovation of buildings aligned with the Taxonomy criteria**. The construction process itself is not climate material and is mostly covered by other sectors of Thailand's Taxonomy, such as transport. Therefore, the construction process itself and its associated financial flows can only be recognised as compliant with the taxonomy if it leads to the construction of a building that meets the criteria of the Thai Taxonomy.

Figure 5 Scope of construction and real estate section activities



The following types of expenditure are eligible under the construction and real estate criteria of the Taxonomy:

- Capital costs of performance upgrades;
- Operating expense of ongoing maintenance and building management;
- Building cost or value;
- Origination or refinancing of loans or mortgages, including portfolios;
- Building assets;
- Green building consulting – only if it is a part of a Taxonomy-eligible construction, renovation, acquisition, or demolition project and relevant buildings meet their respective activity criteria. Note that this is not eligible as a standalone activity;
- Demolition and site preparation projects.

Construction and real estate criteria methodological approach

The construction and real estate sector's diverse use of fossil fuel, both on-site and offsite, requires a metric that allows cross-comparison of assets from a holistic, climate-impact perspective. The traditional energy use intensity (EUI) metric used by the industry is unable to measure climate impact effectively, and, by contrast, it is necessary to measure emissions directly to both account for high performers and identify assets that require refurbishment.

A focus on emissions can also help uncover opportunities for fuel switching, where assets can improve their emissions intensity by moving from direct combustion for heat to indirect electricity from decarbonised grids to run a heat pump.

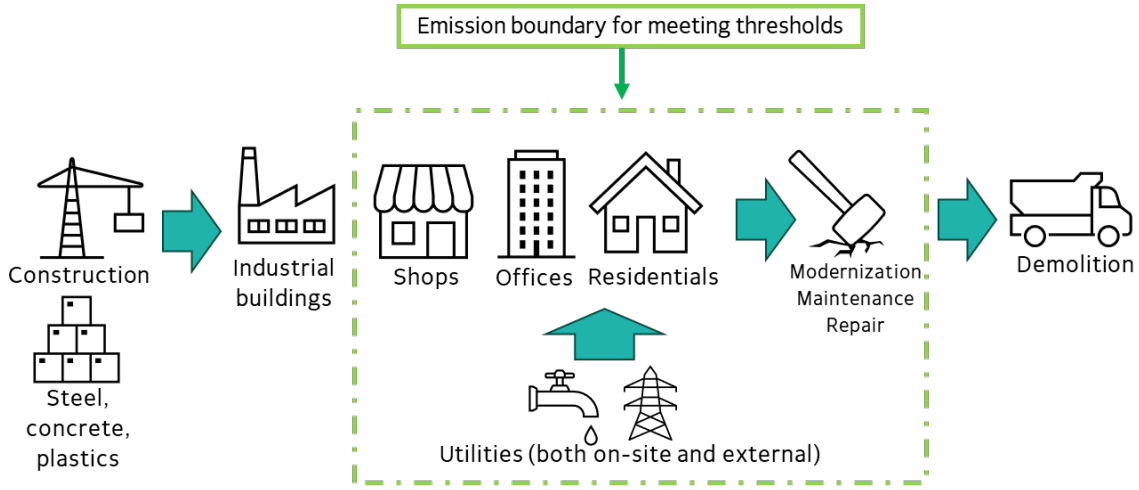
For this reason, Thailand Taxonomy uses emission per square metre (carbon intensity) as the metric for evaluating a building's performance. In practical terms, this includes the following scope of emissions, as defined in the Greenhouse Gas Protocol methodology[29]:

- **Scope 1**. Direct emission sources from buildings including the energy conversion-through-combustion of fossil fuels such as natural gas, fuel oil and in some cases coal on-site. Other types of direct emissions such as refrigerants **are not included**.
- **Scope 2**. Indirect emissions sources from building include the energy conversion-through combustion of fossil fuels such as coal, oil, and natural gas, and/or the emissions associated with non-fossil fuel such as nuclear and renewables (when substantial enough i.e., reservoir emissions from hydro) when providing electricity and/or district heating/cooling to the building.
- **Scope 3.** Indirect emissions sources associated with the sourcing, transmission, and distribution of energy to the building. Other Scope 3 emissions from transport, waste, and water **are not currently incorporated.**

While embodied emissions are material, there is a current lack of data available which makes it unreasonable to set mandatory emissions targets and decarbonisation pathways. Depending on the availability of data in the upcoming years, future iterations of the Taxonomy may require projects to disclose their lifecycle emissions.

[29] Greenhouse Gas Protocol, "Commercial and Residential Building Sector Guidance," May 2015, https://ghgprotocol.org/sites/default/files/2022-12/Buildings%20-%20Additional%20Guidance.pdf.

Figure 6 Emission calculation boundary for construction and real estate activities



Construction and real estate criteria also focus on the emissions associated with energy use within the control of the landlord, i.e., base building services, also known as "core and shell," and not on the emission of the tenant. The reasons for this are:

- Light, power, and miscellaneous end-use energy demand within tenant spaces is outside the financial or management control of the building manager.
- Commercial buildings may experience a change in occupiers during the term of the green/transitional bond or loan, distorting the parameters.

To qualify for the Climate Change Mitigation green category for new buildings, one of two options can be selected:

Option 1: Thailand buildings national decarbonisation pathways

Following a decarbonisation pathway calculated specifically for Thailand or its major cities based on data provided by relevant ministries and agencies. The pathway is calculated as a straight line drawn between today's emission intensity parameters for different classes of buildings in Thailand and zero emissions in 2050.

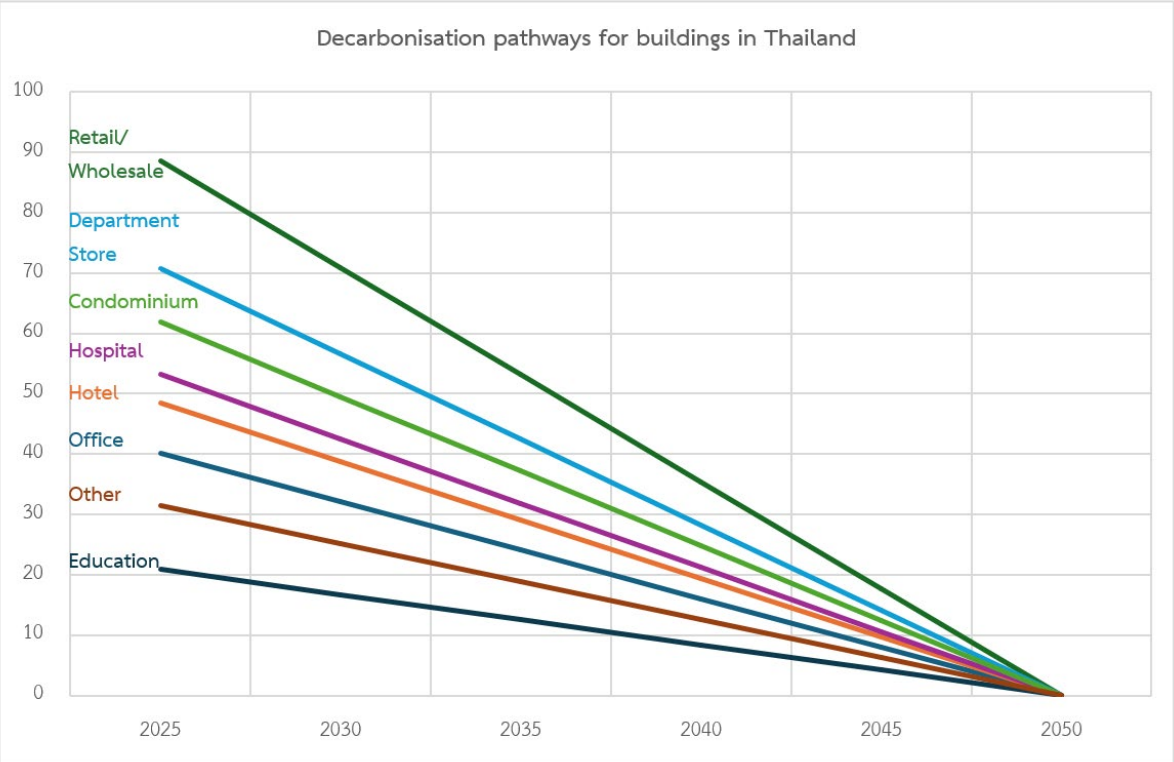
In order to use this option, the building must comply with the operational CO2 intensity figure. For new buildings targeted operational intensity must be achieved for the date of building commissioning. For example, if the manager is seeking a green loan for the building due to be commissioned in 2029 and wishes to use this option, he/she must present documentation

proving that in 2029 the building operational emissions will not exceed the threshold stipulated in the table for the specified building type.

For the activity of renovation of the existing buildings the activity manager seeking a green loan must prove that the renovation project will lead to building's alignment with the corresponding threshold. In this case threshold must be selected for the year of renovation project completion. For example, if the green loan is being taken for the renovation project that is supposed to end in 2030, the manager must present proof that the building in question will meet the threshold defined for 2030.

The table below provides you with pathways that are built based on DEDE's energy data (kWh/m2/y) which is then converted to emissions intensity (kgCO2/m2/y) using the current grid emissions factors provided by DEDE using Climate Bonds Initiative "best in class scenario" methodology: the numbers represent 15% best buildings in each category in terms of kgCo2/m2/y.

Figure 7 Decarbonisation pathways for buildings in Thailand (kgCo2/m2/y)



Source: calculation from DEDE

Table 1 Decarbonisation pathways for buildings in Thailand (kgCo2/m2/y)

Year	Office	Hotel	Retail/ Wholesale	Department Store	Hospital	Condominium	Education	Other
2025	40.16	48.4	88.6	70.77	53.14	61.94	20.92	31.47
2026	38.55	46.46	85.06	67.94	51.01	59.46	20.08	30.21
2027	36.94	44.53	81.51	65.11	48.89	56.98	19.25	28.96
2028	35.34	42.59	77.97	62.28	46.76	54.51	18.41	27.7
2029	33.73	40.66	74.43	59.45	44.63	52.03	17.57	26.44
2030	32.12	38.72	70.88	56.62	42.51	49.55	16.74	25.18
2031	30.52	36.78	67.34	53.78	40.38	47.07	15.9	23.92
2032	28.91	34.85	63.79	50.95	38.26	44.6	15.06	22.66
2033	27.31	32.91	60.25	48.12	36.13	42.12	14.22	21.4
2034	25.7	30.98	56.71	45.29	34.01	39.64	13.39	20.14
2035	24.09	29.04	53.16	42.46	31.88	37.16	12.55	18.88
2036	22.49	27.1	49.62	39.63	29.76	34.69	11.71	17.63
2037	20.88	25.17	46.07	36.8	27.63	32.21	10.88	16.37
2038	19.27	23.23	42.53	33.97	25.51	29.73	10.04	15.11
2039	17.67	21.3	38.99	31.14	23.38	27.25	9.2	13.85
2040	16.06	19.36	35.44	28.31	21.25	24.78	8.37	12.59
2041	14.46	17.42	31.9	25.48	19.13	22.3	7.53	11.33
2042	12.85	15.49	28.35	22.65	17	19.82	6.69	10.07
2043	11.24	13.55	24.81	19.82	14.88	17.34	5.86	8.81
2044	9.64	11.62	21.26	16.98	12.75	14.87	5.02	7.55
2045	8.03	9.68	17.72	14.15	10.63	12.39	4.18	6.29
2046	6.42	7.74	14.18	11.32	8.5	9.91	3.35	5.04
2047	4.82	5.81	10.63	8.49	6.38	7.43	2.51	3.78
2048	3.21	3.87	7.09	5.66	4.25	4.96	1.67	2.52
2049	1.61	1.94	3.54	2.83	2.13	2.48	0.84	1.26
2050	0	0	0	0	0	0	0	0

Source: calculation from DEDE

Option 2: Proxy certification labels and additional requirements

Under option two, in the absence of data on operational emissions, alignment can be achieved through obtaining internationally recognised green building labels. Tables below provide a list of international green building certification schemes that can be used as proxies for emission intensity in Thailand.

Table 2 Proxy certification labels and additional requirements for residential buildings

Proxy Label	Proxies
House No.5 (Sustainable Energy and Environmental Label)	▪ Top-runners or premium labels are compliant ▪ Refer to EGAT's Label No.5 for Houses criteria[30]
TREES	Meet all of the following criteria: ▪ TREES Gold or Platinum and ▪ 30% improvement above the levels in the latest version of ASHRAE 90.1 and If for a debt instrument: Date of TREES certification must be within five years before bond issuance
Green Star Homes	Certified by the GBCA and comply with Renewable Energy Pathway A or B and do not include a swimming pool.
Evaluation Standard for Green Building	Evaluation Standard for Green Building rating of 3-Star
IGBC Green Homes	Buildings certified under the IGBC Green Homes ® Rating system
LEED	Meet all of the following criteria: ▪ LEED Gold OR Platinum ▪ 30% improvement above the levels in the latest version of ASHRAE 90.2 (1-3 floors) or ASHRAE 90.1 (4 or more floors) If for a debt instrument: Date of LEED certification must be within five years before bond issuance.
EDGE	▪ EDGE level 2 or 3 certified ▪ No offsets use allowed ▪ This option is only able to be used in developing countries (including Thailand) as defined by the UN[31]

[30] Electricity Generating Authority of Thailand, บ้านและอาคารเบอร์ 5, https://homeno5.egat.co.th/มาตรการ-taxonomy/

[31] United Nations, "World Economic Situation and Prospects 2014: Country Classification," 2014, https://www.un.org/en/development/desa/policy/wesp/wesp_current/2014wesp_country_classification.pdf.

Proxy Label	Proxies
	If for a bond: 10-year limit on bond tenor
Living Building Challenge Certified	Living Building Challenge Certified
Climate Bonds Initiative	Climate Bonds Buildings Criteria
Singapore BCA Green Mark Scheme	Gold or the above levels are compliant.
BEAM	▪ Gold or the above levels are compliant ▪ Refer to Thailand's Building Energy Code for HVAC and lighting criteria

Important note: In each case the latest published version of the certificate must apply. For additional ASHRAE the version mentioned in the main certificate itself must apply.

Table 3 Proxy certification labels for commercial buildings

Proxy Label	Proxies
Building No.5 (Sustainable Energy and Environmental Label)	▪ Top-runners or premium labels are compliant ▪ Refer to EGAT's Label No.5 for Buildings criteria[32]
TREES	Meet all the following criteria: ▪ TREES Gold OR Platinum and ▪ 30% improvement above the levels in the latest version of ASHRAE 90.1. ▪ If debt instrument: the 6-year limit on tenor. If debt instrument: The date of TREES certification must be within five years before bond issuance.
Australian Proxy for Green Star Buildings	▪ Certified by the GBCA under the Green Star Buildings scheme and complies with the Climate Positive Path. ▪ Buildings certified with 6 Star automatically comply. 5-star rated buildings registered after 2023 will also comply. More information[33]
IGBC Net Zero Building rating system	Buildings that achieve a Net Zero Rating under the IGBC Net Zero Building rating system. Buildings in construction and recently

[32] Electricity Generating Authority of Thailand, บ้านและอาคารเบอร์ 5, https://homeno5.egat.co.th/มาตรการ-taxonomy/

[33] Climate Bonds Initiative, "AUS - Green Star Buildings proxy v1",2021 , https://www.climatebonds.net/files/files/standards/Buildings/Proxies/AUS%20-%20Green%20Star%20Buildings%20proxy%20v1.pdf.

Proxy Label	Proxies
	completed buildings must provide additional pre-issuance document.
LEED	Meet all the following criteria: ▪ LEED Gold OR Platinum and ▪ 30% improvement above the levels in the latest version of ASHRAE 90.1. ▪ If debt instrument: the 6-year limit on tenor. If debt instrument: The date of LEED certification must be within five years before bond issuance.
EDGE	▪ EDGE Certified ▪ This option is only able to be used in developing countries (including Thailand) as defined by the UN[34]
Living Building Challenge	Living Building Challenge Certified (all tiers)
Climate Bonds Initiative	Climate Bonds Buildings Criteria
Singapore BCA Green Mark Scheme	Gold or the above levels are compliant
BEAM	▪ Gold or the above levels are compliant ▪ Refer to Thailand's Building Energy Code for HVAC and lighting criteria

Important note: In each case the latest published version of certificate must apply. For additional ASHRAE the version mentioned in the main certificate itself must apply.

In order to be labelled as green, a new building project must either comply with emission intensity thresholds shown in Thailand buildings national decarbonisation pathways (Option 1) or with the requirements of Proxy certification labels and additional requirements (Option 2) at the date of completion. In this case, the construction project, as well as the building and all financial streams associated with it, can be considered aligned with the Taxonomy.

How to comply with green building certificates before the building itself is built?

The issuing authority for voluntary green building certifications will first issue a pre-certification indicating the projected level of achievement. This review focuses on design

[34] United Nations, "World Economic Situation and Prospects 2014: Country Classification,"2014, https://www.un.org/en/development/desa/policy/wesp/wesp_current/2014wesp_country_classification.pdf.

intent rather than actual performance, as the building is not yet constructed. Once the building is completed, a thorough site inspection and performance review are conducted. If the building meets the necessary criteria and adheres to the original design intent, the final certification is awarded at the desired level.

As for the demolition and site preparation activities, green category involves careful assessment of the demolition site and maximisation of recycling of construction waste. For projects associated with the construction of new buildings and renovation of existing buildings, where the demolition works, and the construction or renovation works are procured under the same contract, the technical screening criteria for those respective activities apply.

The amber category available in this section involves the modernisation of buildings that do not meet the green criteria but still take sufficiently ambitious steps towards reducing emissions or consumption of basic resources against the baseline established at the start of the project. One of two parameters can be summarised by the following criterion:

- Primary Energy Demand (PED - also known as energy use index). This metric, used by both the EU taxonomy and Thailand Buildings Energy Code (BEC), refers to the calculated amount of energy needed to meet the energy demand associated with the typical uses of a building expressed by a numeric indicator of total primary energy use in kWh/m2 per year.

- Emission intensity. As was described before, emissions per square metre of residential area or landlord area in the commercial buildings can be reduced to improve climate credentials of the building.

This option is available before the established sunset date for the Thailand Taxonomy (2040).

As for the acquisition and ownership activities, the amber category allows operations with buildings that demonstrate at least 30% improvement compared to all categories stipulated in the requirements of Thailand BEC[35]. This threshold must be revised when additional energy performance categories for buildings in Thailand (HEPS, ECON and ZEB) are finally developed.

[35] การอนุญาตก่อสร้างอาคารเพื่อการอนุรักษ์พลังงาน, “การอนุญาตก่อสร้างอาคาร เพื่อการอนุรักษ์พลังงาน,” การอนุญาตก่อสร้างอาคาร เพื่อการอนุรักษ์พลังงาน Building Energy Code (BEC), April 27, 2023, https://bec.dede.go.th/.

Red activities in the sector are associated with operations with buildings that are dedicated to the extraction, storage, manufacturing, and transport of fossil fuels. To avoid doubt, this does not include buildings providing office space to fossil companies for administrative or trading activities.

Construction and real estate criteria methodological approach for climate change adaptation

The adaptation criteria for the construction and real estate sector were developed based on ASEAN Taxonomy v.3[36] criteria for climate change adaptation.

Climate change adaptation focuses on managing the expected negative effects of climate change through identifying evidence and relevant information with regards to the impacts of climate change. The objective of climate change adaptation is to lower the negative effects caused by climate change and increase resilience to withstand adverse physical impact of current and future climate change, through implementation of processes or actions.

The construction and real estate sector must demonstrate resilience to identified negative impacts, and must also not adversely affect the adaptation efforts, or increase the physical risk, of other stakeholders. Under the context of climate change adaptation, construction activities for new and existing buildings need to positively promote resilience in the face of changing climates and for buildings to provide utility over time in the face of potential climate disruption.

Adaptation guiding principles of Buildings Sector activities are as follows:

- Activity shall positively contribute to a reduction in material physical climate risk and/or shall reasonably reduce material physical risk from current and future climate change. This can include obvious physical risks, such as flooding, but also less immediately visible effects, such as impact on health from higher temperatures;
- Impact assessments under a broad range of climate scenarios shall be conducted to provide better understanding and insights on the effectiveness and benefits of the activity;

[36] ASEAN Taxonomy Board, "ASEAN Taxonomy for Sustainable Finance Version 3", April 25, 2024, https://www.theacmf.org/images/downloads/pdf/ASEAN-Taxonomy-Version-3.pdf

- Activity that enables adaptation of other activities should reduce the impact of material physical risk from other activities and/or reduce barriers to adaptation through technology, services, or products.
- Activity must not adversely affect the adaptation efforts, or increase the physical risk, of other stakeholders;
- Adaptation solutions should be location-specific and context-specific and shall be assessed and ranked in order of priority using the best available climate projections in order to prevent and/or reduce the adverse impact on people, nature, or assets.

Activities that can contribute to climate change adaptation also include construction of new buildings, renovation of existing buildings, acquisition and ownership of buildings demonstrating significant adaptation potential, and installation of early warning systems[37].

Criteria application scheme

Either the financial flows (revenues, CapEx, OpEx, bonds and loans) associated with an activity or the entire project (for example, a renovation project) can qualify as aligned with the Taxonomy.

- To align the construction or renovation project, the manager must fulfil the relevant requirements of the activity cards, and the buildings must meet the characteristics required by the Taxonomy at the time of completion. The building construction process itself and the costs associated with it may also be recognised as meeting the taxonomy criteria if the construction process results in a Taxonomy-aligned building or structure.
- For the alignment of the building itself, the manager must provide evidence that the building at the time of checking alignment meets the requirements of the Taxonomy.

[37] According to the United Nations Office for Disaster Risk Reduction (UNDRR) early warning systems are "an integrated system of hazard monitoring, forecasting and prediction, disaster risk assessment, communication and preparedness activities systems and processes that enables individuals, communities, governments, businesses and others to take timely action to reduce disaster risks in advance of hazardous events".

- For acquisition or ownership of buildings, the property must have a taxonomy-compliant status at the time of the transaction.
- For adaptation activities BOTH expenditures required to procure adaptation solutions themselves AND services required to install this equipment is eligible.

The relevant Thailand authorities should set guidelines on when and how taxonomy compliance status must be revoked and what consequences should it imply.

Construction and real estate subsector criteria and thresholds

1. Construction of new buildings

Sector	Construction and Real Estate
Activity	Construction of new buildings
ISIC Code	4100
Description	Development of building projects for residential and non-residential buildings by bringing together financial, technical, and physical means to realise the building projects for later sale as well as the construction of complete residential or non-residential buildings, on own account for sale or on a fee or contract basis.
Objective	Climate change mitigation
Green	The building must meet one of the following criteria: • Building emission intensity is in line with the decarbonisation trajectory indicated in Thailand buildings national decarbonisation pathways (Table 1); • Construction of buildings that comply with eligible national and international certification schemes and associated requirements (Tables 2 and 3). For the purpose of alignment with the current taxonomy, the certificate is valid for a maximum period of three years regardless of the requirements of the certification system itself.

	A whole life carbon assessment (WLCA) of the building must be conducted and reported in line with the current WLCA guidelines[38]. The present version of the taxonomy does not contain any WLCA-based criteria, but the future versions of the taxonomy might feature them. The manager of the building must report all data relevant for the alignment in line with International Performance Measurement and Verification Protocol requirements (where applicable).
Amber	N/A (New buildings need to meet green criteria)
Red	Construction of new buildings that are dedicated to the extraction, storage, manufacturing, and transport of fossil fuels is harmful to the objective of climate change mitigation. To avoid doubt, the above does not include buildings providing office space to fossil companies for administrative or trading activities.
Criteria Reference	Climate Bonds Buildings Criteria

Sector	Construction and Real Estate
Activity	Construction of new buildings
ISIC Code	4100
Description	The construction of new buildings aimed to be adaptive to climate change physical and non-physical risks
Objective	Climate change adaptation
Green	A new building complies with the green category for adaptation if: • The physical climate risks that are material to the building have been identified by performing a robust climate risk and vulnerability assessment (CRVA) in accordance with the guidance provided in Annex: Guidance on performing a Climate Risk and Vulnerability Assessment; OR • The physical climate risks that are material to the building have been identified by performing a robust climate risk and vulnerability assessment through any other internationally recognised methodology.

[38] Royal Institution of Chartered Surveyors [RICS], "Whole life carbon assessment (WLCA) for the built environment", n.d., https://www.rics.org/profession-standards/rics-standards-and-guidance/sector-standards/construction-standards/whole-life-carbon-assessment

	The climate projections and assessment of impact of climate change on the building must be based on best practice and available guidance and take into account the state-of-the-art science for vulnerability and risk analysis and related methodologies in line with the most recent Intergovernmental Panel on Climate Change reports, scientific peer-reviewed publications and open source or paying models; AND The project of the building and/or finished building incorporate physical and non-physical solutions ('adaptation solutions') that substantially reduce the most important physical climate risks that are material to that building that have been implemented; AND The adaptation solutions implemented: • do not adversely affect the adaptation efforts or the level of resilience to physical climate risks of other people, of nature, of cultural heritage, of assets and of other economic activities; • favour nature-based solutions or rely on blue or green infrastructure to the extent possible; • are consistent with local, sectoral, regional, or national adaptation plans and strategies; • are monitored and measured against pre-defined indicators and remedial action is considered where those indicators are not met; The manager of the building must report all data relevant for the alignment in line with International Performance Measurement and Verification Protocol requirements (where applicable).
Amber	N/A (New buildings need to meet green criteria)
Red	N/A (New buildings need to meet green criteria)
Criteria Reference	ASEAN Taxonomy V3

2. Renovation of existing buildings

Sector	Construction and Real Estate
Activity	Renovation of the existing residential or commercial buildings
ISIC Code	4100/4330
Description	Construction and civil engineering works or preparation thereof
Objective	Climate change mitigation

Green	A renovation leads to the building compliance with the green criteria of the "Construction of new buildings" activity card. A whole life carbon assessment (WLCA) of the building must be conducted and reported in line with the current WLCA guidelines[39]. The present version of the taxonomy does not contain any WLCA-based criteria, but the future versions of the taxonomy might feature them. The manager of the building must report all data relevant for the alignment in line with International Performance Measurement and Verification Protocol requirements (where applicable).
Amber	Renovation projects must lead to at least a 30% reduction in greenhouse gas emissions intensity or energy use for buildings under 10,000 m² or a 20% reduction for buildings 10,000 m² or larger, compared to baseline levels at the start of the project. This option remains valid until the adaptation period ends in 2040.
Red	Renovation of buildings that are dedicated to extraction, storage, manufacturing, transport of fossil fuels is harmful to the objective of climate change mitigation. For the avoidance of doubt, the above does not include buildings providing office space to fossil companies for administrative or trading activities.
Criteria Reference	Climate Bonds Buildings Criteria

Sector	Construction and Real Estate
Activity	Renovation of the existing buildings
ISIC Code	4100/4330
Description	Renovation of the existing buildings aimed to be adaptive to climate change physical and non-physical risks.
Objective	Climate change adaptation
Green	A renovation project complies with the green category for adaptation if: • The physical climate risks that are material to the building have been identified by performing a robust climate risk and vulnerability assessment (CRVA) in accordance with the guidance provided in

[39] Ibid.

	Annex: Guidance on performing a Climate Risk and Vulnerability Assessment; OR • The physical climate risks that are material to the building have been identified by performing a robust climate risk and vulnerability assessment through any other internationally recognised methodology. The climate projections and assessment of impact of climate change on the building must be based on best practice and available guidance and take into account the state-of-the-art science for vulnerability and risk analysis and related methodologies in line with the most recent Intergovernmental Panel on Climate Change reports, scientific peer-reviewed publications and open source or paying models; AND Physical and non-physical solutions ('adaptation solutions') that substantially reduce the most important physical climate risks that are material to that building that have been implemented during the renovation; AND The adaptation solutions implemented: • do not adversely affect the adaptation efforts or the level of resilience to physical climate risks of other people, of nature, of cultural heritage, of assets and of other economic activities; • favour nature-based solutions or rely on blue or green infrastructure to the extent possible; • are consistent with local, sectoral, regional, or national adaptation plans and strategies; • are monitored and measured against pre-defined indicators and remedial action is considered where those indicators are not met; The manager of the building must report all data relevant for the alignment in line with International Performance Measurement and Verification Protocol requirements (where applicable).
Amber	N/A (Existing buildings need to meet green criteria)
Red	N/A (Existing buildings need to meet green criteria)
Criteria Reference	ASEAN Taxonomy V3

3. Acquisition or ownership of buildings

Sector	Construction and Real Estate
Activity	Acquisition or ownership of buildings
ISIC Code	6810
Description	Buying real estate and exercising ownership of that real estate
Objective	Climate change mitigation
Green	Financial operations (buying, selling) with the buildings in question are in compliance with the green criteria of the "Construction of new buildings" activity card. A whole life carbon assessment (WLCA) of the building must be conducted and reported in line with the current WLCA guidelines[40]. The present version of the taxonomy does not contain any WLCA-based criteria, but the future versions of the taxonomy might feature them. The manager of the building must report all data relevant for the alignment in line with International Performance Measurement and Verification Protocol requirements (where applicable).
Amber	Acquisition or ownership of buildings that demonstrate a 30% energy efficiency improvement over the latest version of the Thailand's Buildings Energy Code. This option is available until the established sunset date (2040)
Red	Acquisition and ownership of buildings that are dedicated to the extraction, storage, manufacturing, and transport of fossil fuels is harmful to the objective of climate change mitigation. To avoid doubt, the above does not include buildings providing office space to fossil companies for administrative or trading activities.
Criteria Reference	Climate Bonds Buildings Criteria

Sector	Construction and Real Estate
Activity	Acquisition or ownership of buildings
ISIC Code	6810
Description	Buying, selling, owning, and renting out real estate objects with certain adaptation characteristics defined in the criteria

[40] Ibid.

Objective	Climate change adaptation
Green	The activity of acquisition or ownership of buildings complies with the green category for adaptation if: • The physical climate risks that are material to the building in question have been identified by performing a robust climate risk and vulnerability assessment (CRVA) in accordance with the guidance provided in Annex: Guidance on performing a Climate Risk and Vulnerability Assessment; OR • The physical climate risks that are material to the building have been identified by performing a robust climate risk and vulnerability assessment through any other internationally recognised methodology. The climate projections and assessment of impact of climate change on the building must be based on best practice and available guidance and take into account the state-of-the-art science for vulnerability and risk analysis and related methodologies in line with the most recent Intergovernmental Panel on Climate Change reports, scientific peer-reviewed publications and open source or paying models; AND The building in question has implemented physical and non-physical solutions ('adaptation solutions') that substantially reduce the most important physical climate risks that are material to that activity that have been implemented; AND The adaptation solutions implemented: • do not adversely affect the adaptation efforts or the level of resilience to physical climate risks of other people, of nature, of cultural heritage, of assets and of other economic activities; • favour nature-based solutions or rely on blue or green infrastructure to the extent possible; • are consistent with local, sectoral, regional, or national adaptation plans and strategies;

	• are monitored and measured against pre-defined indicators and remedial action is considered where those indicators are not met; The manager of the building must report all data relevant for the alignment in line with International Performance Measurement and Verification Protocol requirements (where applicable).
Amber	N/A (Existing buildings need to meet green criteria)
Red	N/A (Existing buildings need to meet green criteria)
Criteria Reference	ASEAN Taxonomy V3

4. Installation, maintenance, and repair of special-purpose building equipment

Sector	Construction and Real Estate
Activity	Installation, maintenance, and repair of special-purpose building equipment
ISIC Code	4321/ 4322/ 4329
Description	Individual measures and professional services aimed at helping the building achieve energy or resource savings and enabling other activities as defined by Thailand Taxonomy.
Objective	Climate change mitigation;
Green	At least one of the following projects must be implemented to comply with the Taxonomy: • Installation of renewable energy equipment, renewable energy charging stations and regulation devices; • Installation of the equipment that decreases building operational emissions and consumption of water, gas, or electricity; • Installation of infrastructure for charging electric cars using grid electricity; • Installation of equipment within the two highest energy efficiency classes for equipment, as determined by relevant international labelling schemes or Thailand regulation[41] • Addition of insulation to existing envelope components, such as: - external walls (including green walls),

[41] Energy-saving Label No.5 certification can be used here

	- roofs (including green roofs), - lofts, - basements and ground floors (including measures to ensure airtightness, - measures to reduce the effects of thermal bridges and scaffolding, - products for the application of the insulation to the building envelope (including mechanical fixings and adhesive); • Replacement of existing windows with new energy-efficient windows; • Replacement of existing external doors with new energy-efficient doors; • Installation and replacement of energy-efficient light sources; All installed equipment must comply with the highest standards of energy efficiency as defined by relevant national or international labels (e.g., Label No.5, Energy Saving Label or comparable)
Amber	N/A
Red	Installation of equipment that facilitates the use of fossil fuels is harmful to the objective of climate change mitigation.
Criteria Reference	Climate Bonds Buildings criteria; ASEAN Taxonomy v.3

Sector	Construction and Real Estate
Activity	Installation, maintenance, and repair of special-purpose building equipment
ISIC Code	4321/ 4322/ 4329
Description	Individual measures and professional services aimed at helping the building increase its resilience to the negative consequences of climate change
Objective	Climate change adaptation
Green	The activity of installation, maintenance or repair of special-purpose building equipment complies with the green category for adaptation if: • The physical climate risks that are material to the building in question have been identified by performing a robust climate risk and vulnerability assessment (CRVA) in accordance with the guidance provided in Annex: Guidance on performing a Climate Risk and Vulnerability Assessment;

	OR • The physical climate risks that are material to the building have been identified by performing a robust climate risk and vulnerability assessment through any other internationally recognised methodology. The climate projections and assessment of impact of climate change on the building must be based on best practice and available guidance and take into account the state-of-the-art science for vulnerability and risk analysis and related methodologies in line with the most recent Intergovernmental Panel on Climate Change reports, scientific peer-reviewed publications and open source or paying models; AND Installed, maintained or repaired equipment substantially reduces physical or non-physical climate risks that are material to that building in question; AND Installed, maintained, or repaired equipment: • does not adversely affect the adaptation efforts or the level of resilience to physical climate risks of other people, of nature, of cultural heritage, of assets and of other economic activities; • favours nature-based solutions or rely on blue or green infrastructure to the extent possible; • is consistent with local, sectoral, regional, or national adaptation plans and strategies; • is monitored and measured against pre-defined indicators and remedial action is considered where those indicators are not met; The manager of the building must report all data relevant for the alignment in line with International Performance Measurement and Verification Protocol requirements (where applicable).
Amber	N/A (Existing buildings need to meet green criteria)
Red	N/A (Existing buildings need to meet green criteria)
Criteria Reference	ASEAN Taxonomy v.3

5. Demolition and site preparation

Sector	Construction and Real Estate
Activity	Demolition and site preparation
ISIC Code	4311/ 4312
Description	Demolition or wrecking of buildings and other structures as well as preparation of sites for subsequent construction activities
Objective	Resource resilience and promotion of circular economy
Green	In order to comply with the green category, both of the following criteria must be fulfilled: 1. Prior to the start of the demolition or wrecking activity, at least the following aspects are discussed and agreed upon with the client: • definition of key performance indicators and target ambition level[42]; • identification of project-specific constraints that may compromise the target ambition level (such as time, labour and space) and how to minimise these constraints; • details of the pre-demolition auditing procedure; • an outline waste management plan that prioritises selective deconstruction, decontamination, and source separation of waste streams. Where these actions are not prioritised, an explanation is provided to justify why selective deconstruction, decontamination, or source separation of waste streams are not technologically feasible in the project. Cost or financial considerations are not an acceptable reason to avoid complying with this requirement; 2. The operator of the activity conducts a pre-demolition audit: • All demolition waste generated during the demolition or wrecking activity is treated in accordance with regional waste legislation; • At least 90% (by weight) of the non-hazardous demolition waste generated on the demolition site is prepared for reuse or recycling. This excludes naturally occurring material. Alternatively, at least 95% of the mineral fraction and 70% of the non-mineral fraction of

[42] Detailed description can be found here: https://susproc.jrc.ec.europa.eu/product-bureau//sites/default/files/2021-01/UM3_Indicator_2.2_v1.1_40pp.pdf

	nonhazardous demolition waste is separately collected and prepared for reuse or recycling. **Definitions:** • Building demolition material reuse is the practice of salvaging and repurposing construction materials and components from a demolished structure. These materials are then either incorporated into the development of the same site or made available for use in other construction projects. • Building demolition material recycling is the process of collecting, sorting, and reprocessing materials and components that are removed during the demolition of a building. These materials, such as concrete, wood, metal, and other construction materials, are treated to remove contaminants and then transformed into new construction materials or products.
Amber	N/A
Red	Demolition works that are not compliant with the green category are harmful to the objective of resource resilience and promotion of circular economy.
Criteria Reference	ASEAN Taxonomy v.3

6. Early Warning System

Sector	Construction and Real Estate
Activity	Early Warning Systems
ISIC Code	4321
Description	Individual renovation measures consisting in installation, maintenance, testing and repair of instruments and devices for providing early warning for climate related hazards. Instruments and devices can include both early warning communication systems and hazard specific systems.
Objective	Climate change adaptation
Green	The activity of installation, maintenance or repair of early warning systems complies with the green category for adaptation if: • The physical climate risks that are material to the building have been identified by performing a robust climate risk and vulnerability assessment through any other internationally recognised methodology. The climate projections and assessment of impact of

	climate change on the building must be based on best practice and available guidance and take into account the state-of-the-art science for vulnerability and risk analysis and related methodologies in line with the most recent Intergovernmental Panel on Climate Change reports, scientific peer-reviewed publications and open source or paying models; OR • The climate projections and assessment of impacts are based on best practice and available guidance and take into account the state-of-the-art science for vulnerability and risk analysis and related methodologies in line with the most recent Intergovernmental Panel on Climate Change reports, scientific peer-reviewed publications and open source or paying models; AND Installed early warning systems reduce physical or non-physical climate risks that are material to the building in question; AND Installed, maintained, or repaired equipment: • does not adversely affect the adaptation efforts or the level of resilience to physical climate risks of other people, of nature, of cultural heritage, of assets and of other economic activities; • favours nature-based solutions or rely on blue or green infrastructure to the extent possible; • is consistent with local, sectoral, regional, or national adaptation plans and strategies; • is monitored and measured against pre-defined indicators and remedial action is considered where those indicators are not met.
Amber	N/A (Existing buildings need to meet green criteria)
Red	N/A (Existing buildings need to meet green criteria)
Criteria Reference	ASEAN Taxonomy V3