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Thailand Taxonomy Board

Thailand Taxonomy

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FTI

FTI
Renewable Energy Industry Club

*BOT and SEC are representatives of Working Group on Sustainable Finance (WG-SF)

Thailand Taxonomy Board

The Thailand Taxonomy Board is established to develop Thailand Taxonomy, a classification system of economic activities deemed as environmentally-sustainable. The Board comprises agencies from both the public and private sectors to ensure all sectors' views are reflected. In the initial phase, the list of agencies is as follows:

1. Bank of Thailand (BOT)*
2. The Securities and Exchange Commission, Thailand (SEC)*
3. Office of Natural Resources and Environmental Policy and Planning (ONEP), Ministry of Natural Resource and Environment
4. Department of Alternative Energy Development and Efficiency (DEDE), Ministry of Energy
5. Energy Policy and Planning Office (EPPO), Ministry of Energy
6. Office of Transport and Traffic Policy and Planning (OTP), Ministry of Transport
7. Thailand Greenhouse Gas Management Organization (Public Organization) (TGO)
8. Federation of Thai Industries (FTI)
9. Renewable Energy Industry Club, Federation of Thai Industries (RE-FTI)
10. Thai Chamber of Commerce and Board of Trade of Thailand
11. The Thai Bankers' Association (TBA)
12. Association of International Bank (Thailand) (AIB)
13. Government Financial Institutions Association (GFA)

*The BOT and SEC are representatives of the Working Group on Sustainable Finance (WG-SF), in collaboration with the Fiscal Policy Office (FPO), the Office of Insurance Commission (OIC), and the Stock Exchange of Thailand (SET).

Contents

List of Abbreviations

ADB	Asian Development Bank
AER	Annual Efficiency Ratio
ASEAN	Association of Southeast Asian Nations
BAU	Business-as-usual
BUR4	Thailand's Fourth Biennial Update Report
CBI	Climate Bonds Initiative
CCMP	Climate Change Master Plan (2015-2050)
CSP	Concentrated solar power
DCS	Fuel Oil Data Collection System
EU	European Union
FDI	Foreign direct investments
GHG	Greenhouse gases
ICMA	International Capital Market Association
IEA	International Energy Agency
IPPU	Industrial processes and products use
IPCC	Intergovernmental Panel on Climate Change
IMO	International Maritime Organisation
IRENA	International Renewable Energy Agency
LCA	Lifecycle Assessment
LT-LEDS	Long-Term Low Greenhouse Gas Emission Development Strategy
LULUCF	Land Use, Land-Use Change and Forestry Sector
NDC	Nationally Determined Contribution
PED	Primary energy demand
PW	Photovoltaic
RCP	Representative Concentration Pathway, a greenhouse gas concentration trajectory adopted by the IPCC
SDG	Sustainable Development Goals
THB	Thai baht
TPI	Transition Pathway Initiative
TSIC	Thailand Standard Industrial Classification
WG-SF	Working Group on Sustainable Finance

List of Metrics Abbreviations

GgCO2e or GgCO2eq	**Greenhouse gases** in carbon dioxide equivalent
MtCO2e/year	**Gross emission** calculated as metric tons of carbon dioxide equivalent emitted per year
MW	**Megawatt**
CO2e/kWh	**Greenhouse gas emission intensity** calculated as amount of greenhouse gases in carbon dioxide equivalent per kilowatt hour
EJ/year	**Energy consumption** calculated as exajoules consumed per year
ktoe	**Thousand tons of oil equivalent**
tkm or t-km	**tonne-kilometre** is a unit of measure of freight transport which represents the transport of one tonne of goods by a given transport mode (road, rail, air, sea, inland waterways, pipeline etc.) over a distance of one kilometre
pkm or p-km	**passenger-kilometre** is the unit of measurement representing the transport of one passenger by a defined mode of transport (road, rail, air, sea, inland waterways etc.) over one kilometre
RTK	**Revenue-tonne-kilometre**, measures how much revenue a company makes per volume of freight transported

List of Figures

List of Tables

1. Thailand Taxonomy Development framework

1.1. The rationale for the development of a national taxonomy

Given the importance of private and public finance to combat the challenges of climate change, creating and transitioning to a dedicated green finance taxonomy is catalytic to a more vigorous and effective sustainable finance sector. A taxonomy aims to provide a common framework for classifying economic activities to enable stakeholders to gather investment information and mobilise green financing. Taxonomies help market participants, regulators, and policymakers understand risk management and promote investments that meet robust sustainability goals. This increases the level of transparency in financial market priorities and could give a government a tool to direct capital flows in the desired direction that delivers measurable environmental, social and governance (ESG) benefits and net zero emission target.

Taxonomies also facilitate the development of sustainable finance products, including green bonds, green loans, green asset-backed securities, and green indices. A granular taxonomy also allows investors and state authorities to measure the degree of decarbonisation of the different sectors of the economy, the efficiency of their investments, and to identify related weak spots.

In particular, this taxonomy is a multipurpose tool that can be used for a variety of objectives. These could include:

- **To steer the market and provide guidance, frameworks and standards for investors and stakeholders**. It helps to avoid greenwashing and to increase capital flows to green projects as more and more people and institutions want their investments to be sustainable. It can also use to provide better clarity when complying with other frameworks such as the Taskforce on Climate-Related Financial Disclosures (TCFD) Recommendations.
- **To attract international climate-oriented capital**. A national taxonomy which is compatible with international standards and other recognised taxonomies can increase investment flow into that country and improve conditions for domestic borrowers operating on global markets.
- **To enable and harmonize data disclosure**. As the taxonomy is adopted by intermediaries, it will be possible to benchmark the share of green investments in portfolios of banks, insurance companies, and non-financial entities, with a consistent set of nomenclature.
- **To assess environmental risks and risk mitigation options.** Compliance with the taxonomy criteria can provide valuable information on climate-related risks for risk assessment specialists within the financial sector.
- **To modulate state policy in the desired manner**. Under the Paris Agreement and Nationally Determined Contribution (NDC), Thailand is committed to mitigating its

GHG emissions. The Taxonomy provides the government with a tool to define target activities and develop support policies to achieve the country's emission reduction goals.

- **To serve as a basis for data collection**. Granular taxonomies are a valuable tool for understanding the situation in the economy related to GHG emissions and climate action.

This initiative is an extension of the work carried out by the Working Group on Sustainable Finance (WG-SF) of Thailand. This body includes the Fiscal Policy Office of the Ministry of Finance (MoF), the Bank of Thailand (BoT), the Securities and Exchange Commission (SEC), the Office of Insurance Commission (OIC) and the Stock Exchange of Thailand (SET). The work of this working group has also been supported by international partners including International Financial Corporation (IFC), Australian Aid, and GBRW. In light of Thailand's vulnerability to climate change and the pressing need to move to a more sustainable economy, the WG-SF was established to develop a sustainable finance plan to support the Thai economy in achieving the Sustainable Development Goals (SDGs) and carbon emission reduction targets in line with the Paris Agreement goals.

The group's work resulted in the creation of the Sustainable Finance Initiatives, containing five key initiatives, the first of which was the task of creating the Taxonomy for Thailand. The other four initiatives include improving the data environment, implementing effective incentives, creating demand-led products and services, and building human capital. According to the WG-SF members, the taxonomy will establish a common investment language for the Thai sustainable finance market and help to accelerate its development further. It could greatly facilitate the creation of innovative products and services (green bonds, loans, index-linked services, etc.) and serve the objective of developing a cohort of well-regarded monitoring, reporting, and verifying actors, thus enhancing the broader ecosystem of sustainable finance in Thailand. Creating a taxonomy will also facilitate all other initiatives proposed by the WG-SF.

According to the group's recommendations, the taxonomy shall be compatible with significant international taxonomies (especially ASEAN), reflecting both the global context and Thailand's specific circumstances.

At the first stage, covering the green (e.g. climate change mitigation) aspect of sustainable finance, the initial version of the taxonomy is limited in terms of environmental objectives and sectoral scope. Taking into account the rapid change in climate science and technology, the Thailand Taxonomy will be a living document which represents a working taxonomy suitable for use by local markets and regulators.

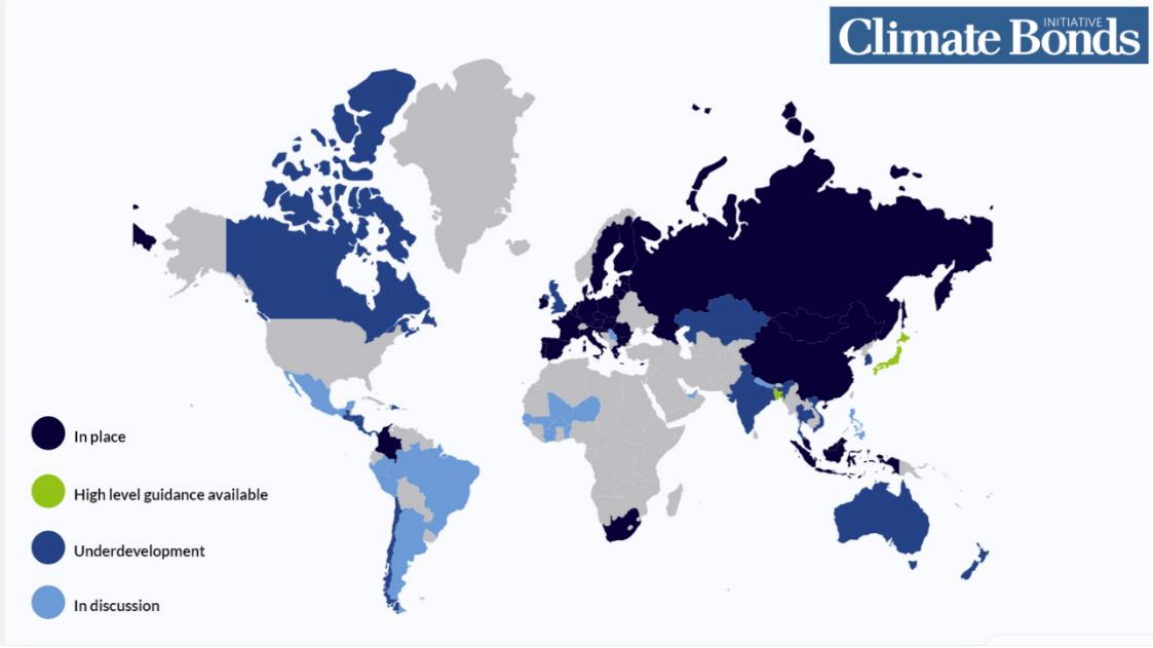
1.2. The world of green taxonomies

The green bond market has become a leading tool for mobilising and directing capital towards climate investment opportunities and driving policy action on climate change. The year 2021 saw an increase in the global sustainable finance market to USD 1.6 trillion, with green

bond issuance doubling in 2021 compared to 2020 to USD 640 billion[1]. Within ASEAN, cumulative green deals (bonds and loans) originating from the ASEAN-6 countries (Singapore, Thailand, Indonesia, Malaysia, Vietnam, and the Philippines) stood at USD 39.4 billion at the end of 2021, contributing 72% to the cumulative total sustainable finance-themed issuances between 2016-2021.[2]

The concept of green taxonomy was introduced in 2012 by the CBI as a voluntary guideline for the green bond market[3]. The taxonomy concept has since evolved from a voluntary market-led tool to a one that is increasingly led by governments. Currently, over 20 jurisdictions have or are in the process of establishing a green or sustainable finance taxonomy or similar classification scheme[4]. These include the European Union (EU)[5], ASEAN[6], China[7], Russia[8], South Africa[9] and many others. The EU, Climate Bonds and ASEAN taxonomies usually serve as benchmarks with countries and regions adjusting their respective national schemes to be compatible with them.

Figure 1. Taxonomy development around the world



***Source**: CBI, 2022*

As the taxonomies around the world multiple, there are concerns of market fragmentation. Capital from all over the world is critical to achieving climate goals, but discrepancies

[1] BloombergNEF. (2022). 1H 2022 Sustainable Finance Market Outlook

[2] Climate Bonds Initiative. (2022). ASEAN Sustainable Finance State of the Market 2021

[3] Climate Bonds Initiative. (2023). Climate Bonds Taxonomy

[4] Climate Bonds Initiative. (2022). Global Green Taxonomy Development, Alignment, and Implementation

[5] European Commission. EU Taxonomy Navigator

[6] ASEAN Taxonomy Board. (2021). ASEAN Taxonomy for Sustainable Finance Version 1

[7] Climate Cooperation China. (2020). Green Bond Endorsed Project Catalogue (2020 Edition)

[8] Government of the Russian Federation. (2021). Decree of the Government of the Russian Federation No. 21 of 09.2021.1587

[9] National Treasury, Republic of South Africa. (2022). South African Green Finance Taxonomy 1st Edition

between taxonomies may confuse investors and disincentivise cross-border capital flows. To avoid this, efforts are being made to harmonise compliant assets and metrics covered by the different taxonomies across jurisdictions. The most prominent attempt in this sphere has been the development of a Common Ground Taxonomy between the EU and China by the International Platform on Sustainable Finance (IPSF).

The East and Southeast Asian regions have the largest number of national taxonomies developed or in development. China, Japan, Mongolia, South Korea, Indonesia, Malaysia and India, Vietnam, the Philippines, Singapore, and Sri Lanka have moved along this path.

A key feature of taxonomies is the criteria used to identify green activities and separate them from non-green activities. Globally, there are three different methods used to define green:

- **Whitelist-based taxonomies**, which identify compliant projects or economic activities under each sector or sub-sector (China, Russia, Mongolia)
- **Technical screening criteria-based taxonomies**, which define quantitative thresholds and screening criteria for economic activities and their compliance with the specific objectives (EU, Colombia, South Africa)
- **Principle-based taxonomies** define a set of core principles for the market without specifying compliant activities or thresholds (Japan, Malaysia, ICMA)

In this context, the ASEAN Taxonomy for Sustainable Finance (ASEAN Taxonomy), with which the Thailand Taxonomy is closely aligned, is being developed as a two-tier set of principles of sustainable development and a reference point for sustainable projects and activities in ASEAN. Its goal is to help issuers and investors understand the sustainability impact of a project or economic activity. Its first version was published in November 2021 and came along the second version in March 2023. The ASEAN Taxonomy is meant to serve as an overarching guide to introduce a common language across the different jurisdictions to communicate and coordinate the labelling for economic activities and financial instruments.

1.3. Key reference taxonomies

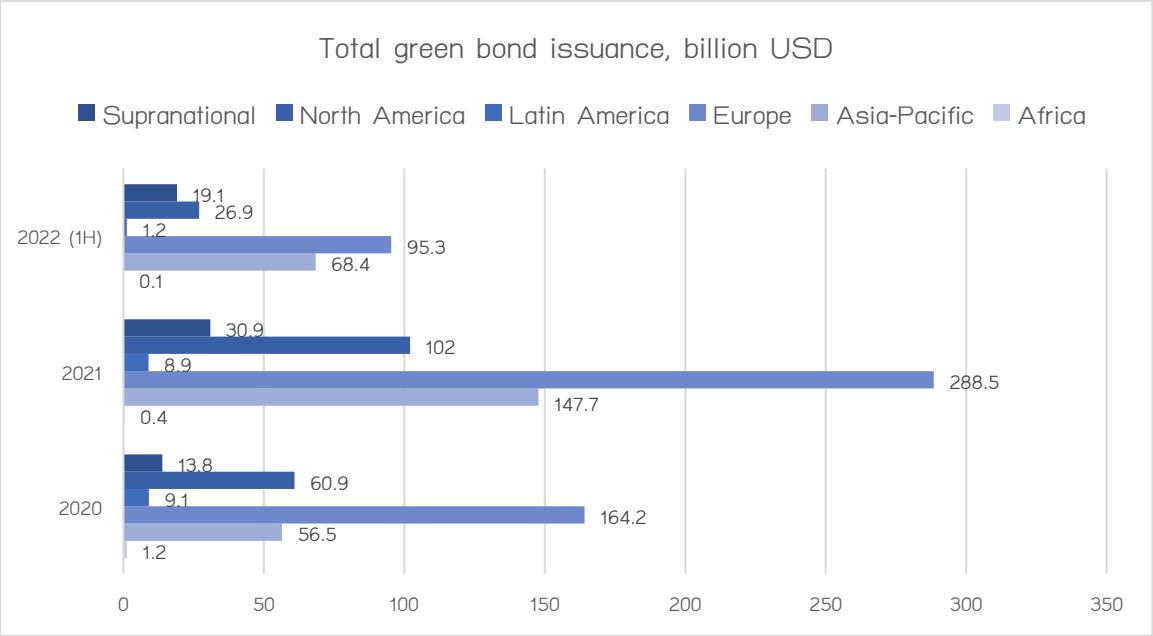
The EU Taxonomy is widely considered to be a global benchmark for taxonomies worldwide, given the large number of investors in the EU as well as its leadership in sustainable finance. As a result, investors regard compatibility with the EU Taxonomy as an important reference point to attract capital from the international market.

The Asia-Pacific region occupies the second place in the world in terms of volume of the green bond market, is the home region for Thailand and the majority of its key trade partners (13 of 15 top trade partners of Thailand are situated in the region)[10]. The Chinese Green Bond Endorsed Project Catalogue and the ASEAN Taxonomy are dominant in the region

[10] Daniel Workman. (2023). Thailand's Top Trading Partners

and additionally they serve as the reference point for investors. Finally, the Climate Bonds Taxonomy is incorporated into most existing taxonomies worldwide as it provides high quality, science-based and politically neutral technical screening criteria.

Figure 2. Total green bonds issuance by region



***Source**: CBI Interactive Market Data Platform*

The EU taxonomy has the most advanced technical screening criteria and activity thresholds. Although many of the requirements include references to specific EU laws and regulations, many taxonomies (South Africa, Russia, Colombia, and others) use it as a reference point. It is also at the centre of IPSF efforts to build a Common Ground Taxonomy. The current version of the EU Taxonomy includes hard-to-abate activities but does not give adequate guidance on how they can transition to meet a transition pathway.

China's green bond market is regulated by several different regulators and while each had a slightly different taxonomy, they jointly released the Green Bond Endorsed Project Catalogue in May 2020 which marked the beginning of the harmonisation of domestic green finance definitions. For the sake of clarity, it is referred to as the Chinese Taxonomy throughout this document. Unlike the EU Taxonomy, it is a whitelist-based taxonomy that, in most cases, does not have specific thresholds, but it defines assets and activities that are considered green. These definitions tend to be relatively broad and less stringent than those of the EU or Climate Bonds Taxonomy and, therefore, in many cases, if an activity is aligned with the EU taxonomy, then it is compliant under the Chinese Taxonomy as well. The Chinese Taxonomy (just as the EU one) contains a lot of references to domestic law, which makes it difficult to apply outside China.

The ASEAN Taxonomy does not yet have sectoral screening criteria but, it can serve as an overarching framework of guiding principles for decarbonisation and environmental objectives for the Thailand Taxonomy. Its multi-tiered system allows countries at different economic development levels to co-exist within the same decarbonisation framework,

adjusting it to their specific capabilities. It also employs a so-called traffic light system that distinguishes between green, amber (transitional), and red activities depending on their role in climate change mitigation. The traffic light approach will also be employed in the Thailand Taxonomy.

As the Thailand Taxonomy will be developed in close alignment with the ASEAN Taxonomy, it is essential to understand the key characteristics of the latter. The key feature of the ASEAN Taxonomy is its two-tier structure: the Fundamental Framework Tier and the Plus Standard Tier.

- **The Foundation Framework** tier of the ASEAN Taxonomy is a single sector-agnostic decision tree to classify activities into three categories: green, amber (transitional), or red. It is intended to be a simple one-dimensional tool for those countries that consider it sufficient to only have an overarching guiding framework from the point of view of their capabilities and level of economic development.
- **The Plus Standard** tier enables taxonomy users to further assess economic activities using activity-level threshold criteria to determine whether the activity falls into one of the three categories of the traffic light system. This option is more aligned with international best practices and applies to Thailand as a practical approach to achieving its climate policy objectives. As ASEAN's second-largest economy with developed manufacturing industries and the fourth biggest per capita GDP, Thailand is positioned as one of Asia's economic powerhouses because it has the necessary resources to fund an ambitious transition to a net-zero economy and to become one of the climate champions of the region.

The ASEAN Taxonomy acknowledges the existence of unique differences among the member-states of the regional community and allows them to achieve their adopted environmental and climate goals at their own individual pace. In addition, it serves as the additional reference for Thailand Taxonomy.

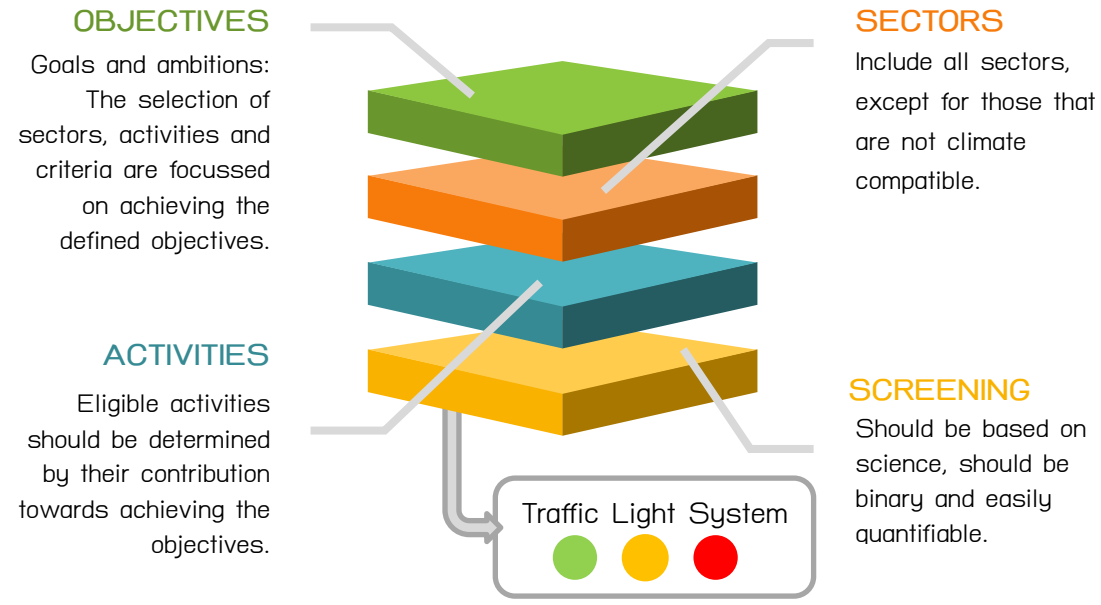
The Climate Bonds Taxonomy is the first international taxonomy and was published in 2013. It includes the fundamental features that can be used to develop robust national taxonomies. Firstly, it pays special attention to transitional activities. Secondly, it is constantly updated based on the latest climate science, including research from the IPCC and the International Energy Agency (IEA) whilst also benefiting from the input of hundreds of technical experts worldwide. Finally, it is independent of political or economic considerations and does not contain references to any national documents and therefore may be applied worldwide.

The current taxonomy is broadly compatible with all above-mentioned taxonomies although there are some differences as the granular level. Further details on the comparability between the Climate Bonds Taxonomy and the Chinese Taxonomy, please see the table in Annex 1 at the end of the paper.

1.4. Taxonomy structure overview

The structure of most taxonomies follows a pattern similar to a tapering funnel: objectives, sectors, activities, screening criteria. This pattern is not universal (the Chinese Green Bond Endorsed Projects Catalogue and Malaysia Principles-based taxonomy are structured differently) but it is the most common and usable one for financial markets. It also provides a necessary degree of compatibility with other taxonomies and makes it easier for the taxonomy development committee to update it.

Figure 3. Key elements involved in taxonomy development



***Source**: CBI, 2022*

The following sections discuss the processes and analyses that have informed the definition of the Thailand Taxonomy objectives, the section of key economic sectors and activities, and the design of screening criteria and thresholds for the sectors and activities.

1.5. Defining the objectives of the Thailand Taxonomy

Objectives of the Thailand Taxonomy are the top-level criteria with which all green activities need to be aligned. The principles of the Paris Agreement and SDGs lie at the core of any set of objectives. In the case of national taxonomies like the Thailand Taxonomy, they are defined by a country's policy, priorities, and environmental situation. The objectives one chooses may affect the sectoral composition of the taxonomy as every single activity must lead to accomplishing at least one objective.

The primarily focus of the Thailand Taxonomy is to define activities that reduce GHG emissions to achieve the climate change mitigation objectives of the Kingdom of Thailand, which are in line with its climate policy and international obligations. Mitigation is also the most important objective that exists in all other taxonomies and leads to achieving one of the main goals of the Paris Agreement. This Taxonomy lists economic activities and the

relevant criteria to classify them as green, excluded (red), or transitional (amber). It does not intend to single out "good" or "bad" actions and it does not serve as a tool for assessing the possible financial performance of companies.

Its basic guiding principles are as follows:

- **Science-based**. The taxonomy is based on scientific findings and recommendations.
- **Aimed at achieving Paris Agreement targets**. The goal of the Paris Agreement, to which Thailand is a signatory, is to limit global warming by 2°C and ideally by 1.5°C compared to pre-industrial levels.
- **Technologically neutral**. The taxonomy does not rule out the use of any kind of technology as long as it brings the country/activity closer to its mitigation target and meets established green or amber criteria.
- **Regularly revised**. The taxonomy will be subjected to regular updates to reflect the development of climate science and technology.

Table 1. Examples of objectives from international and national taxonomies

EU Taxonomy	ASEAN Taxonomy	Climate Bonds Taxonomy	China	Colombian Taxonomy[11]
Climate change mitigation	Climate change mitigation	Climate change mitigation	Addressing climate change;	Climate change mitigation
Climate change adaptation	Climate change adaptation	Climate change adaptation		Climate change adaptation
Sustainable use and protection of water resources				Water management
Transition to a circular economy	Promote resource resilience & transition to a circular economy		More efficient resource utilization	
Pollution prevention and control				
Protection and restoration of biodiversity and ecosystems	Preservation of healthy ecosystem & biodiversity		Environmental improvement	Conservation of ecosystems and biodiversity
				Land management

[11] Colombian taxonomy added as it's the last taxonomy produced with CBI assistance that absorbed all the best practices existing in the world as of mid-2022.

The objectives of the Thailand Taxonomy are built around Thailand's decarbonisation goals as well as the objectives of international and regional taxonomies to which it is aligned.

1.6. National environmental objectives

In its Climate Change Master Plan (2015-2050) (CCMP), Thailand indicates three key strategies that translate into climate objectives:

- **Climate Change Adaptation**, which aims to build climate resilience by integrating adaptation and resilience objectives into policies and measures in all sectors
- **Mitigation and Low Carbon Development**, which facilitates the development of mechanisms for GHG emissions reduction and leads to sustainable low carbon growth, and
- **Enabling Environment for Climate Change Management,** which seeks to build capacity around climate change by raising the awareness of relevant stakeholders as well as developing information-based tools and technologies to support climate change adaptation and mitigation

In the "Long-Term Low Greenhouse Gas Emission Development Strategy (LT-LEDS)"[12] **mitigation** is a key priority. It is noted, however, that "*although Thailand's LT-LEDS primarily focuses on GHG mitigation, Thailand recognises that* ***adaptation*** *and climate* ***resilience*** *are equally important. Thailand, therefore, looks forward to further elaborating its policies and priorities on climate change* ***adaptation*** *in future communications*".

The country's updated NDC (2020) also states that "*in addition to its* ***mitigation*** *efforts, Thailand has placed* ***adaptation*** *as equally important*".

In this context, Thailand's National Strategy (2018-2037)[13] puts forward the following environment-related goals:

1. Promoting green growth and sustainable development
2. Conserving and rehabilitating biological diversity
3. Conserving and restoring rivers, canals, and other natural water sources
4. Maintaining and expanding eco-friendly green areas
5. Promoting sustainable consumption and production
6. Promoting sustainable maritime-based economic growth
7. Increasing value of a maritime bioeconomy
8. Improving, rehabilitating, and developing the entire marine and coastal resource ecosystem
9. Rehabilitating tourist beaches, protecting and improving the entire coastal resource ecosystem, and setting out an integrated coastal management policy
10. Developing and increasing eco-friendly marine activities
11. Promoting sustainable, climate-friendly based society growth

[12] UNFCCC, Office of Natural Resources and Environmental Policy and Planning, Ministry of Natural Resources and Environment. (2021). Mid-century, Long-term Low Greenhouse Gas Emission Development Strategy: Thailand

[13] Office of the National Economic and Social Development Council. National Strategy

12. Mitigating greenhouse gas emissions
13. Adapting to prevent and reduce losses and damages caused by natural disasters and impacts of climate change
14. Focusing on investment in public and private sectors' climate-friendly infrastructure development
15. Developing preparedness and response systems for emerging and remerging infectious diseases caused by climate change
16. Developing urban, rural, agricultural, and industrial areas with a critical focus on a sustainable growth
17. Establishing ecological landscape plans to promote urban, rural, agricultural, industrial, and conservation area development on an integrated basis in harmony with area capacity and suitability
18. Developing urban, rural as well as agricultural and industrial areas in line with the ecological landscape plans
19. Eliminating pollution and damaging agricultural chemicals in line with international standard
20. Sustainably conserving, rehabilitating, and developing natural resources, architectural heritage, art, and culture, as well as local identity and lifestyles
21. Developing networks of urban and community development institutions and volunteers through a mechanism of local sectors' involvement and participation
22. Strengthening public health and environmental health systems as well as enhancing capacity needed to address preventive and controlling measures of emerging and re-emerging infectious diseases
23. Creating eco-friendly water, energy, and agricultural security
24. Developing the entire river basin management system to ensure national water security
25. Enhancing the productivity of an entire water system to promote water-use efficiency and generate value added for water consumption adequate with international standard
26. Creating national energy security and promoting eco-friendly energy usage
27. Enhancing energy efficiency through energy intensity reduction
28. Developing agricultural and food security in terms of quantity, quality, pricing, and access at both national and community levels
29. Improving the paradigm for determining the country's future by promoting a sense of environmental stewardship among Thai people
30. Promoting desirable environmentally friendly characteristics and behaviours among Thai people that positively contribute to the environment and quality of life of Thai people
31. Developing tools, justice mechanisms, and systems, environmental democracy on efficient natural resources, and environment management
32. Establishing institutional structures to manage significant issues concerning natural resources and environmental management
33. Initiating projects that can improve a development paradigm to determine the country's future in terms of natural resource, environmental, and cultural sustainability based on public participation and good governance

If these goals are grouped according to the general categories that are used in the international practice of taxonomy development, the following six main taxonomy objectives can be identified for Thailand.

Table 2. Thailand decarbonisation objectives grouping

Point number	Potential taxonomy objective
12, 27	Climate change mitigation
13, 15,	Climate change adaptation
3, 6, 7, 8, 9, 10, 24, 25	Sustainable use and protection of marine and water resources
5, 26	Resource resilience and transition to a circular economy
19	Pollution prevention and control
2, 4, 20	Protection and restoration of biodiversity and ecosystems
1, 11, 14, 16, 17, 18, 21, 22, 23, 28, 29, 30, 31, 32, 33	Not targeting environmental objectives (out of scope)

This categorization enables the mapping of all important priorities reflected in the Thai strategic documents as per Table 3 below.

Table 3. Thailand's national environmental priorities matrix

National Strategy (thematical grouping)	CCMP	LEDS	NDC
Climate change mitigation	Mitigation and Low Carbon Development	Mitigation	Mitigation
Climate change adaptation	Climate Change Adaptation	Adaptation and Resilience	Adaptation
Sustainable use and protection of marine and water resources	Enabling Environment for Climate Change Management		
Resource resilience and transition to a circular economy			
Pollution prevention and control			
Protection and restoration of biodiversity and ecosystems			

Another consideration when developing the objectives for the Thailand Taxonomy would be to consider the decarbonisation objectives of key ASEAN strategic documents apart from the ASEAN Taxonomy. According to the ASEAN Socio-Cultural Community Blueprint

2025[14], ASEAN member states need to identify individual as well as common climate and environment goals. Overall regional priorities include:

- *"A resilient community with enhanced capacity and capability to adapt and respond to social and economic vulnerabilities, disasters, climate change as well as emerging threats and challenges."*
- *To "protect, restore, promote sustainable use of terrestrial ecosystem sources, halt biodiversity loss and reserve land degradation."*
- *"Sustainable forest management in the context of forest fire prevention and control."*
- *"Protection, restoration and sustainable use of the coastal and marine environment, respond and deal with the risk of pollution and threats to marine ecosystems and coastal environment."*
- *To "conserve, develop and sustainably manage marine wetlands, peatlands, biodiversity and land, and water resources."*

Finally, two significant aspects must be considered when outlining the Thailand Taxonomy objectives. Firstly, these objectives must reflect international obligations and national strategic documents. Secondly, they must be compatible with existing taxonomies to avoid market fragmentation. As such, the following list of objectives for the Thailand Taxonomy have been identified:

Table 4. Thai Taxonomy objectives alignment

Alignment table			
Documents: / Objectives:	Thailand's National Priorities	EU Taxonomy	ASEAN Taxonomy
Climate change mitigation	+	+	+
Climate change adaptation	+	+	+
Sustainable use and protection of marine and water resources	+	+	+\-[15]
Resource resilience and transition to a circular economy	+	+	+
Pollution prevention and control	+	+	+\-
Protection and restoration of biodiversity and ecosystems	+	+	+

[14] ASEAN. (2016). ASEAN Socio-cultural Community Blueprint 2025

[15] Means the objective is partially aligned

It must be recognised that the ASEAN Taxonomy does not have any specific objectives for pollution prevention and water/marine resources management. However, those can be partially aligned with the existing objectives of resource resilience and the protection of ecosystems. In conclusion, as per Table 4 above, the identified six objectives of the Thailand Taxonomy give us 100% alignment with the EU taxonomy and 90-95% (depending on the final list of activities) alignment with the ASEAN Taxonomy on a broad level.

1.7. The final list of the objectives and their description

Based on the analysis in the previous section, it is proposed that the Thailand Taxonomy is designed to cover the following six environmental objectives: climate change mitigation, climate change adaptation, sustainable use and protection of marine and water resources, protection and restoration of biodiversity and ecosystems, pollution prevention and control, and resource resilience and transition to a circular economy. While this first version of the Thailand Taxonomy will only develop the screening criteria and thresholds for the climate change mitigation objective as a start, it incorporates the principles of Do Not Significant Harm (DNSH) to the other five objectives. Over time, it is expected that future versions of the Thailand Taxonomy will include screening criteria and thresholds of other environmental objectives listed below as well.

Climate change mitigation

The objective of climate change mitigation demands the reduction of GHGs emitted as the result of human activity in the country, which is necessary to avoid catastrophic consequences of climate change.

An activity can be considered to have met this objective if it makes a substantial contribution to:

- **Avoidance of GHG emissions**. These are 'green activities' already having very low or near-zero emissions. More capital is required to increase their development and broader deployment
- **Reduction of GHG emissions**. Some activities (the production of steel, cement, aluminium, etc.) are critical to the functioning of the modern economy but are carbon intensive. These activities are called transitional. The current level of technological development is insufficient to decarbonise them entirely in short term, but they must significantly improve their performance over time
- **Enabling GHG-reducing activities**. These activities do not reduce GHG emissions but facilitate other mitigation activities. Examples are renewable power transmission, carbon capture, utilisation and storage, data-driven solutions etc.

According to Thailand's Second Updated NDC, the country aims to increase emission reductions to 30-40% by 2030 in order to achieve carbon neutrality by 2050 and net zero GHG emissions by 2065. The long-term strategy to achieve carbon neutrality by 2050 will also largely depend on emission reductions in the energy sector, including using carbon

capture, utilisation and storage (CCUS) technologies.[16] Sectoral decarbonisation strategies must also be developed to facilitate this task.

Climate change adaptation

The objective of climate change adaptation demands Thailand to substantially reduce the adverse impact of climate change on its people, nature, and assets as well as on economic activity itself. Climate change adaptation may also increase the country's resilience to the adverse physical impacts of current and future climate changes and/or capture new economic opportunities from climate change.

To be developed further in the subsequent phases of the Thailand Taxonomy development.

Sustainable use and protection of marine and water resources

The objective of sustainable use and protection of marine and water resources deals with a broad range of issues important to Thailand, from sustainable development of coastal areas to retrofitting of water treatment facilities.

To be developed further in the subsequent phases of the Thailand Taxonomy development.

Protection and restoration of biodiversity and ecosystems

The objective of ecosystems and biodiversity protection implies preventing the loss of plants and living species whilst also sustainably managing, conserving, and restoring their habitats. This is important not only for protecting Thailand's unique landscapes and ecosystems but also for climate change mitigation because healthy habitats remove a substantial portion of carbon from the atmosphere.

To be developed further in the subsequent phases of the Thailand Taxonomy development.

Pollution prevention and control

This objective leads to implementing activities that help the country to prevent and control pollution on all levels, including industrial, agricultural, and household pollution. It helps to improve the quality of air, soil, and water, as well as decrease the waste of valuable resources.

To be developed further in the subsequent phases of the Thailand Taxonomy development.

Promote resource resilience and transition to a circular economy

The objective of promoting resource resilience and transition to a circular economy stems from the necessity to maximise resource productivity. With the growth of the Earth's population and aggravating climate change effects, Thailand (as well as all other countries) will have to deal with the ever-increasing scarcity of natural resources (primarily food and water) and rising prices. The introduction of lean manufacturing and circular economy practices will benefit Thailand from environmental and economic perspectives.

To be developed further in the subsequent phases of the Thailand Taxonomy development.

[16] Thammasart University. (2020). The revision and update of Thailand's Long-Term Low Greenhouse Gas Emission lopment Strategy (LT-LEDS) and Thailand's National Determined Contribution (NDC)

2. Sectoral assessment

2.1. Economic Sectors Selection

In order to better define sectors that have the biggest potential to contribute to climate change mitigation, a matrix of all country-level economic activities in the country is built with respect to their GHG emission profile and economic parameters. The International Standard Industrial Classification (ISIC) of economic activities was selected as a general framework for classifying all sector-specific activities. The ISIC framework was established by the United Nations; it is largely compatible with other international frameworks and provides a sufficient degree of granularity. There is also currently no ASEAN-specific industrial standard that is commonly adopted, so the ISIC codes can provide a common reference framework across ASEAN countries.

Using ISIC-based sector and activity classification, the Thailand Taxonomy should include all economic sectors and activities in the economy that could be considered green and transitional, as well as providing the basis for the exclusion of red activities. In the context of the current version of Thailand taxonomy, which focuses only on climate change mitigation, red activities refer to those activities that are not climate-aligned from the perspective of reducing greenhouse gas emissions (e.g., electricity generation from coal, manufacturing of single use plastics, transport of fossil fuels, timber production on peatland, waste transport to open dumpsites, landfill without gas capture). As a consequence, the sectors and activities covered by the taxonomy must be prioritised based on:

> **The substantial contribution** of the sectors and activities to the key objectives of the taxonomy, which for the current version of the taxonomy, is climate change mitigation.
>
> **The evaluation of multiple parameters** such as (among others) their GHG emission profile, their contribution to the country's Gross Domestic Product (GDP), the share of Foreign Direct Investment (FDI), and the technical viability for decarbonisation.

The first parameter that must be assessed is the share of GHG emissions produced by each different sector of the economy. As demonstrated in Table 5, energy and transport are the top two contributors of GHG emissions in Thailand. It is important to notice, that emissions in the LULUCF sector, which serves both as a carbon emitter and as a carbon sink, are excluded if the amount of the carbon absorbed by the sink exceeds the carbon emitted by the sector, thus resulting in net removals. This sector in Thailand demonstrates a trend of increased net removals because the total removals exceeded the total emissions. In 2018, the LULUCF sector contributed to a net removal of 85968 GgCO2eq, accounting for an increase by two folds compared with the year 2000[xviii]. For this reason, the LULUCF sector is not included in the table below on sectoral emission profiles.

Table 5. GHG Emissions by sectors of the economy

Subsector[17]	IPCC 2006 Code[18]	GHG Emission, total in GgCO2eq[19] (Share of total, %)
Energy industries	1A1	103,055.20 (28.51%)
Transport	1A3	75,029.65 (20.76%)
Manufacturing Industries and Construction[20]	1A2	52,078.20 (14.41%)
Rice Cultivation	3I	29,990.25 (8.30%)
Mineral Industry	2A	20,574.46 (5.69%)
Other Sectors within Energy	1A4	16,884.56 (4.67%)
Chemical Industry	2B	12,354.17 (3.42%)
Fugitive Emissions from Fuels	1B	10293.28 (2.85%)
Enteric Fermentation	3A	10,052.24 (2.78%)
Solid Waste Disposal	5A	8,774.67 (2.43%)
Direct N2O Emission from Managed Soils	3F	8,715.01 (2.41%)
Wastewater Treatment and Discharge	5D	7,635.72 (2.11%)
Indirect N2O Emission from Managed Soils	3G	3,259.34 (0.90%)
Manure Management	3B	2,494.12 (0.69%)
Incineration and Open Burning of Waste	5C	180.54 (0.05%)
Biological Treatment of Solid Waste	5B	112.76 (0.03%)
	Total	361,483.58[21]

***Source**: Thailand's Fourth National Communication*

Note: This table uses a sector classification according to Thailand's NDC, which lists sectoral emissions based on the IPCC's 2006 code. This system of classification is different from the ISIC system that form the basis on the Thailand Taxonomy. Further details on how the Thailand Taxonomy translates IPCC 2006-based sectors in the NDC into ISIC-based sectors are provided below in the Table 7.

In terms of contribution to the Thai GDP, the service sector makes the biggest contribution with more than 58% of GDP in 2021 followed by manufacturing (27.1%), which contains carbon-intensive industries representing between a quarter and a third of the country 's

[17] Not all economically relevant sectors are included but only those having significant contribution to GHG emissions

[18] Calculations of the national GHG inventory have been made in accordance with the 2006 IPCC Guidelines for National Greenhouse Gas Inventories

[19] Data used is derived from Thailand's Fourth National Communication (NC4)

[20] Includes "emissions from fuel combustion" in construction and manufacturing and thus counts as part of the "energy" basket

[21] Total GHG emission stood at 372,648.77 GgCO2eq in 2018 according to NC4, so the table covers 97% of all non-LULUCF emissions in the country

economic activity. The Thailand Taxonomy should therefore be developed to cover these economically important sectors to facilitate their green transition. At the same time, the Thailand Taxonomy should also be developed to cover economic sectors where Foreign Direct Investment (FDI) play an important role, or where there is potential to attract more FDI, particularly for sectors that are essential to accelerate the country's decarbonisation pathway.

Table 6. Major economic indicators and trends in carbon-intensive industries, USD billion

	Agriculture, forestry and fishing	Manufacturing of chemicals	Manufacturing without chemicals	Electricity, gas, steam, conditioning supply	Construction	Transportation and storage	Water Supply Sewerage, Waste & Remediation Activities
Foreign Direct Investments, USD biliion (share or total FDI, %)							
2017	0.003 (0.04%)	-0.171	1.109 (13.4%)	0.640 (7.72%)	-0.035	-0.117	N/A
2021 (est.)	0.008 (0.07%)	0.725 (5.96%)	4.181 (34.39%)	0.139 (1.14%)	0.058 (0.48%)	0.113 (0.93%)	N/A
Share of GDP, USD billion (share of total GDP, %)							
2017	38.4 (8.41%)	123.4 (27.3%)		11.7[22] (2.56%)	11.6 (2.54%)	27.1 (5.94%)	1.8 (0.39%)
2021 (est.)	43.2 (8.54%)	136.6 (27.1%)		12.4 (2.45%)	13.7 (2.71%)	23.0 (4.55%)	2.2 (0.43%)

***Source**: World Bank, Bank of Thailand*

Based on the data and information provided above, it is therefore possible to derive a long list of sectors to be initially covered by the Thailand Taxonomy: energy, water supply (sewerage, waste & remediation), transport, agriculture, and industrial production. As shown in Table 7 below, these sectors combined encompass the majority of the country's GHG emissions (more than 95% of GHG emissions) and more than 40% of its economic activity. In addition, these sectors consist of both sectors considered green as well as sectors that are in the process of transitioning towards low carbon. The ratio of emissions share to GDP share reflects the hard-to-abate industries that should be decarbonised first to achieve maximum results in terms of climate change mitigation.

It should be noted that the sectors that are in list above appear differently in the sector list of individual official documents because they use different sector classification systems. More specifically, Thailand's NDC document reports sector-based emissions by using the IPCC's 2006 code for sector classification, while the Bank of Thailand and other Thai government agencies use the ISIC. To illustrate the comparability and discrepancy between the IPCC's 2006 code and the ISIC code, the following matrix shows how the

[22] GDP for this sector given without petroleum refining

IPCC's 2006 sectors can be mapped against the ISIC sectors, thus allowing users of the Thailand Taxonomy to relate the ISIC-based sectors in the Thailand Taxonomy and to those in the NDC. The matrix is indicative in nature and is intended to provide guidance for further actions rather than precisely equate one groups with the others.

Table 7. Sector prioritisation matrix

Sector	*IPCC 2006*	*ISIC 4*	*Share of GHG emission, % of country total (2018)*	*Share of FDI, % of total (2021)*	*Share of GDP, % of total (2021)*	*Emissions share to GDP share ratio*	*Comment*
Energy	1A2, 1A1, 1A4,	D	47.59%	1.14%	2.45%	19.45	Biggest ratio, biggest mitigation potential, a lot of available technologies
Water Supply Sewerage, Waste & Remediation Activities	5A, 5B, 5C, 5D	E	4.62%	N/A	0.43%	10.70	High ratio, but relatively small part of the GDP and small gross emissions
Transportation	1A3	H49, H50, H51, H52	20.76%	0.93%	4.55%	4.56	Average ratio, but large potential for decarbonisation due to a vast array of available technologies
Agriculture, hunting, fishing, forestry	3A, 3B, 3G, 3F, 3I	A	15.08%	0.07%	8.54%	1.76	Huge contributor to GHG emissions, small ratio, the most complicated sector for emission reduction due to multiple factors
Manufacturing (industrials)	2A, 2B	C, F	9.11%	40.35%	29.81%	0.30	Average emission, but low ratio. Large FDI Inflow of capital means increasing future emissions

***Source**: Bank of Thailand, Thailand's Fourth National Communication*

It is important to note that this prioritisation exercise is based both on an expert assessment and quantitative measures as well as technological viability of decarbonisation. Thus, the sectors that have been prioritised for the climate change mitigation objective of the Thailand Taxonomy are as follow:

Table 8. Sector prioritisation rationale

Sector	Rationale
Energy	The energy sector is a major contributor to greenhouse gas emissions in almost every country in the world. Existing technologies have reached a level at which replacing high-emission fuels with renewable energy sources is justified not only climatically, but also economically. Including this sector in the taxonomy would help direct capital flows in the right direction.
Transportation	The sector is the second biggest in terms of emissions and prioritised by the Government of Thailand decarbonisation policies, but it is underinvested, both generally and from the point of view of green transition. The sector is well-researched and provides numerous technological opportunities for GHG emissions abatement, from electric cars to sustainable fuels
Industrials	The sector attracts the bulk of all investments in the country but also concentrates "red" and hard-to abate activities such as fossil fuels, production of steel and cement. Technologies are lacking in many cases, but the application of carbon capture and new energy sources such as hydrogen may lead to positive mitigation outcomes
Agriculture	Agriculture is one of the hardest sectors to decarbonise because of its diversity and complexity. In particular, the units where activities are carried out are generally small and not always able to get access to the latest innovations. Nevertheless, thanks to low-carbon farming technologies, the science-based approach to decarbonising the sector can help to strengthen its component as a carbon sink.
Water and Wastewater Supply, Processing and Remediation	Although small in scale, this sector is very important for human well-being and quality of life. Its huge emissions-to-GDP share ratio makes it an important decarbonisation target, and in many cases the technologies applied for this decarbonisation have numerous positive side-effects on economy, ecology, and health

2.2. Final sector breakdown and activities mapping

For the first version of the Thailand Taxonomy, the Thailand Taxonomy Board decided to set its scope to the first two sectors in the table above: energy and transportation. Based on the ISIC-4 Code System, the scope of the energy sector covered in this taxonomy refers primarily to the production of electricity from various sources, including related activities on heat and cooling, transmission, distribution, and storage. The scope of the transport sector reflects to different modes of transport of passengers and freight from one point to another without covering the manufacturing of vehicles (according to ISIC this is a part of the manufacturing sector).

Energy and transportation are highlighted as being at the focus of Thailand's government efforts to decrease emissions because, on the one hand, the two sectors account for a

significant share of the country's GHG emissions and high energy intensity use but, on the other hand, a vast array of available technological solutions allow a swift decarbonisation sectoral pathway. Moreover, these two high-emitting sectors represent small shares of the country's FDI, which contributes to insufficient investments for decarbonisation. Therefore, a specific focus of the Taxonomy on both energy and transportation could help Thailand establish a set of internationally interoperable green investment standards in these two sectors, thus attracting additional green capital both from the domestic and international markets.

Based on the ISIC-4 code system, the energy and transport sectors could be further disaggregated into the main types of activities as shown in the Table 9 below. The Inclusion of these two sectors in the Thailand Taxonomy means that the taxonomy will be applied to economic activities covering 247046 GgCO2eq, or 66% of all emissions of Thailand (with total GHG emission in 2018 standing at 372648.77 GgCO2eq excluding LULUCF).

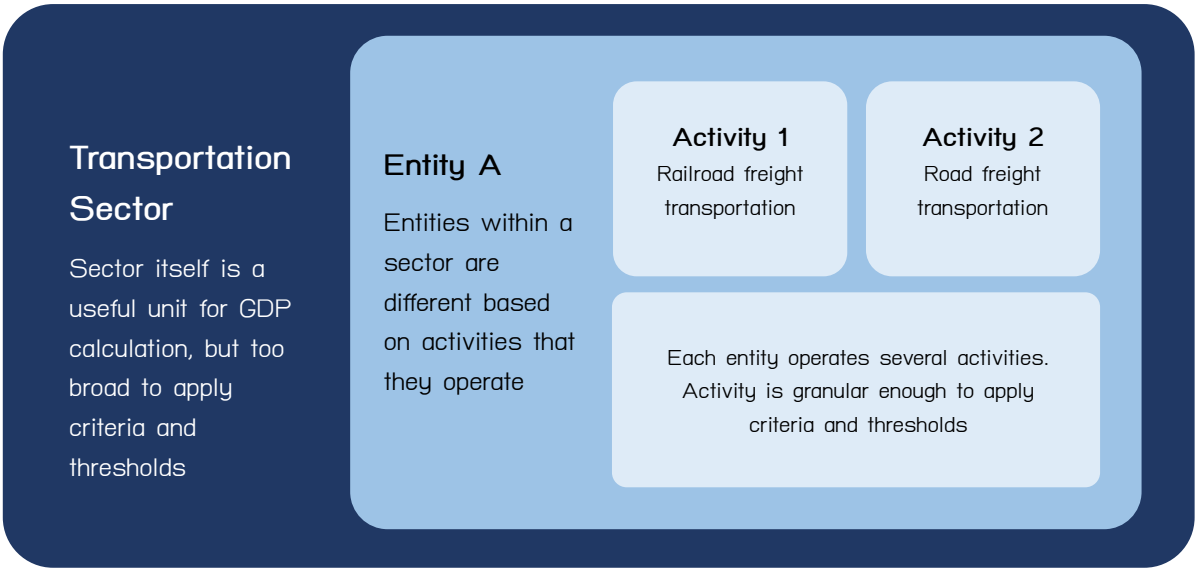
Table 9. Final set of the ISIC-4 code-based sectors and sub-sectors to be included into the Thailand Taxonomy Phase 1

Sector	Subsector by ISIC 4 Code (UNSD)	Subsector by ISIC 4 Code (TSIC)
Energy	D351 - Electric power generation, transmission and distribution	
	D352 - Manufacture of gas; distribution of gaseous fuels through mains	
	D353 - Steam and air conditioning supply	
Transportation[23]	H491 - Transport via railways	
	H492 - Other land transport	H492 - Transport via buses H493 - Other land transport
	H493 - Transport via pipeline	H494 - Transport via pipeline
	H501 - Sea and coastal water transport	
	H502 - Inland water transport	
	C3312 - Repair of Machinery	

Activities are the processes to which specific criteria and screening thresholds are applied within this taxonomy. All major international taxonomies work with activities as operational taxonomical units and not, for example, sectors or entities. This is convenient because an activity is, on the one hand, large enough to be the object of a bond or loan issuance and, on the other hand, granular enough to be separated from similar activities. An entity comprises several activities, some of which can be decarbonised with significant emission reduction benefits (e.g., steelmaking, battery production, power generation etc.), while the effect of others on climate is negligible (e.g., management, accounting etc.).

[23] Storage sector was removed from further calculations due to its negligible effect on climate. Repair of Machinery was added due to its high relevance to other sectors in the context of Taxonomy

Figure 4. Example of the relationship between sectors, entities and activities



***Source**: CBI*

Another important factor that was taken into consideration when mapping out the final list of activities is their inclusion in other taxonomies. If activities were not already in other taxonomies, they could not be included at this stage due to time constraints. However, results from both expert and public consultations during the Thailand Taxonomy development phase also did identify any unique activities not already covered by other international taxonomies. Thai-specific activities, if any, can be considered in future stages of taxonomy development if they are important to the Thai context.

It should be noted that the ASEAN Taxonomy (which is under development) uses the Activities Not Defined By ISIC (ANDBI) classification system, which is different from ISIC 4. ANDBI sectors are added to the table below to facilitate comparison between activities in the Sector 4 of this Thailand Taxonomy with those in the ASEAN Taxonomy.

Table 10. Table of sub-sectors and activities of the Thailand Taxonomy (First Phase)

ISIC Sector (TSIC)	ANDBI Sector[24]	Activity in the Section 4
D351 - Electric power generation, transmission, and distribution	D35104 Solar power gen generation	Solar energy
	D35105 Wind power generation	Wind energy
	D35106 Hydro power generation (incl. pump storage)	Hydropower
	D35107 Geothermal power generation	Geothermal power
	D35108 Bio power generation	Bioenergy

[24] Based on ASEAN Taxonomy Version 1 (November 2021)

ISIC Sector (TSIC)	ANDBI Sector[24]	Activity in the Section 4
	D35101 Gas power generation	Natural gas
	D35109 Marine power generation	Ocean energy
	N/A	Electricity generation from renewable non-fossil gaseous and liquid fuels
	D35111 Energy storage (not incl. pump storage)	Storage of electricity and thermal energy
	D35110 Transmission and distribution (incl. ICT and smart technology)	Transmission and distribution of energy
	N/A	Cogeneration of heating/cooling and power using renewable sources of energy
D352 - Manufacture of gas; distribution of gaseous fuels through mains	D35110 Transmission and distribution (incl. ICT and smart technology) D 35203 Gas distribution	Transmission and distribution networks for renewable and low-carbon gases
D353 - Steam and air conditioning supply	D35302 Provision of steam / air conditioning (renewable production)	Production of heating and cooling using waste heat Installation and operation of electric heat pumps Heating and cooling distribution
H491 - Transport via railways	• H49101 Electrified rail and associated infrastructure • H49102 Low emission rolling stock • H49103 Improved railway efficiency measures	Transport via railways
H492 - Transport via buses **H493 - Other land transport**	N/A	Other passenger land transport
		Urban and suburban passenger land transport
		Freight transport by road
H494 - Transport via pipeline	H49302 Gas transport (gas from renewable production)	Transmission and distribution networks for renewable and low-carbon gases

ISIC Sector (TSIC)	ANDBI Sector[24]	Activity in the Section 4
H501 - Sea and coastal water transport	• H50101 Low emission fossil powered vessels • H50102 Electric vessels • H50103 Other low-emissions vessels	Sea and coastal water transport
H502 - Inland water transport	• H50201 Low emission fossil powered vessels • H50202 Electric vessels • H50203 Other low-emissions vessels	Inland water transport
C3312 - Repair of machinery[25]	N/A	Retrofitting of sea and coastal freight and passenger water transport
Non-ISIC Transport Activities[26]	N/A	Enabling infrastructure for low-emission transport

2.3. Traffic light system

2.3.1 Transition as a concept

"Transition" as a concept is the **journey, over time, to green**. However, given the steep decarbonisation required to meet the goals of the Paris Agreement, this journey cannot last forever. The time component is critical to whether the world can stay within 1.5 degrees of warming by the end of the century. In this regard, it can be stated that **all sectors of the economy should collectively be in transition to reach net-zero by 2050**. This date has been established by the Intergovernmental Panel on Climate Change that includes world's best experts on the issue from all continents.

At the granular activity level, it is clear that **certain activities have a more difficult pathway to transition with significant economic and technological barriers to overcome than the others**. Such activities are sometimes called "transitional" or "hard-to-abate". Here, we prefer to use "hard to abate" to refer to heavy industry and other high emitting sectors given that almost every sector and activity will have to make some type of transition.

The White Paper published by the Climate Bonds Initiative and entitled "Financing Credible Transitions"[27] proposes that a "transition" label may also apply to interim activities or investments that are making a substantial contribution to halving global emissions by 2030 and reaching net zero by 2050 but do not have a long-term role to play post-2050.

[25] An activity outside of chosen sectors is added due to its paramount importance to all other activities in the sector
[26] An activity outside of ISIC is added due to its paramount importance to all other activities in the sector
[27] Climate Bonds Initiative. (2020). Financing Credible Transitions - A framework for identifying credible transitions

The overwhelming majority of taxonomies focus on activities that have the most significant potential to mitigate GHG emissions including 'green' criteria for "hard-to-abate activities" such as cement or aluminium production. Such hard-to-abate sectors occupy an important place in modern economies, including Thailand. This means that criteria for hard to abate activities are an important element to be included in the Thailand Taxonomy.

In the context of green taxonomies focusing on climate change mitigation, a traffic light system refers to a cascade of criteria and screening thresholds, covering activities that are considered "green" or friendly to GHG emission reduction and aligned with the 1.5 degree goal of the Paris Agreement; are "amber" or transitioning towards green within a credible time frame; and are "red" or not aligned with the GHG emissions reduction objective. To date, however, few taxonomies have adopted a traffic light system and so the challenge of an amber category is for it to be ambitious enough to facilitate the rapid change required to shift to a low carbon economy while also allowing a space for laggards to achieve interim goals and to act.

To balance these two objectives, the transition of an activity may be eligible for inclusion if it:

- Significantly improves its performance over time, demonstrated by tracking, monitoring, and disclosing CO_2 equivalent emissions. Alignment with a pathway to net-zero by 2050 must be the ending point of any transitional activity.
- Does not lock in carbon-intensive assets or processes for the future. If it is impossible to decarbonise, the activity must be phased out.
- Does not hamper the development and deployment of low-carbon alternatives.
- Demonstrates a pathway to approach the climate objectives

To create thresholds that meet these objectives, several measures can be utilised:

- **Sunset dates**. The taxonomy establishes a date after which transitional activities cease to be compliant. For example, new amendments to the EU Taxonomy deem low-emitting (270g CO_2e/kWh) gas power plants suitable if their construction permit is issued before 31 December 2030.[28]
- **Best in class**. The threshold for the activity may be established as representing the top 10-15% of best installations in the country, region, or globally. This method is widely used in sectors with no clear way to calculate a 1.5-degree aligned path such the manufacturing sector (Cement, Steel, Chemicals).
- **Percentage change**. If retrofitting or modernisation of the facility is discussed, a fixed percentage change may be an excellent way to establish a threshold. For example, in buildings renovation, the point is based on reducing Primary Energy Demand (PED) by at least 30%.

[28] European Commission. (2022). European Commission Delegated Regulation (EU) 2022/1214 of 9 March 2022

In short, green activities are already aligned with a 1.5-degree pathway (although not necessarily near zero emissions already) while amber activities are moving towards alignment.

The amber transition represents a time period and pathway to move towards the green transition pathway.

The amber transition category is not a catch-all for activities that are a light shade of green or represent only a slight change from business as usual. In fact, transitioning in line with the Paris Agreement requires a complete re-orientation of the global economy and, for some entities and activities, a complete transformation. The transition concept captures this ambitious journey that each activity and entity needs to make for the world to avoid catastrophic climate change.

2.3.2 Traffic light system for the Thailand Taxonomy

Green activities are substantially contributing to the goal of climate change mitigation by operating at or close to the net-zero goal by 2050. In most cases green thresholds are either EU Taxonomy or Climate Bonds Taxonomy-aligned because both taxonomies are based on extensive multiyear research by international technical expert groups, and therefore serve as reference taxonomies for international taxonomies. Two types of activities are included into this category:

- **Near zero activities**: activities already at or near net-zero emissions that may require some further decarbonisation but not a significant transition (e.g., solar or wind power generation or operation of electric fleet-based transportation services).
- **Pathway to zero activities**: activities that are needed beyond 2050 and have a clear 1.5-degree decarbonisation pathway to 2050 (e.g., shipping).

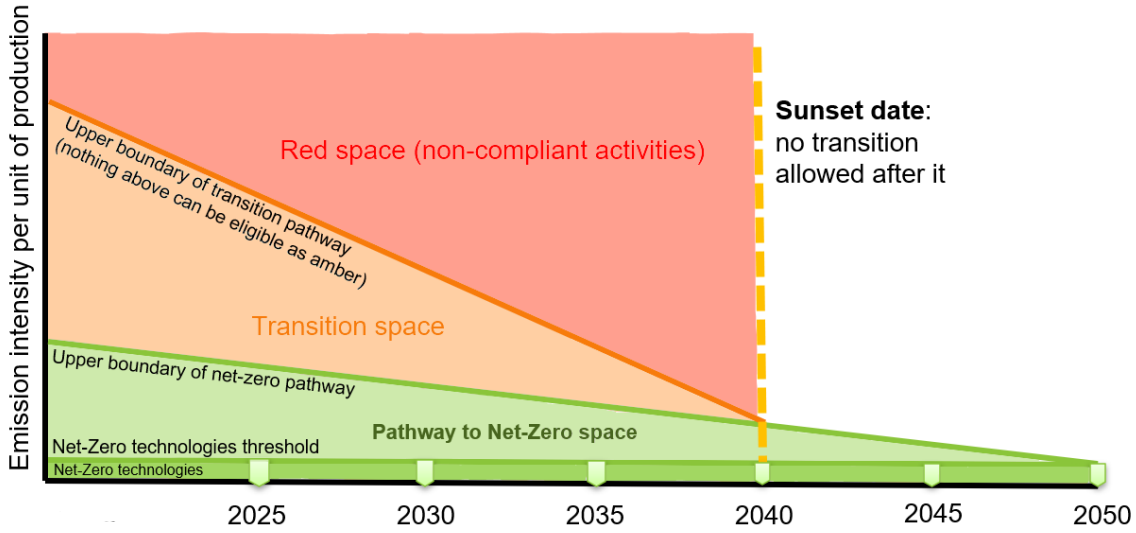
Amber activities are facilitating significant emissions reductions in the short term with a reliable decarbonization pathways and prescribed sunset dates. The activities have not yet reached net zero emission but can still be improved with viable technologies. The amber category is generally relevant only for the existing infrastructure and activities that can be retrofitted and cannot be applied to new ones (which should directly adopt green technologies) to avoid locking-in unsustainable technologies in new projects. In some cases, enabling activities (those that serve as enabling other green activities but not green themselves, e.g., grid infrastructure) are also included in this category. For Thailand Taxonomy, the pathways are taking the national context (Nationally Determined Contribution: NDC) into account.

Red activities ("stranded") are the ones that are currently not compatible with net-zero trajectory and are not going to become compatible anytime soon. For the transition to net zero by 2050 to happen, they should be phased out completely (for example, electricity generation from coal). It is very important to note that not all activities are assessed yet by international climate science, so the absence of activity in the green and amber categories does not mean that it is red.

3. Models for activities assessment

Modelling allows the creation of thresholds for activities that must transition to a pathway to net-zero by 2050. In most cases, these are transition (amber) activities that need to follow an ambitious pathway to decarbonize in a journey towards green, as green activities are the category used for those that are already near-zero or have a clear pathway alongside trajectory. Some activities will have two thresholds: a **green one**, representing the Paris-aligned activities, and the **amber one**, representing activities, that are in transition towards a green/Paris-aligned pathway. Below is the general idea behind establishing pathways and thresholds that will be repeated for each single sector.

Figure 5. A practical meaning and graphic representation of green, transition and red spaces



For modelling credible transition pathways for the activities of this taxonomy the Sectoral Decarbonisation Approach (SDA) is applied, which is a widely adopted methodology used by the Transition Pathway Initiative (TPI) and the Science Based Targets Initiative (SBTi)[29]. The SDA utilises data and scenarios developed by international organisations, such as IEA, IPCC, and International Institute for Applied System Analysis (IIASA). The present model will include the following scenarios:

- Nationally Determined Contribution scenario (based on the Thailand's latest NDC and other national documents)
- Below 2 Degrees Scenario (based on SDA calculations and consistent with Paris Agreement targets)
- 1.5 Degree Scenario (based on SDA calculations and fully consistent with Paris Agreement targets)

[29] Transition Pathway Initiative. (2021). Carbon Performance Assessment of Electricity Utilities: Note on Methodology

- International Organisations Scenario, calculated by respected international organisations based on data by national participants. Pathways created this way often represent internationally agreed scenarios rather than the most ambitious.

The Taxonomy's activity thresholds will be calculated based on the 1.5-degree scenario, meaning that all sectors must move to net-zero by 2050. This is in line with the latest climate science. There are several objective reasons for utilizing 1.5-degree for this taxonomy:

- **Alignment**. International taxonomies (EU, Climate Bonds, ASEAN) either directly postulate the need to pursue 1.5-degree pathway or consider it strongly preferable[30].
- **Attractiveness**. International climate-aware investors want to see 1.5-degree compliant projects and this fact needs to be considered if an access to international financial market is a prerogative.
- **Closing the gap**. To stay within 1.5-degrees requires a 45 - 50% cut in global emissions by 2030. Right now, the world is on track to achieve 9% emission cut by 2030 – way off that requirement for even a 2-degree warming scenario. Setting the ambition of 1.5 degrees keeps that sense of urgency at the forefront of policy and decision making.
- **Cost effectiveness**. The cost of aligning with 1.5 degrees is much lower than the cost of exceeding it.

3.1. Scope of emissions

For all activities emissions include only scope 1 and 2 emissions unless stated otherwise.

3.2. Relevant decarbonization measures

This taxonomy aims to reduce greenhouse gas emissions by various economic agents in Thailand as well as the Thailand economy as a whole. It is technology-neutral, i.e., it allows any means of achieving the below mentioned thresholds for compliance with green and amber criteria. These techniques can include complete replacement of relevant units, devices and machines with less emitting (if allowed by a specific article in Section 4) application of energy efficiency measures, installation of additional carbon capture and sequestration units, etc.

3.3. NDC-based amber thresholds

Thailand's NDC-based pathways and thresholds are applied as amber criteria for certain activities in order to consider national conditions of Thailand. They're calculated based on the best available sectoral data, published in the Thailand's Long-Term Low Greenhouse

[30] ASEAN Taxonomy says that the goal is to "limit the global average temperature increase to well below 2°C, **preferably 1.5°C**, above preindustrial levels".

Gas Emission Development Strategy (Revised Version November 2022), which are generally more precise than those calculated on "best-in-class" principle.

However, as was mentioned, like most countries, the NDC is not aligned with a 1.5-degree trajectory. According to Climate Tracker, the Thailand NDC is aligned with 4 degrees of warming and, global climate breakdown, which is challenging for Thailand and 195 other countries to align with the Paris Agreement.[31]

Although many activities have a starting point that is yet to align with the green transition pathway (Paris-aligned), the NDC is used as the upper boundary for an amber transition zone that can be seen as a grace period to allow users to attract finance to reach a green pathway. As highlighted, this transition period cannot last indefinitely.

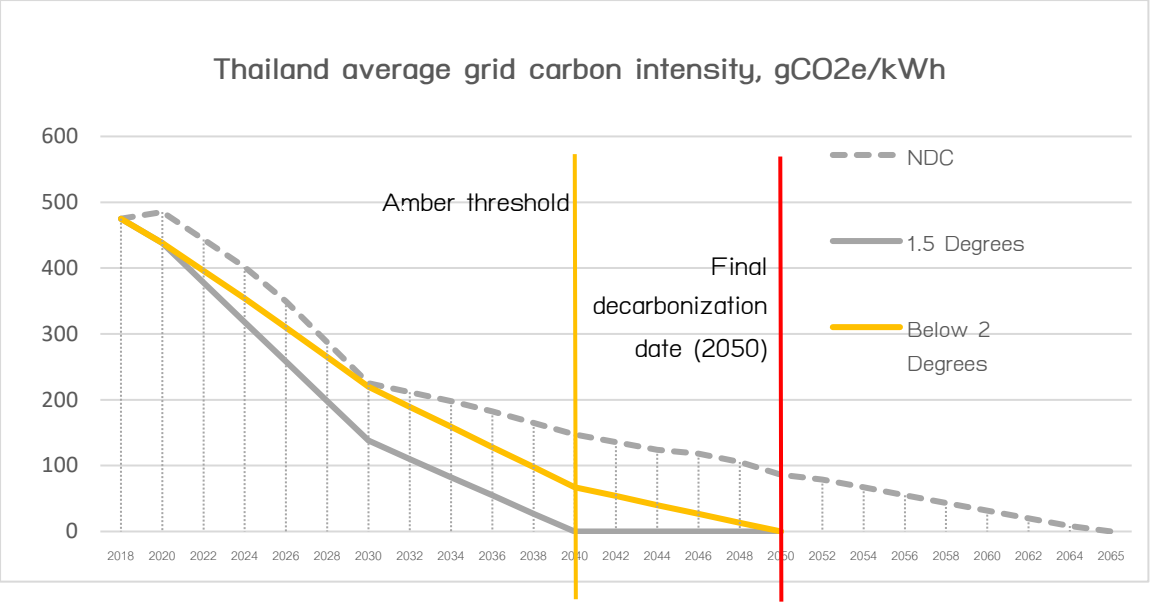
3.4. Energy

Energy activities in the present taxonomy can be divided into two parts: those associated with the production of energy (wind, solar, ocean energy-based generation etc.) and those that are not about production but are related activities (energy storage, energy transmission etc.). Eligibility criteria for the first group usually (but not always) include adherence to the decarbonisation pathway presented below (Figure 6). Criteria for the second group are usually unique for every activity and are based on characteristics of each individual activity.

Electricity generation is a key part of energy production in any country. As a sector, its carbon emission reduction is at the core of decarbonisation efforts worldwide. In the Figure 6 below, thresholds for alignment with the 1.5 and 2 degrees are calculated based on science-based and country-neutral decarbonisation pathways provided by the Transition Pathway Initiative; green thresholds in this Taxonomy are set to align with the 1.5 degree scenario. The dotted line corresponds to the NDC-based pathway of Thailand and is meant to provide data for the building of an amber thresholds. Thailand's Updated NDC presumes lowering the overall volume of emitted carbon by 40% by 2030[xxv] from a baseline of 2005 (that is 555 $MtCO_2$) and then achieving Net-Zero emissions by 2065.

[31] Climate Action Tracker

Figure 6. Thailand grid carbon intensity modelling 2018-2050



Source: TPI, Calculated from Thailand's Long-term Low Greenhouse Gas Emission Development Strategy (Revised Version – November 2022)

As it is seen from the modelling above, for Thailand to be able to go along the 1.5-degree pathway green carbon intensity must reach on average 138 grams CO_2 per kilowatt-hour by 2030 and net-zero by 2040. For a minimal 2-degree scenario the corresponding figures are 220 grams CO_2 per kilowatt-hour by 2030 and net-zero by 2050. Achieving this will require major changes to electricity production, including the use of renewable technologies, adoption of the CCS and the reconfiguring of existing fossil fuel facilities to increase renewable uptake.

The **green threshold** in the Thailand Taxonomy will be established as 100 gCO_2e/kWh until 2040 with the emission of 50 gCO2e/kWh afterwards. This threshold is justifiable from the point of view of international compatibility as both EU and Climate Bonds taxonomies consider it appropriate. It is an ambitious threshold that allows the state and the market to bring emissions down rapidly.

For **amber threshold** is defined following the NDC-based pathway. This is applicable for existing activities only – which means that the activity/asset is in existing before 1 January 2024. 2040 is established as a sunset date for the amber threshold. After this date only green thresholds and criteria are applicable for all activities. It is noted that the sunset date may be subject to change based on new technologies or evolving scientific views.

Red activities can under no circumstances be considered contributing to climate change mitigation. In some cases, there are no such circumstances (for example, if the activity is unequivocally green and there are no old installations that may be too emitting to retrofit), and in this case the activity is marked as N/A.

Table 11. Thresholds for certain energy sector activities, gCO2e/kWh

	2022-2025	2026-2030	2031-2035	2036-2040	2041-2045*	2046-2050*
Green Activities	100	100	100	100	50	
Amber Activities	381	225	191	148	N/A	N/A
Red Activities	>381g	>225g	>191g	>148g	>50g	>50g

Note: All thresholds are subject to review every three to five years in accordance with new data and technological development.

* Post-sunset dates, amber certification is no longer available

** Energy efficiency measures are covered under these energy sector criteria by the very means of establishing thresholds using emission intensity (gCO_2 per unit of production). In order to achieve a certain threshold, the activity must reduce its emission intensity, including by implementing measures to improve efficiency as an option.

To clarify, amber thresholds are necessary to facilitate the transition to low carbon economy, but an activity cannot be 'in transition' indefinitely. By the sunset date all new installations must be compliant with the green threshold, or they lose their alignment with the Taxonomy.

3.4.1. Bioenergy

While many energy activities in the Section 4.1 below will refer to the above table for sectoral energy thresholds (Table 11. Thresholds for certain energy sector activitiesTable 11), it should be noted that bioenergy (see bioenergy definition in the Definitions Annex), due to its unique characteristics, has its own screening thresholds that do not follow Table 11. The screening table on Bioenergy in Section 4.1. will refer to the specific Bioenergy Thresholds presented here.

Bioenergy green thresholds have been calculated separately according to the CBI Biomass criteria[32] build up to the latest scientific and technological data. These Criteria apply to assets and projects relating to:

- Facilities producing biomass/biofuel
- Heating/cooling, and co-generation facilities using biofuel/biomass
- Bio-refinery facilities
- Supporting infrastructure associated with the above

For facilities producing biomass/biofuel as a final product, including liquid biofuel, solid and gaseous biomass for heating and co-generation, and biofuel for transport, the biomass/biofuel

[32] Climate Bonds Initiative. (2022). Bioenergy Criteria under the Climate Bonds Standard

produced needs to meet specific GHG emissions thresholds in terms of gCO2e/kWh (converted from the original gCO2e/MJ (primary energy) for compatibility purposes).

For heating/cooling, and co-generation (combined heat and power – CHP) facilities using biofuel/biomass, the biofuel/biomass being used needs to meet specific GHG emissions thresholds in terms of gCO2e/kWh, and the facilities are required to achieve energy conversion efficiency of 80%. Note that CHP facilities need to meet requirements when they are in CHP mode. In addition, CHP is required to follow the requirements in 4.1.5 (Bioenergy generation and production)

Table 12 provides the summary of these thresholds. The rationale of determining these specific thresholds can be found in the Climate Bonds Bioenergy Criteria Background Paper. [33]

Table 12. Bioenergy criteria

Asset type	Thresholds for biofuel/biomass produced/used (primary energy)	Energy efficiency thresholds
Facilities producing liquid biofuel, solid and gaseous biomass for heating and co-generation	57.6g CO2e/ kWh	N/A
Facilities producing biofuel for transport	67.7g CO2e/ kWh	N/A
Heating/cooling, and co-generation facilities using biofuel/biomass	57.6g CO2e/kWh	80%

***Source**: CBI*

To demonstrate they meet this threshold, issuers are required to conduct a life cycle assessment (LCA) of GHG emissions from their bioenergy.

The scope of the LCA should include:

- Feedstock production
- Feedstock processing
- Biofuel/bioenergy production
- Biofuel storage and blending
- Intermediate and final transport steps: transportation of feedstock to processing facilities to fuel production facilities, and transportation of fuel to the point of consumption

For facilities producing both biomass-based products for energy purpose (power and heat), and for non-energy use (such as food and feed ingredients, pharmaceuticals, chemicals,

[33] Climate Bonds Initiative. Bioenergy Criteria under the Climate Bonds Standard: Non-Wood Feedstocks Background Paper

materials and minerals), issuers are required to allocate GHG emissions to the biomass for energy purpose based on energy content of the biomass-based products. For such facilities, only the biomass for energy purposes need to meet the GHG emissions thresholds detailed in Table 12 above. That is, currently no additional GHG emissions thresholds for biomass products for non-energy use. However, users of these Criteria are reminded that if biomass products for energy use accounts for less than 50% of feedstock inputs then the facility is not aligned with this Taxonomy.

To check the compliance with the threshold it is required to use RSB GHG Calculator Tool for GHG emissions calculation.

Compliant feedstock

Under the present Criteria, all types of feedstocks are eligible with these exceptions:

- Wood (and all woody biomass)
- Third generation biofuels (algae)
- Biodegradable Municipal Solid Waste (MSW), including sewage sludge and food waste

  Feedstock used for production of bioenergy should comply with one of the following:

  - Forest Stewardship Council (FSC);
  - Biomass Biofuels voluntary scheme (2BSvs);
  - Bonsucro; International Sustainability and Carbon Certification (ISCC Plus);
  - Roundtable of Sustainable Biomaterials (RSB)
  - Round Table on Responsible Soy (RTRS)

Bioenergy facilities must also either:

- Be certified under the RSB low indirect land use change (iLUC) optional module14 to demonstrate that they have low indirect land use impact; or
- Provide evidence and documentation to demonstrate that they meet low iLUC risk biomass criteria and compliance indicators under the RSB optional module, i.e.:
  - Yield increase: issuers demonstrate that source feedstock for the facility is produced through an increase in yield compared to a reference date, without any additional land conversion. The biomass that is produced above the baseline scenario is eligible.
  - Unused/degraded land: issuers demonstrate that source feedstock for the facility is produced from land that was not previously cultivated or was not considered arable land.
  - Use of waste / residues: issuers demonstrate that the raw material used is derived from existing supply chains and does not require dedicated production out of arable land

3.4.2. Hydropower

Projects in hydropower have a potential of causing massive damage to the environment by their scale and operation. Thus, in order to be eligible for the construction of a new hydropower plant under the current Taxonomy the executor of the project must additionally (to the criteria indicated in the activity card 4.1.3) adhere to the following rules:

- All technically feasible and ecologically relevant mitigation measures have been implemented to reduce adverse impacts on water as well as on protected habitats and species directly dependent on water. Measures include, where relevant and depending on the ecosystems naturally present in the affected water bodies:
  - measures to ensure downstream and upstream fish migration (such as fish friendly turbines, fish guidance structures, state-of-the-art fully functional fish passes, measures to stop or minimise operation and discharges during migration or spawning);
  - measures to ensure minimum ecological flow (including mitigation of rapid, short-term variations in flow or hydro-peaking operations) and sediment flow;
  - measures to protect or enhance habitats
- The effectiveness of those measures is monitored in the context of the authorisation or permit setting out the conditions aimed at achieving good status or potential of the affected water body.
- For new power plants, it must be established on the basis of that impact assessment, that the plant is conceived, by design and location and by mitigation measures, so that it complies with one of the following requirements:
  - the plant does not entail any deterioration nor compromises the achievement of good status or potential of the specific water body it relates to;
  - where the plant risks to deteriorate or compromise the achievement of good status/potential of the specific water body it relates to, such deterioration is not significant, and is justified by a detailed cost-benefit assessment demonstrating both of the following:
    - the reasons of overriding public interest or the fact that benefits expected from the planned hydropower plant outweigh the costs from deteriorating the status of water that are accruing to the environment and to society;
    - the fact that the overriding public interest or the benefits expected from the plant cannot, for reasons of technical feasibility or disproportionate cost, be achieved by alternative means that would lead to a better environmental outcome (such as refurbishing of existing hydropower plants or use of technologies not disrupting river continuity).
- A new plant should not permanently compromise the achievement of good status/potential in any of the water bodies in the same river basin district.
- Compensatory measures must be implemented to ensure that the project does not increase the fragmentation of water bodies in the same river basin district. This is

achieved by restoring continuity within the same river basin district to an extent that compensates the disruption of continuity, which the planned hydropower plant may cause. Compensation starts prior to the execution of the project.

3.5. Transportation

The decarbonisation of transportation is critically important for the overall climate strategy of Thailand. Thresholds and screening criteria for the activities in this sector are primarily based upon the developments of the Climate Bonds and EU taxonomies, but also consider national targets as well as the specific conditions of Thailand and ASEAN in general.

Due to the diverse nature of the sector itself, multiple models are used for transportation emissions mitigation. There are also limited opportunities to improve existing assets with regards to energy efficiency measures or reduction of GHG emissions (for example, the car can be replaced but not retrofitted unlike the factory.). The decarbonisation strategy here relies on the fast replacement of internal combustion engines with zero-emission solutions and phase-out of carbon-intensive technologies. Hence, most activities within the transport sector do not have an amber category, especially activities for which zero-emission alternatives exist.

The following section discusses specific considerations in establishing threshold for shipping before presenting the overall Sectoral Criteria and Thresholds for the transport sector, which contain relevant information for shipping and other transport activities in section 3.5.2.

3.5.1. Shipping Sector

The shipping sector is global, and vessels produced in different parts of the world possess roughly similar characteristics. Ships, however, are a very diverse, both in terms of sizes and in terms of purposes, and any eligibility criteria for them must be granular enough to encompass all of them.

The **green threshold** for the shipping sector is calculated according to the Climate Bonds Initiative Shipping Criteria[34]. In essence, for the shipping activity to be considered green, the expected carbon-equivalent intensity of the ship must be aligned with the decarbonisation trajectory (emissions intensity threshold) of the ship's type/size category reaching zero emissions by 2050.

Ships below 5,000 GT with zero emissions (propelled and powered by batteries or zero-emissions fuels) not violating any conditions in the .

Table 14 are automatically eligible.

The related measurement metric for shipping criteria is the Annual Efficiency Ratio (AER) and it measures carbon emissions associated with transport work, but it uses a ship's size (deadweight) as a proxy for cargo carried and assumes that the ship is fully loaded on all journeys. Any vessel 5,000 GT and above must report using International Maritime

[34] Climate Bonds Initiative. (2021). CBI Shipping Criteria – Criteria Document

Organisation Data Collection System. Mandatory collection and universal applicability of this data allows us to use AER measurement.

Table 13. Decarbonisation pathways for different ship types

No.	Type	Size	Target AER 2020-2029	Target AER 2030-2039	Target AER 2040-2049	Target AER 2050
1	Bulk carrier	0-9999 DWT	24.6	16.4	8.2	0
2	Bulk carrier	10000-39999 DWT	6.6	4.4	2.2	0
3	Bulk carrier	35000-59999 DWT	4.6	3.1	1.5	0
4	Bulk carrier	60000-99999 DWT	3.6	1.4	1.2	0
5	Bulk carrier	100000-199999 DWT	2.4	1.6	0.8	0
6	Bulk carrier	200000+ DWT	2.3	1.5	0.8	0
7	Chemical tanker	0-4999 DWT	35.4	23.6	11.8	0
8	Chemical tanker	5000-9999 DWT	19	12.7	6.3	0
9	Chemical tanker	10000-19999 DWT	11.9	7.9	4	0
10	Chemical tanker	20000+ DWT	6.5	4.3	2.2	0
11	Container	0-999 TEU	16.9	11.3	5.6	0
12	Container	1000-1999 TEU	14.8	9.9	4.9	0
13	Container	2000-2999 TEU	10	6.7	3.3	0
14	Container	3000-4999 TEU	8.3	5.5	2.8	0
15	Container	5000-7999 TEU	7.8	5.2	2.6	0
16	Container	8000-11999 TEU	6.7	4.5	2.2	0
17	Container	12000-14500 TEU	4.6	3.1	1.5	0
18	Container	14500+ TEU	4.6	3.1	1.5	0
19	General cargo	0-4999 DWT	24.2	16.1	8.1	0
20	General cargo	5000-9999 DWT	16.7	11.1	5.6	0
21	General cargo	10000+ DWT	13.1	8.8	4.4	0
22	Other liquid tanker	0+ DWT	97.6	65.1	32.5	0
23	Refrigerated bulk	0-1999 DWT	48.7	32.5	16.2	0

No.	Type	Size	Target AER 2020-2029	Target AER 2030-2039	Target AER 2040-2049	Target AER 2050
24	Ro-Ro	0-4999 GT	212.4	141.6	70.8	0
25	Ro-Ro	5000+ GT	45.9	30.6	15.3	0
26	Vehicle	0-3999 vehicles	46	30.7	15.3	0
27	Vehicle	4000+ vehicles	13.8	9.2	4.6	0
28	Criuse	60000-99999 GT	1738613.6	1159075.7	579537.9	0
29	Criuse	100000+ GT	1337274.9	891516.6	445758.3	0
30	Ferry-RoPax	0-1999 GT	822123.9	548082.6	274041.3	0
31	Ferry-RoPax	2000+ GT	1137003.8	758002.5	379001.3	0
32	Ferry-pax only	0-1999 GT	1272135.8	848090.5	424045.3	0
33	Ferry-pax only	2000+ GT	1740606.6	1160404.4	580202.2	0
34	Criuse	0-1999 GT	2044403.4	1362935.6	681467.8	0
35	Criuse	2000-9999 GT	1286641.3	857760.8	428880.4	0
36	Criuse	10000-59999 GT	1495064.7	996709.8	498354.9	0

***Source**: CBI Green Shipping Criteria*

Note: 1) AER for cargo ships (lines 1-27) is measured in gCO2-e/tonne-nm. In the case of passenger ships (lines 28-39) gCO2-e/GT is used instead 2) DWT (Dead Weight Tonnes) for the weight of the cargo 3) TEU (Twenty-foot Equivalent Unit) and 4) GT (Gross tonnage, a proxy) for the number of passengers

The following types of ships are automatically ineligible regardless of their compatibility with the thresholds from Table 13.

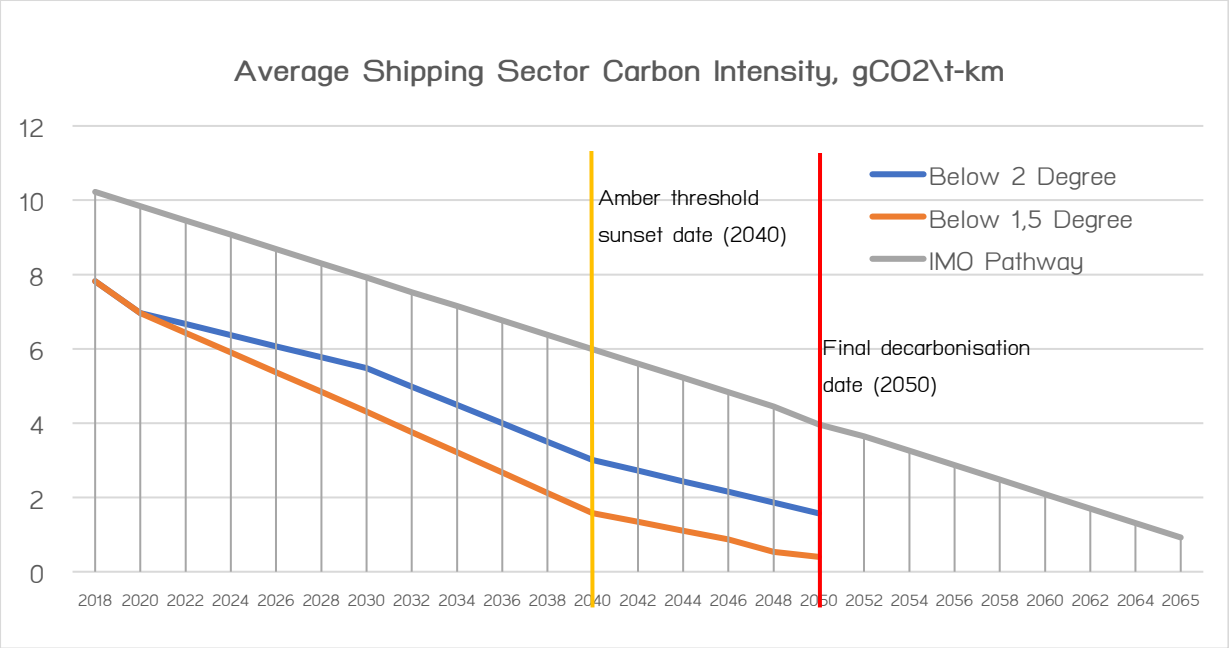
Table 14. Red (non-compliant) activities for the shipping sector

Assets	Explanation
Crude Oil Tankers and Liquefied Gas Tankers	Assets which are dedicated to transporting fossil fuels are not compliant under the criteria. This is applicable to ships which are classified as liquified natural gas (LNG) Carriers or Crude Oil Tankers.
Dry Bulk Carriers IF transporting more than the maximum threshold of coal	Assets where more than 25% of tonnage transported annually is coal or other fossil fuels. This threshold declines geometrically at 5.3% from the year 2020 onwards.
Assets dedicated to supporting the fossil fuel sector	Assets used for the exploration or production of fossil fuels are not compliant under the present taxonomy. This includes but is not limited to: Floating Production, Supply and Offloading (FPSO) Vessels; Subsea, Umbilical, Risers, Flowlines (SURF) Vessels; Drilling Units; Platform Supply Vessels; Well Intervention Vessels.

For the activity of ship exploitation to be eligible as green, the ship must comply with the threshold for the time of the particular period (bond or loan period, data collection timeframe etc.). Ships that are not zero-emissions must provide a managed reduction plan (MRP) that shows how the ship can remain under the emissions intensity threshold during the operational life of the ship.

Concerning the **amber threshold**, it was considered appropriate to apply the guidelines proposed by the International Maritime Organisation decarbonisation pathway metrics. They are relatively less stringent but are suitable for the purpose of retrofitting existing ships. According to the IMO, the average emission of ships must fall by at least 40% by 2030, pursuing efforts towards 70% by 2050, compared to 2008.[35]. In 2008 Thailand, average emissions were 13.2 gCO2/t-km.[36]. Subtracting of 40% gives 7.92 gCO2/t-km by 2030 while subtracting 70% gives us 3.96 gCO2/t-km by 2050.

Figure 7. Shipping sector decarbonisation pathways



***Source**: TPI; Thailand Ministry of Transportation*

Note: all the thresholds after 2030 are indicative and will be subject to change due to the development of science and technology.

3.5.1.1. Individual amber pathways calculation

Note, that these figures are relevant for the sector in general. In order to calculate **individual amber decarbonisation pathways** for specific ships according to the IMO recommendations, the following methodology should be applied:

- First, one needs to find the emission number of the baseline year (that is 2008, the data on emission of different classes of ships must be taken from the Second IMO GHG Study, table 9.1, last column "Total Efficiency".

[35] International Maritime Organization. Annex 11: Initial Imo Strategy on Reduction of Ghg Emissions from Ships

[36] Information and Communication Technology Center, Ministry of Transport. (2022). GHG Water

- Second, one needs to subtract 40% and 70% from this number and put it on a timeline, where the first dot represents the actual current emission of the ship in the year of calculation, the second one – the result of subtracting 40% from a 2008 baseline attached to 2030, the third one – the result of subtracting 70% from a 2008 baseline attached to 2050.
- Third, the resulting graph should be utilized as an actual decarbonization pathway for the purpose of the activity owner (for example, for issuing a bond).

For example, if the activity in question is the transportation of goods using a bulk carrier of 210.000 DWT, the table in the Second IMO GHG Study gives us 2.5 gCO2e/tkm in 2008. Subtracting 40% gives us 1.5 gCO2e/tkm by 2030, subtracting 70% gives us 0.75 gCO2/tkm by 2050. Decarbonisation path for this type of ship should be built along this pathway.

3.5.2. Sectoral thresholds and metrics

While the principles by which the green criteria and thresholds for Shipping were explained above, the green thresholds for railway and non-railway transport are set to be in line with the EU Taxonomy. Table 15 provides a summary of the overall transport sector's criteria and thresholds. Some specific transport activities discussed in Section 4.2. will cross-reference with this Table.

Table 15. Transportation sector activities criteria and thresholds

Thresholds and criteria for activities in the transportation sector							
	Main threshold						Additional Criteria
	2022-2025	2026-2030	2031-2035	2036-2040	2041-2045	2046-2050	
Green Activities							
Railway; Non-Railway, gCO2/t-km	0	0	0	0	0	0	
Shipping, gCO2/t-km	Declining threshold for different ship classes according to Table 13						
Amber Activities							
	2022-2025	2026-2030	2031-2035	2036-2040	2041-2045*	2046-2050*	
Railway Non-Railway	See individual articles in Section 4						
Shipping, gCO2/t-km	8.9	7.92	7	6	N/A	N/A	
Red Activities	The activities carried out with the ships, that belong to the categories from Table 14 as well as those that exceed the thresholds for amber and green are not compliant						

Note: All thresholds are subject to review every three to five years in accordance with new data and technological development.

* Post-sunset dates, amber certification is no longer available

4. Activities thresholds and criteria

While the previous section presented general Sectoral thresholds and criteria for the energy and transport sectors, this section presents specific thresholds and criteria for each individual activity within each sector. It should be noted that for some individual activities (such as solar energy generation, hydropower generation etc.), their own screening tables below will contain complete information on eligibility criteria for green and amber activities, and can thus be used independently without having to refer back to the table of sectoral thresholds and criteria (Table 11) in the previous section. But for other activities, such as natural gas and bioenergy, their screening tables will contain information which needs to be used in conjunction with the table of sectoral thresholds and criteria in the previous section. The cross-referencing situation is also applicable for many of the transport activities presented in Section 4.2 as well.

This report will reference ISIC codes from National Statistical Office Thailand (TSIC).

4.1. Energy sector activities: an overview

Based on the most recent data, Thailand's total installed generation capacity was 47 GW in 2019, with peak electricity demand around 30 GW..[37] Thailand has achieved near complete access to energy, with 99.21% of Thai households having access to electricity in 2020. This results from the country's efforts to promote local energy generation in far off areas and to increase the efficiency of energy generation throughout the energy chain. In 2020, energy intensity (EI) in Thailand also significantly improved, with a decrease to 7.53 KOTE/bn baht from 8.54 KOTE/bn in 2010..[38]

During the development of Thailand Taxonomy, the setting of threshold has been calculated based on the revised version of Thailand LT-LEDS which is likely to be aligned with the (draft) NEP 2022, revised version of PDP (as a part of the draft NEP 2022), and other plans in the draft NEP 2022.

The following sections present the screening criteria and thresholds for the different activities within the energy sector.

[37] EA. (2021). Thailand Power System Flexibility Study

[38] Department of Alternative Energy Development and Efficiency, Ministry of Energy. (2021). Energy Balance of Thailand 2020.

4.1.1. Solar energy generation

Sector classification and activity		
Sector and activity	Energy generation with solar technologies	
ISIC CODE	3510	
Description	Construction and operation of electricity generation facilities that produce electricity, heating and cooling from Solar Photovoltaic, Concentrated Solar Power (CSP) or any other types of solar energy-based technologies	
Scope	Construction and operation	
The activity makes significant contribution to climate change mitigation		
Metrics and thresholds	Green	All energy generation is eligible
	Amber	N/A
	Red	Power plants dedicated to support fossil fuel infrastructure
Criteria reference[39]	Climate Bonds Initiative Solar Energy Background paper	

4.1.2. Wind energy generation

Sector classification and activity		
Sector and activity	Wind energy generation	
ISIC CODE	3510	
Description	Construction and operation of electricity generation facilities that produce electricity, heating and cooling using wind power	
Scope	Construction and operation	
The activity makes significant contribution to climate change mitigation		
Metrics and thresholds	Green	All electricity generation activities from onshore and offshore wind power plants are eligible
	Amber	N/A
	Red	Power plants dedicated to support fossil fuel infrastructure are excluded
Criteria reference	Climate Bonds Initiative Wind Energy Background Paper	

[39] Hereinafter "criteria reference" is provided for information only and are not a part of eligibility requirements. Only major reference sources are provided. All criteria are adapted for local context.

4.1.3. Hydropower generation

Sector classification and activity		
Sector and activity	Hydropower	
ISIC CODE	3510	
Description	Construction and operation of electricity generation facilities that produce electricity, heating, and cooling from Hydropower	
Scope	Construction and operation	
The activity makes significant contribution to climate change mitigation		
Metrics and thresholds	Green	A hydropower facility in operation before 1 January 2024 is eligible if it has either: • A power density > 5W/m2 OR • GHG emissions intensity < 100g CO2e/kWh during the life cycle of the powerplant. A hydropower facility commencing operation on 1 January 2024 or after this date is eligible if it has either: • A power density > 10W/m2 OR • GHG emissions intensity < 50g CO2e/kWh during the life cycle of the powerplant. In addition, pumped storage facilities must also meet one of the following criteria: • The facility is demonstrably purposefully built in conjunction with intermittent renewables AND / OR • The facility is contributing to a grid which already has a share of intermittent renewables deployment of at least 20% or has credible evidence of programmes in place that increase the share of intermittent renewables to this level within the next 10 years. Evidence of such programmes might be the current development of renewable energy facilities that are due to come online in the near term, or the auction of PPAs for renewables. AND / OR • The facility can credibly demonstrate that the pumped storage will not be charged with an off-peak grid intensity that is higher than the intensity of the electricity that it will displace when it is discharged. For example, demonstrating that there is no combination of the following in the merit order: (1) mid-merit coal and (2) gas used at times of peak demand. For any new project the executor must also follow additional criteria outlined in Section 3.4.2

	Amber	Retrofitting that improves either power density or decreases emission intensity of the existing hydropower plant by at least 15% is eligible
	Red	• The activities that are not compliant with green or amber criteria are non-compliant • Power plants dedicated to support fossil fuel infrastructure are excluded
Criteria reference	Climate Bonds Initiative Hydropower Criteria Document and Background Paper In this current version, the existing facility refers to the facility that is operating or receives the construction permit from the relevant authorities before 1 January 2024. The new facility refers to the facility that receives the construction permit after 31 December 2023.	

4.1.4. Geothermal power generation

Sector classification and activity		
Sector and activity	Geothermal power	
ISIC CODE	3510	
Description	Construction and operation of electricity generation facilities that produce electricity, heating, and cooling from geothermal power	
Scope	Construction and operation	
The activity makes significant contribution to climate change mitigation		
Metrics and thresholds	Green	New facilities meeting declining green threshold for the Energy Sector (Table 11)
	Amber	Existing facilities meeting declining amber threshold for Energy Sector with a prescribed sunset date (Table 11)
	Red	• The activities that are not compliant with green or amber criteria are non-compliant • Power plants dedicated to support fossil fuel infrastructure are excluded
Criteria reference	Climate Bonds Initiative Geothermal Energy Background Paper In this current version, the existing facility refers to the facility that is operating or receives the construction permit from the relevant authorities before 1 January 2024. The new facility refers to the facility that receives the construction permit after 31 December 2023.	

4.1.5. Bioenergy generation and production

Sector classification and activity		
Sector and activity	Bioenergy	
ISIC CODE	3510	
Description	Construction and operation of electricity generation facilities that produce electricity, heating and cooling from bioenergy (biomass, biogas and biofuels).	
Scope	Construction and operation. These Criteria apply to assets and projects relating to: • Facilities producing biomass/biofuel • Heating/cooling, and co-generation facilities using biofuel/biomass • Bio-refinery facilities • Supporting infrastructure associated with the above	
The activity makes significant contribution to climate change mitigation		
Metrics and thresholds	Green	• New and existing facilities meeting the criteria for Bioenergy (3.4.1 Bioenergy) • All types of feedstocks are eligible, including residues, energy crops and lignocellulosic biomass such as straw, **with three exceptions**: - Wood (and all woody biomass) - Algae - Biodegradable Municipal Solid Waste (MSW), including sewage sludge and food waste • Feedstocks used for production of bioenergy should comply with the guidelines from one of the following bodies: - Forest Stewardship Council (FSC); - Biomass Biofuels voluntary scheme (2BSvs); - Bonsucro; - International Sustainability and Carbon Certification (ISCC Plus); - Roundtable of Sustainable Biomaterials (RSB) - Round Table on Responsible Soy (RTRS)
	Amber	• Only existing facilities are eligible • Lifecycle emission intensity meets amber thresholds for Energy Sector (Table 11) • All types of feedstock used for production of bioenergy are eligible, including residues, energy crops and lignocellulosic biomass such as straw, with three exceptions: - Wood (and all woody biomass)

		- Algae - Biodegradable Municipal Solid Waste (MSW), including sewage sludge and food waste ● Feedstock used for production of bioenergy should comply with one of the following: - Forest Stewardship Council (FSC); - Biomass Biofuels voluntary scheme (2BSvs); - Bonsucro; - International Sustainability and Carbon Certification (ISCC Plus); - Roundtable of Sustainable Biomaterials (RSB) - Round Table on Responsible Soy (RTRS)
	Red	The activities that are not compliant with green or amber criteria are non-compliant
Criteria reference	Climate Bonds Initiative Bioenergy Background Paper In this current version, the existing facility refers to the facility that is operating or receives the construction permit from the relevant authorities before 1 January 2024. The new facility refers to the facility that receives the construction permit after 31 December 2023.	

4.1.6. Energy production from natural gas

Sector classification and activity		
Sector and activity	Energy production from natural gas	
ISIC CODE	3510	
Description	Retrofitting of facilities that produce energy from natural gas	
Scope	Conversion and retrofitting projects only	
The activity makes significant contribution to climate change mitigation		
Metrics and thresholds	Green	Conversion of existing natural gas power plants to use green hydrogen leading to an emission intensity of the plant of less than indicated in the Table 11
	Amber	● Retrofit of existing natural gas plants that leads to life cycle emission intensity meets declining amber thresholds for the Energy Sector with a prescribed sunset date (Table 11) ● Life-cycle GHG emissions are calculated based on project-specific data using ISO 14067:2018 or:2018 or ISO 14064-2:2019 or equivalent ● At retrofitting, measurement equipment for monitoring of physical emissions, such as those from methane leakage, is installed or a leak detection and repair program is introduced

		• At operation, physical measurement of emissions are reported and leak is eliminated. • Compliance with the current Amber criteria is verified by an independent third party and must be published for public assessment
	Red	New natural gas-based power plants (where the project got construction permit after 31 December 2023) are excluded
Criteria reference	European Commission Delegated Regulation (EU) 2022/1214 of 9 March 2022 In this current version, the existing facility refers to the facility that is operating or receives the construction permit from the relevant authorities before 1 January 2024. The new facility refers to the facility that receives the construction permit after 31 December 2023.	

4.1.7. Marine energy generation

Sector classification and activity		
Sector and activity	Marine energy	
ISIC CODE	3510	
Description	Construction and operation of electricity generation facilities that produce electricity, heating, and cooling from marine energy	
Scope	Construction and operation	
The activity makes significant contribution to climate change mitigation		
Metrics and thresholds	Green	All energy generation activities from marine energy are eligible
	Amber	N/A
	Red	N/A
Criteria reference	Climate Bonds Initiative Marine Renewable Energy Background Paper	

4.1.8. Electricity generation from renewable non-fossil gaseous and liquid fuels, including green hydrogen

Sector classification and activity	
Sector and activity	Electricity generation from renewable non-fossil gaseous and liquid fuels, including green hydrogen
ISIC CODE	3510
Description	Construction and operation of electricity generation facilities that produce electricity using gaseous and liquid fuels of renewable origin, including green hydrogen. This activity does not include electricity generation from the exclusive use of biogas and bioliquid fuels (for this see article 4.1.5)
Scope	Construction and operation
The activity makes significant contribution to climate change mitigation	

Metrics and thresholds	Green	• Life-cycle GHG emissions from the generation of electricity using renewable gaseous and liquid fuels must be lower than Green Activities threshold from the Table 11. • Life-cycle GHG emissions are calculated based on project-specific data, where available, using ISO 14067:2018 or ISO 14064-1:2018 or ISO 14064-2:2019 or equivalents • Quantified life-cycle GHG emissions are verified by an independent third party.
	Amber	Lifecycle emission intensity meets declining amber thresholds for the Energy Sector with a prescribed sunset date (Table 11)
	Red	The activities that are not compliant with green or amber criteria are non-compliant
Criteria reference	Climate Bonds Initiative Hydrogen Background Paper and Bioenergy Paper	

4.1.9. Cogeneration of heating/cooling and power using renewable sources of energy

Sector classification and activity		
Sector and activity	Cogeneration of heating/cooling and power using renewable sources of energy	
ISIC CODE	3510, 3530	
Description	Construction and operation of installations used for cogeneration of heat/cool and power exclusively from renewable sources of energy, indicated in the present taxonomy (solar, wind, geothermal, bioenergy, ocean energy, renewable liquid and gaseous fuels, including green hydrogen)	
Scope	Construction and operations	
The activity makes significant contribution to climate change mitigation		
Metrics and thresholds	Green	• The life-cycle GHG emissions from the co-generation of heat/cool and power from renewable energy sources meets declining green threshold (Table 11) • The underlying renewable source of cool/heat and energy (solar, wind, bioenergy etc.) must comply with the green criteria for the respective source of energy from the present Taxonomy • Life-cycle GHG emissions are calculated based on project-specific data, where available, using ISO 14064-1:2018 or ISO 14064-2:2019 or equivalent • Where facilities incorporate any form of abatement (including carbon capture and storage or use of decarbonised fuels) that abatement activity complies with the relevant Section of the Chapter 4 (***to be added in the later phase of Taxonomy development***)
	Amber	• Retrofit of existing cogeneration power plants that leads to life cycle emission intensity meeting declining amber thresholds

		for the Energy Sector with a prescribed sunset date (Table 11) is eligible. • Where facilities incorporate any form of abatement (including carbon capture and storage or use of decarbonised fuels) that abatement activity complies with the relevant Section of the Chapter 4 (***to be added in the later phase of Taxonomy development***)
	Red	Cogeneration of heating/cooling and energy from non-renewable sources, such as fossil fuels and fossil fuels derivatives (like fossil fuels based hydrogen)
Criteria reference	European Commission Delegated Regulation (EU) 2021/2139 of 4 June 2021	

4.1.10. Production of heating and cooling using waste heat

Sector classification and activity		
Sector and activity	Production of heating or cooling using waste heat	
ISIC CODE	3530	
Description	Production of heating and cooling using waste heat	
Scope	Operations only	
The activity makes significant contribution to climate change mitigation		
Metrics and thresholds	Green	The activity produces heating/cooling from waste heat
	Amber	N/A
	Red	N/A
Criteria reference	European Commission Delegated Regulation (EU) 2021/2139 of 4 June 2021	

4.1.11. Installation and operation of electric heat pumps

Sector classification and activity		
Sector and activity	Installation and operation of electric heat pumps	
ISIC CODE	3530	
Description	Installation and operation of electric heat pumps	
Scope	Installation and operations	
The activity makes significant contribution to climate change mitigation		
Metrics and thresholds	Green	• Refrigerant GWP ⩽ 675; AND • A minimum requirement is the implementation and adherence to a recognised environmental management system (ISO 14001 or equivalent)
	Amber	N/A
	Red	N/A

Criteria reference	European Commission Delegated Regulation (EU) 2021/2139 of 4 June 2021

4.1.12. Heating and cooling distribution

Sector classification and activity		
Sector and activity	Heating/Cooling Distribution	
ISIC CODE	3530	
Description	Operation of pipelines and associated infrastructure for distribution of heating and cooling, ending at the sub-station or heat exchanger.	
Scope	Construction and operations	
The activity makes significant contribution to climate change mitigation		
Metrics and thresholds	Green	The system uses at least 50% renewable energy or 50% waste heat or 75% cogenerated heat or 50% of a combination of such energy and heat.
	Amber	N/A
	Red	N/A
Criteria reference	European Commission Delegated Regulation (EU) 2021/2139 of 4 June 2021	

4.1.13. Transmission and distribution networks for renewable and low-carbon gases, including green hydrogen

Sector classification and activity		
Sector and activity	Transmission and distribution networks for renewable and low-carbon gases, including green hydrogen	
ISIC CODE	3520, 4940	
Description	• Repurposing of gas networks for the distribution of gaseous fuels through a system of mains • Repurposing of gas networks for long-distance transport of renewable and low-carbon gases by pipelines • Construction or operation of transmission and distribution pipelines dedicated to the transport of hydrogen or other low-carbon gases • Operation of such networks, including delivery to the final consumer	
Scope	Construction, operations, and retrofitting	
The activity makes significant contribution to climate change mitigation		
Metrics and thresholds	Green	• Transmission and distribution networks for low-carbon gases and green hydrogen are eligible. • Retrofit of natural gas distribution lines to allow 100% green hydrogen or other low carbon gases. Low-emission gases are gases whose emissions when used to generate electricity do

		not exceed the limits specified for the green category in the Table 11 • The activity includes leak detection and repair of existing gas pipelines and other network elements to reduce methane leakage. Noted: Low carbon gases are the gases whose life-cycle GHG emissions from the generation of electricity is lower than Green Activities threshold from the Table 11
	Amber	N/A
	Red	• Transmission and distribution of gases whose emission exceeds green category threshold in the Table 11 • Retrofitting of gas networks for the transmission of gases whose emission exceeds the green category threshold from the Table 11
Criteria reference	Synthetic criteria, more than three sources	

4.1.14. Storage of electricity, thermal energy and green hydrogen

Sector classification and activity		
Sector and activity	Storage of electricity and thermal energy	
ISIC CODE	No specific ISIC Code	
Description	Construction and operation of facilities that store electricity, thermal energy and green hydrogen and return it later	
Scope	Construction and operations	
The activity makes significant contribution to climate change mitigation		
Metrics and thresholds	Green	• All electricity and green hydrogen storage systems are eligible. • All thermal energy storage systems where the generated energy falls below 100 g CO2e/kWh measured on life cycle emission basis are eligible (including geothermal energy storage)
	Amber	N/A
	Red	N/A
Criteria reference	Climate Bonds Electrical Grids and Storage Background Paper, European Commission Delegated Regulation (EU) 2021/2139 of 4 June 2021	

4.1.15. Transmission and distribution of electricity

Sector classification and activity		
Sector and activity	Transmission and distribution of electricity	
ISIC CODE	3510	
Description	• Construction and operation of transmission systems that transport the electricity on the extra high-voltage and high-voltage interconnected System. • Construction and operation of distribution Systems that transport electricity on high-voltage, medium-voltage and low-voltage distribution Systems. • Construction and operation of interconnections that transport electricity between separate systems.	
Scope	Construction and operations	
The activity makes significant contribution to climate change mitigation		
Metrics and thresholds	Green	• Transmission and distribution infrastructure dedicated to a direct connection or an expansion of connection between power plants with energy intensities less than 100 g CO2e/kWh (life cycle emissions) is eligible • Transmission and distribution infrastructure that is on a decarbonisation trajectory where at least 67% of the newly connected generation capacity in the system is below the generation threshold value of 100 gCO2e/kWh measured on a Product Carbon Footprint (PCF) basis, over a rolling five-year period OR • the average System grid emissions factor is below the threshold value of 100gCO2e/kWh measured on a PCF basis, over a rolling five-year average period • Includes all enabling ICT systems and smart management systems for the eligible infrastructure
	Amber	N/A
	Red	Construction and operation of transmission and distribution infrastructure where the share of non-compliant electricity is higher than 33% is considered non-compliant under the present taxonomy. Non-compliant electricity is electricity produced with emission intensity above defined in the green category of the Table 11
Criteria reference	Climate Bonds Electrical Grids and Storage Background Paper	

4.2. Transportation Sector: an overview

The transport sector in Thailand is significantly more developed than its Southeast Asian neighbours. Road transport is the dominant subsector in terms of investment, traffic flow, national coverage, and economic impact, accounting for 98% of passenger traffic and 95% of the country's freight traffic..[40] Despite the developed transport infrastructure network, access to the public transportation system is limited only to city centres. Overall, only 24 percent of the urban population has convenient access to the public transportation system. Other key problems of the sector include road safety, inefficient highway network, and low road infrastructure competitiveness measured in terms of logistics costs. In terms of carbon footprint, the transportation sector contributed the largest share (38.40%) of final energy consumption in 2020..[41]

The following sections present the screening criteria and thresholds for the different activities within the transport sector.

4.2.1. Transport via railways

Sector classification and activity		
Sector and activity	Transport via railways	
ISIC CODE	491	
Description	Rail transportation of passengers and/or freight using railroad rolling stock on mainline networks, usually spread over an extensive geographic area. Freight rail transport over short-line freight railroads is included	
Scope	Operations only	
The activity makes significant contribution to climate change mitigation		
Metrics and thresholds	Green	The activity complies with one of the following criteria: • the trains and passenger coaches/wagons have zero direct (tailpipe) CO_2 emissions; • the trains and passenger coaches/wagons have zero direct (tailpipe) CO_2 emission when operated on a track with necessary infrastructure, and use a conventional engine where such infrastructure is not available (bimodal) AND • The trains and wagons are not solely dedicated to the transport of fossil fuels
	Amber	• Passenger rolling stock is eligible if its direct emissions are below 50 gCO2e/pkm until 2027 (after this year only rolling stock with zero direct emissions will be eligible)

[40] Asian Development Bank. Sector Assessment (Summary): Transport

[41] Department of Alternative Energy Development and Efficiency, Ministry of Energy. (2021). Energy Balance of Thailand 2020.

		• As for freight transport by rail, it is eligible if direct emissions are below 25 gCO2/tkm until 2027 (after this year only rolling stock with zero direct emissions will be eligible)
	Red	The activity does not meet green or amber criteria
Criteria reference	Climate Bonds Initiative Land Transport Criteria Background Paper	

4.2.2. Other passenger land transport

Sector classification and activity		
Sector and activity	Other passenger land transport	
ISIC CODE	4932	
Description	This class includes: • scheduled long-distance bus services; • charters, excursions and other occasional coach services; • taxi operation; • passenger cars; • airport shuttles. • other renting of private cars with driver; • operation of school buses and buses for transport of employees; • passenger transport by man- or animal-drawn vehicles.	
Scope	Operations only	
The activity makes significant contribution to climate change mitigation		
Metrics and thresholds	Green	Direct (tailpipe) CO2 emissions of the vehicle are zero
	Amber	N/A
	Red	The activities that are not compliant with green criteria are non-compliant
Criteria reference	Climate Bonds Initiative Land Transport Criteria Background Paper	

4.2.3. Urban and suburban passenger land transport

Sector classification and activity	
Sector and activity	Urban and suburban passenger land transport
ISIC CODE	4920 4931
Description	This class includes land transport of passengers by urban or suburban transport systems. This may include different modes of land transport, such as: • by motorbus, • tramway, • streetcar, • trolley bus,

	• underground • elevated railways etc. The transport is carried out on scheduled routes normally following a fixed time schedule, entailing the picking up and setting down of passengers at normally fixed stops. The class also includes: • town-to-airport or town-to-station lines • operation of funicular railways, aerial cableways etc. if part of urban or suburban transit systems.	
Scope	Operations only	
The activity makes significant contribution to climate change mitigation		
Metrics and thresholds	Green	For scheduled passenger road transport, the activity complies with the following criteria: • the activity provides urban or suburban passenger transport, and its direct (tailpipe) CO_2 emissions are zero For scheduled passenger urban suburban rail transport, the activity complies with one of the following criteria: • the trains and passenger coaches have zero direct (tailpipe) CO_2 emissions; • the trains and passenger coaches have zero direct tailpipe CO_2 emission when operated on a track with necessary infrastructure, and use a conventional engine where such infrastructure is not available (bimode).
	Amber	N/A
	Red	The activities that are not compliant with green criteria are non-compliant
Criteria reference	Climate Bonds Initiative Land Transport Criteria Background Paper	

4.2.4. Freight transport by road

Sector classification and activity	
Sector and activity	Freight transport by road
ISIC CODE	4933
Description	This class includes: • all freight transport operations by road • logging haulage • stock haulage • refrigerated haulage • heavy haulage • bulk haulage, including haulage in tanker trucks

	• haulage of automobiles • transport of waste and waste materials, without collection or disposal This class also includes: • furniture removal • renting of trucks with driver • freight transport by man or animal-drawn vehicles	
Scope	Operations only	
The activity makes significant contribution to climate change mitigation		
Metrics and thresholds	Green	The activity complies with the following criteria: • direct (tailpipe) CO_2 emissions of vehicles are zero AND • vehicles are not dedicated to fossil fuel transport
	Amber	Amber category is available only for freight transport having a maximum mass exceeding 3.5t[42]. The activity complies with the amber criteria if a vehicle fits into 15% best available in Thailand (in its weight class) in terms of GHG emissions per tkm. Amber category is available **until 2030**, after it only green category is available for this article.
	Red	The activities that are not compliant with green or amber criteria are non-compliant
Criteria reference	Climate Bonds Initiative Land Transport Criteria Background Paper, European Commission Delegated Regulation (EU) 2021/2139 of 4 June 2021	

4.2.5. Enabling infrastructure for low-emission transport

Sector classification and activity		
Sector and activity	Enabling infrastructure for low-emission transport	
ISIC CODE	No specific code available	
Description	Various types of infrastructure and activities that enable and support low-carbon transportation	
Scope	Construction and operations	
The activity makes significant contribution to climate change mitigation		
Metrics and thresholds	Green	• Personal mobility or cycle logistics: pavements, bike lanes and pedestrian zones, electrical charging and hydrogen refuelling installations for personal mobility devices. **Rail transport**:

[42] This is noted as the limit because there are limited technological options available for zero tail pipe emissions for vehicles in this category.

		for electrified trackside infrastructure and associated subsystems: infrastructure, energy, on-board control-command and signalling, and trackside control-command and signalling subsystems. • for new and existing trackside infrastructure and associated subsystems where there is a plan for electrification as regards line tracks, and, to the extent necessary for electric train operations, as regards sidings, or where the infrastructure will be fit for use by zero tailpipe CO2 emission trains within 10 years from the beginning of the activity: infrastructure, energy, onboard control-command and signalling, and trackside control command and signalling subsystems. • the infrastructure and installations that are dedicated to transhipping freight between the modes: terminal infrastructure and superstructures for loading, unloading and transhipment of goods. • infrastructure and installations that are dedicated to the transfer of passengers from rail to rail or from other modes to rail. **Road transport:** • electric charging points, electricity grid connection upgrades, hydrogen fuelling stations or electric road systems (ERS). • the infrastructure and installations are dedicated to transhipping freight between the modes: terminal infrastructure and superstructures for loading, unloading and transhipment of goods. • the infrastructure and installations are dedicated to urban and suburban public passenger transport, including associated signalling systems for metro, tram and rail systems. **Water transport**: • electricity charging, hydrogen-based refueling • the infrastructure is dedicated to the provision of shore-side electrical power to vessels at berth. • the infrastructure is dedicated to the performance of the port's own operations with zero direct (tailpipe) CO2 emissions. • the infrastructure and installations are dedicated to transshipping freight between the modes: terminal infrastructure and superstructures for loading, unloading and transshipment of goods.

		Airports: • electricity charging and hydrogen refueling. • the infrastructure is dedicated to the provision of fixed electrical ground power and preconditioned air to stationary aircrafts. • the infrastructure is dedicated to the zero direct emissions performance of the airport's own operations: electric charging points, electricity grid connection upgrades, hydrogen refueling stations
	Amber	N/A
	Red	Infrastructure dedicated solely to the support of internal combustion engines vehicles as well as transport or storage of fossil fuels, including parking facilities and fossil fuel filling stations, is considered non-compliant
Criteria reference	Climate Bonds Initiative Land Transport Criteria Background Paper, European Commission Delegated Regulation (EU) 2021/2139 of 4 June 2021	

4.2.6. Sea and coastal water transport

Sector classification and activity		
Sector and activity	Sea and coastal water transport	
ISIC CODE	501	
Description	This class includes transport of passengers or freight overseas and coastal waters, whether scheduled or not: • operation of excursion, cruise or sightseeing boats; • operation of ferries, water taxis etc.; • transport of freight overseas and coastal waters, whether scheduled or not; • transport by towing or pushing of barges, oil rigs etc. This class also includes: • rental of pleasure boats with crew for sea and coastal water transport.	
Scope	Operations only	
The activity makes significant contribution to climate change mitigation		
Metrics and thresholds	Green	The activity complies with the green thresholds established for the specific kinds of ships (Table 15) as well as additional criteria in the Section 3.5.1
	Amber	The activity must follow an individual decarbonization path defined against the emission baseline of particular ship class in 2008 (see section 3.5.1.1. for details on that). The activity

		must demonstrate 40% reduction of emissions against the baseline by 2030 and 70% of reduction against the baseline by 2050. AND Vessels are not dedicated to fossil fuel transport
	Red	The activity does not meet green or amber criteria or is one of the activities mentioned in Table 14
Criteria reference	Climate Bonds Initiative Shipping Criteria Background Paper, European Commission Delegated Regulation (EU) 2021/2139 of 4 June 2021	

4.2.7. Inland water transport

Sector classification and activity		
Sector and activity	Inland water transport	
ISIC CODE	502	
Description	This class includes: • transport of passenger or freight via rivers, canals, lakes, and other inland waterways, including inside harbours and ports This class also includes: • rental of pleasure boats with crew for inland water transport	
Scope	Operations only	
The activity makes significant contribution to climate change mitigation		
Metrics and thresholds	Green	The activity complies with the following criteria: vessels have zero direct (tailpipe) CO_2 emissions For passenger inland water transport, the activity complies with the following criteria: • until 31 December 2027, hybrid and dual fuel vessels derive at least 50% of their energy from zero direct (tailpipe) CO_2 emission fuels or plug-in power for their normal operation
	Amber	The activity complies with the amber threshold established for the Shipping Sector with a prescribed sunset date (Table 15) AND Vessels are not dedicated to fossil fuel transport.
	Red	The activity does not meet green or amber criteria
Criteria reference	Climate Bonds Initiative Shipping Criteria Background Paper European Commission Delegated Regulation (EU) 2021/2139 of 4 June 2021	

4.2.8. Retrofitting of sea and coastal freight and passenger water transport

Sector classification and activity		
Sector and activity	Retrofitting of sea and coastal freight and passenger water transport	
ISIC CODE	3312	
Description	Retrofitting of vessels that leads to their compliance with green and amber threshold	
Scope	Retrofitting only	
The activity makes significant contribution to climate change mitigation		
Metrics and thresholds	Green	Retrofitting of vessels that leads to their compliance with the green threshold for the Shipping Sector (Table 15)
	Amber	Retrofitting of vessels that leads to their compliance with amber threshold for the Shipping Sector with a prescribed sunset date (Table 15)
	Red	Retrofitting of fossil fuels carrying vessels
Criteria reference	Various sources of references	

4.3. Red list of activities

Activities that are clearly inconsistent with goals of the present taxonomy are outlined in the table below with their corresponding ISIC codes. Only activities that are outlined in the table are considered non-compliant, not the whole code (if it's not stated explicitly). The activities that are neither green, nor amber, no red **are not considered non-compliant**. They are considered **out of the scope** of the present taxonomy. The taxonomy does not define of cover them.

This table outlines, clarifies and complements, not replaces red categories in all activity cards in the Section 4.

Table 16. List of activities not in compliance with the present taxonomy

ISIC Code	Activity
All codes	Activities that fall into a red category in each specific activity card are considered non-compliant
3510 - Electric power generation, transmission and distribution	• Production of electricity or thermal energy using any fossil fuels (coal, oil, gas, and their derivatives, including fossil-based hydrogen, **but excluding byproducts like waste heat**) is considered non-compliant (except the activities that comply with thresholds and conditions in the amber category) • Construction of any new facilities (including fossil gas powered) than produce electricity and thermal energy using fossil fuels is considered non-compliant

ISIC Code	Activity
	• Construction and operation of any renewable power plants that are fully or partially intended to support any operations related to fossil fuels and their derivatives, including, but not limited to their extraction, processing, transportation, or storage is considered non-compliant • Generation of electricity from renewable gaseous and liquid fuels where GHG emissions from the generation of electricity are higher than 100 g CO2e/kWh is considered non-compliant (except the activities that comply with thresholds and conditions in amber category in 4.1.8)
3520 - Manufacture of gas; distribution of gaseous fuels through mains	• Production of fossil fuel gas and its derivatives is considered non-compliant • Production of gas from biofuel where feedstock is not compliant with requirements from activity article 4.1.5 is considered non-compliant
491 - Transport via railways (all subcodes included)	• Railway vehicles or rolling stock designated as using biofuels, even partially, qualify as non-compliant • Infrastructure and rolling stock for railway lines that are built with the over-riding objective of transporting fossil fuels qualify as non-compliant. They are considered built with this objective if: ○ The primary purpose of the line is clearly described as fossil fuel freight by authoritative government sources; or, in the absence of this: ○ More than 25% of the freight in t-km transported by the line, on average, is comprised of fossil fuels; or alternatively: ○ More than 25% of the rolling stock is dedicated to the transport of fossil fuels
492 - Transport via buses **493 - Other land transport (including 4931, 4932, 4933)**	• For road freight vehicle and component manufacturers, purchasers and operators, any proportion of a vehicle or fleets cargo being made up of fossil fuels makes that vehicle or fleet non-compliant (except for those complying with amber criteria for the activity article 4.2.4) • Road vehicles or rolling stock designated as using biofuels, even partially, are considered non-compliant
4940 - Transport via pipeline	• Transmission and distribution of gases whose emission exceeds green category threshold in the Table 11 • Retrofitting of gas networks for the transmission of gases whose emission when used to generate electricity is above the green category threshold from the Table 11

ISIC Code	Activity
No code – infrastructure for low-carbon transport	Infrastructure dedicated solely to the support of internal combustion engines vehicles as well as transport or storage of fossil fuels, including parking facilities and fossil fuel filling stations, is considered non-compliant
501 Sea and coastal water transport (all subcodes included) **502 Inland water transport (all subcodes included)**	Ships that are solely dedicated to the transport of fossil fuel and/or otherwise support the fossil fuel sector (by shipping staff to the oil rigs, transporting fossil fuel extraction equipment etc.) are considered non-compliant. However, ships that technically may carry non-fossil fuels goods alongside with fossil fuel goods are NOT excluded and may be compliant if comply with the relevant criteria. For this reason, product and chemical tankers are not excluded.

5. Essential Criteria

5.1. Do No Significant Harm

The "Do No Significant Harm" (DNSH) principle is applied to the taxonomies with multiple objectives in order to make sure that one objective does not cause damage to other objectives. As the initial version of the Thailand Taxonomy has only one objective (climate change mitigation), a set of generic DNSH criteria was created to ensure compliance with internationally recognized principles and conventions, and relevant Thailand laws. On later stages of development of the Taxonomy activity-specific DNSH may also be added.

Any activity owner who may want to utilize the present taxonomy must abide by the following set of international norms, rules, and regulations (including, but not limited to):

- Basel Convention on the Control of Transboundary Movements of Hazardous Waste and their Disposal
- Convention on International Trade in Endangered Species of Wild Fauna and Flora
- Convention on Biological Diversity

It is highly important to note that in complying with all the rules of this taxonomy, the entity being evaluated **must first comply with all laws, regulations and requirements established by the law of Thailand or the law of the country where the activity takes place**. The criteria below are additional to all these laws and may in no way conflict with them.

Table 17. Do No Significant Harm table and criteria.

Generic DNSH Requirements	
Objective	**Description**
Climate change adaptation	The physical climate risks that are material to the activity must been identified from those listed in table 18 by performing a robust climate risk and vulnerability assessment with the following steps: • screening of the activity to identify which physical climate risks from the list in table 18 may affect the performance of the economic activity during its expected lifetime; • where the activity is assessed to be at risk from one or more of the physical climate risks listed in table 18, a climate risk and vulnerability assessment to assess the materiality of the physical climate risks on the economic activity; • an assessment of adaptation solutions that can reduce the identified physical climate risk. The climate risk and vulnerability assessment must be proportionate to the scale of the activity and its expected lifespan. The assessment must be

Generic DNSH Requirements	
Objective	**Description**
	performed using the highest available resolution projections across the existing range of future scenarios[43] consistent with the expected lifetime of the activity. The climate projections and assessment of impacts 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[44], scientific peer-reviewed publications, and open source or paying models. For existing activities and new activities using existing physical assets, the economic operator must implement physical and non-physical solutions, over a period of time of up to five years, that reduce the most important identified physical climate risks that are material to that activity. An adaptation plan for the implementation of those solutions is drawn up accordingly. For new activities and existing activities using newly built physical assets, the economic operator integrates the adaptation solutions that reduce the most important identified physical climate risks that are material to that activity at the time of design and construction and must implement them before the start of operations.
Sustainable use and protection of marine and water resources	Risks associated with water consumption and water quality must be identified, assessed and managed. Water risk analysis tools must be used for this purpose (e.g. risk assessments by national environmental authorities, water footprint, WWF Water Risk Filter, WRI Aqueduct etc.). If assets or activities are located in water-stressed areas, ensure that water use and conservation management plans, developed in consultation with relevant local entities, have been implemented.
Resource resilience and transition to a circular economy	National regulations associated with retirement and dismantlement plans for plants and infrastructure related to economic activity in question must be applied. Ambition to maximise the efficient use, reduction, repair, recycling and reuse of materials during the activity operational life cycle (e.g. through contractual agreements with recycling companies and integration of the cost of recycling), proper treatment and waste disposal (e.g. proper end-of-life management of batteries) and compliance, as a producer, with Extended Producer Responsibility standards must be demonstrated.

[43] Future scenarios include Intergovernmental Panel on Climate Change representative concentration pathways RCP2.6, RCP4.5, RCP6.0 and RCP8.5.

[44] Assessments Reports on Climate Change: Impacts, Adaptation and Vulnerability, published periodically by the Intergovernmental Panel on Climate Change (IPCC), the United Nations body for assessing the science related to climate change produces

Generic DNSH Requirements	
Objective	**Description**
	The ambition that new installations are designed and manufactured for high durability, easy to dismantle, refurbishment and recycling must be demonstrated. Proper repair of facilities and equipment, and the accessibility and interchangeability of the activity's equipment components must be ensured.
Pollution prevention and control	Discharges to water bodies must comply with water discharge permits from the relevant local authorities. Emissions that pollute the air must have the required permits and comply with relevant regulations (with particular focus on hazardous waste). Integrated management of the waste generated must be carried out by duly authorised waste managers.
Protection and restoration of biodiversity and ecosystems	New financed facilities and infrastructure should not be located in ecosystems that are strategic for food security, rich in biodiversity, or that serve as habitat for endangered species (flora and fauna) that are in the list of nationally protected areas or on the IUCN Red List[45]. Museums or technical facilities are exempt from this requirement. For sites and operations located in or near biodiversity sensitive areas (UNESCO World Heritage Sites, key Biodiversity Areas, as well as those defined by the National Protected Areas Systems), an appropriate assessment must be carried out in line with the criteria set by IFC Performance Standard No.6. For these sites, a long-term biodiversity monitoring and assessment programme must be implemented.

If the activity, project, or company in question does not comply with the DNSH criteria but otherwise passes relevant technical screening criteria and metrics, it may be considered compliant for the corresponding green or amber category if the operating company submits an additional plan indicating how it will correct the deficiencies within three years after the assessment. The operating company is encouraged to publish the plan in a public domain or public space where it can be seen and tracked by the general public.

5.1.1 Classification of climate-related hazards[46]

Table 18. Classification of climate-related hazards

	Temperature-related	Wind-related	Water-related	Solid mass-related
Chronic	• Changing temperature (air,	Changing wind patterns	• Changing precipitation patterns and	• Coastal erosion • Soil degradation

[45] IUCN. The IUCN Red List of Threatened Species

[46] Developed by EU Technical Expert Group

	Temperature-related	Wind-related	Water-related	Solid mass-related
	freshwater, marine water • Heat stress • Temperature variability • Permafrost thawing		types (rain, hail, snow/ice) • Precipitation or hydrological variability • Ocean acidification • Saline intrusion • Sea level rise • Water stress	• Soil erosion • Solifluction
Acute	• Heat wave • Cold wave/frost • Wildfire	• Cyclone, hurricane, typhoon • Storm (including blizzards, dust and sandstorms) • Tornado	• Drought • Heavy precipitation (rain, hail, snow/ice • Flood (coastal, fluvial, pluvial, ground water) • Glacial lake outburst	• Avalanche • Landslide • Subsidence

5.2. Minimum Social Safeguards

The eligible asset or activity must ensure that it does not generate a negative social impact and observe minimum social safeguards (MSS). For this, **the owner of the activity must adhere to the relevant local regulatory framework and policies, relevant internationally recognized principles and conventions,** and have a social management system in place. The minimum number of laws, standards and regulations that should be observed by the owner includes (including, but not limited to):

International Labour Organization core conventions:

- Freedom of Association and Protection of the Right to Organise Convention, 1948 (No. 87)
- Right to Organise and Collective Bargaining Convention, 1949 (No. 98)
- Forced Labour Convention, 1930 (No. 29) (and its 2014 Protocol)
- Abolition of Forced Labour Convention, 1957 (No. 105)
- Minimum Age Convention, 1973 (No. 138)
- Worst Forms of Child Labour Convention, 1999 (No. 182)
- Equal Remuneration Convention, 1951 (No. 100)

- Discrimination (Employment and Occupation) Convention, 1958 (No. 111)

International Bill of Human Rights conventions:

1. Universal Declaration of Human Rights (1948)
2. International Covenant on Civil and Political Rights (1966)
3. International Covenant on Economic, Social and Cultural Rights (1966)

The practices of activity owner must also be in line with the following **IFC Performance Standards**[47]**,** where applicable:

- Performance Standard 1: Assessment and management of environmental and social risks and impacts.
- Performance Standard 2: Labour and working conditions
- Performance Standard 3: Resource efficiency and pollution prevention (in parts where it does not contradict to the DNSH requirements of the present Taxonomy)
- Performance Standard 4: Community Health and Safety
- Performance Standard 5: Land Acquisition and Involuntary Resettlement
- Performance Standard 6: Biodiversity Conservation
- Performance Standard 7: Indigenous Peoples
- Performance Standard 8: Cultural Heritage

If the owner of the activity in question considers some of the standards unapplicable, he or she should specify why does he think so and attach this opinion to the relevant set of documents.

If the activity, project, or company in question does not comply with the MSS criteria but otherwise passes relevant technical screening criteria and metrics, it may be considered compliant for the corresponding green or amber category if the operating company submits an additional plan indicating how it will correct the deficiencies within three years after the assessment. The operating company is encouraged to publish the plan in a public domain or public space where it can be seen and tracked by the general public.

[47] International Finance Corporation. Performance Standards

Appendix 1. Thailand and its climate policy in global and regional context

1. Global context

Climate emergency is one of the most pressing issues the world is facing today. Global net anthropogenic greenhouse gas (GHG) emissions were about 12% higher in 2019 than in 2010 and 54% higher than in 1990[48]. According to the Intergovernmental Panel on Climate Change (IPCC), current world policies on GHG emission mitigation announced before the COP 26 conference in November 2021 are unlikely to lead us to limiting global warming to 1.5°C during the 21st century. Even limiting it to 2°C will require tremendous efforts from all members of the world community. IPCC climate modelling shows that in order to maintain temperatures below 1.5°C, it is necessary to reduce anthropogenic emissions at least by 45% compared to 2010 before 2030 and to reach net-zero emissions by 2050.

Without ambitious climate change mitigation actions, the world will experience negative consequences of climate change on a scale never envisioned before, and some of this change will be irreversible. Increased heatwaves, droughts and floods are already exceeding plants' and animals' tolerance thresholds, driving mass mortalities in species such as trees and corals. Hundreds of millions of people living in the coastal areas will be among the first to experience worsening living conditions, but the rest will follow soon. Acute food and water shortages all over the world will change the lives of billions and seriously undermine the prospects of future generations.

In this context, climate change also causes economic impacts which translate into financial risks. A recent risk survey by the World Economic Forum found that 3 out of the top 5 perceived most important global risks in terms of impact are climate-related (i.e., climate action failure, biodiversity loss, and extreme weather). More than 200 of the world's largest firms estimate that climate change will generate a total cost of USD 1 trillion in damage to economy and people's livelihood if appropriate actions are not taken. Consequently, insurances could become unaffordable or unavailable for several businesses and individuals. In 2018, the global "catastrophe protection gap", referring to assets that should have been insured but were not, equalled almost USD 280 bn[49].

The Association of Southeast Asian Nations (ASEAN) region and its 640 million people are particularly vulnerable to the consequences of climate change, given that 450 million live near retreating shorelines. The Asian Development Bank (ADB) estimates that Southeast Asia needs USD210 bn annually till 2030 for investments in climate-resilient infrastructure and notes the private sector's important role in closing gaps in public finance for these investments.

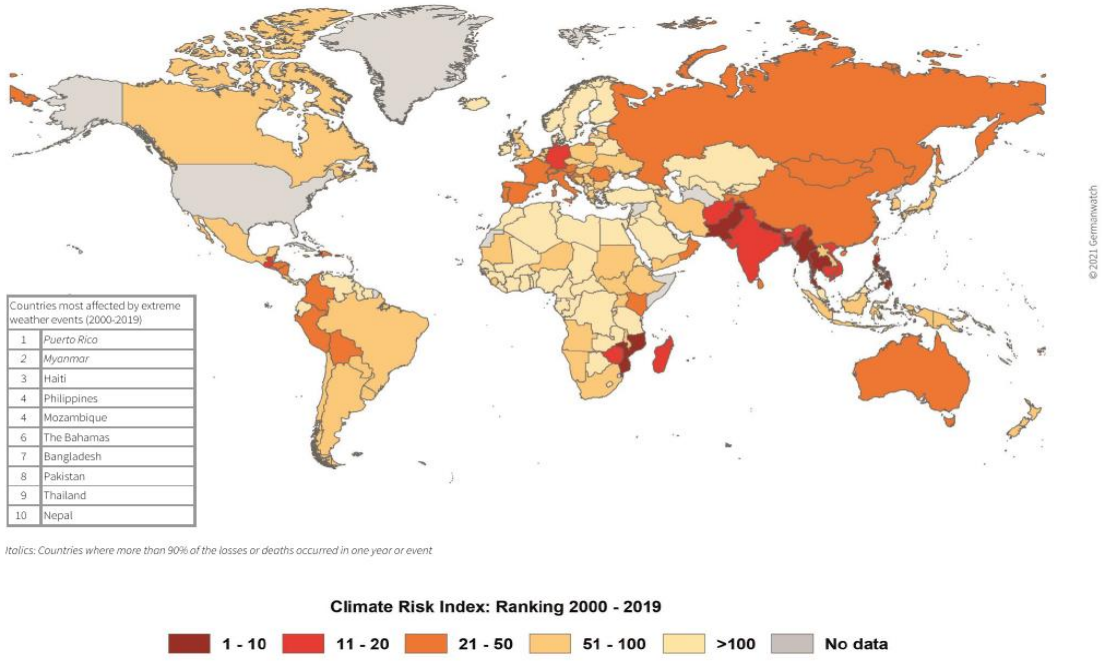
[48] IPCC. (2022). Summary for Policymakers

[49] Asian Development Bank. (2021). Accelerating Sustainable Development after COVID-19: The Role of SDG Bonds

2. Thailand and climate change

Evidence shows that Thailand is highly vulnerable to the negative impacts of climate change and heavy rainfalls, floods, droughts, cyclones, and storm surges are among the country's significant extreme hazards. Floods, including riverine, flash, and coastal flooding, are by far the most significant hazard in terms of economic and human impacts[50], followed by droughts and cyclones.[51] Reflecting very high exposure to these hazards, Thailand was ranked the 9th most affected country globally by extreme weather events between 2000–2019.[52] These events may intensify under future climate scenarios. For example, it is projected that the number of people in Thailand affected by an extreme river flood could grow by over 2 million during 2035–2044, and coastal flooding could involve a further 2.4 million people during 2070–2100.

Figure 8: Countries most affected by extreme weather events, 2000-2019



***Source**: Data from GermanWatch and Munich Re NatCatSERVICE. Graphic from GermanWatch. 2021*

Thailand is also exposed to slow-onset climate change impacts from rising sea levels, rising temperatures, and fluctuations in precipitation regimes. Observations show temperature increases across Thailand since the mid-20th century and an increase in annual precipitation, with most of this increase occurring during the wet season. Thailand's Fourth Biennial Update Report (BUR4) (2022) highlighted Thailand's coastal zone as one of the most vulnerable areas at greater risk of intensive flooding resulting from sea-level rise and coastal erosion[53]. In addition to sinking land, the combination of rising seas and potential cyclone-

[50] World Bank, Asian Development Bank. (2021). Climate Risk Country Profile Thailand

[51] European Commission. (2022). Inform Index for Risk Management. Thailand – Country Profile 2022 Scores

[52] German Watch. (2019). Global Climate Risk Index 2020.

[53] UNFCCC, Office of Natural Resources and Environmental Policy and Planning, Ministry of Natural Resources and Environment. (2022). Thailand. Biennial update report (BUR). BUR 4

induced storm surges threaten large amounts of Thailand's critical public and private infrastructure in low-lying areas, including Bangkok, which is often ranked among the most climate vulnerable cities in the world.

3. National context

Thailand has been an upper middle-income country since 2011 and has experienced successive decades of remarkable economic and social development, including substantial progress toward Sustainable Development Goals (SDGs). The coronavirus disease (COVID-19) pandemic crisis severely impacted the country, given its high dependence on trade and tourism.

According to the World Bank, the economy expanded by 1.6% in 2021 amid four waves of the pandemic and is not expected to recover to pre-COVID-19 levels until 2023.[54]. Thailand is addressing the twin challenges of accelerating post-COVID-19 recovery and making climate-resilient and low-carbon development a key pillar of long-term sustainable economic growth.

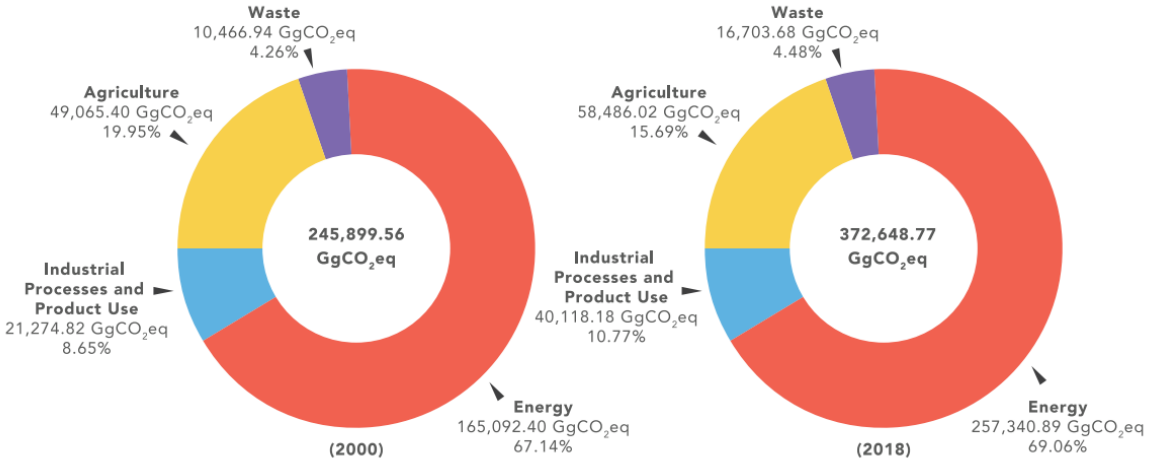
While adapting to these impacts of climate change is a priority, Thailand also needs to simultaneously engage in ambitious climate mitigation actions by reducing GHG emissions across key economic sectors. According to the Thailand's Fourth National Communication (NC4) report, between 2000-2018, the main source of GHG emissions in Thailand was the energy sector, which saw an increase of 55.88% from 165,092 GgCO2eq in 2000 to 257,341 GgCO2eq in 2018.

In 2018, total GHG emissions (excluding those from the Land Use and the Land-Use Change and Forestry (LULUCF) sector) were 372,649 GgCO2eq and net GHG emissions were 286,680 GgCO2eq (including those from LULUCF, which contributes to a net removal of 85,968 GgCO2eq. in 2018.[55]). The energy sector remains the most significant contributor to Thailand's GHG emissions in 2018, accounting for 69% of the total GHG emissions, making it the most important sector for Thailand's climate change mitigation actions. The share of emissions from the Agriculture, IPPU, and Waste sectors in 2018 were 16%, 11%, and 4%, respectively.

[54] World Bank. Thailand

[55] UNFCCC, Office of Natural Resources and Environmental Policy and Planning, Ministry of Natural Resources and Environment. (2022). Thailand's Fourth National Communication

Figure 9. Thailand GHG Emission Profile (Excluding LULUCF), 2018



Source: Thailand's Fourth National Communication

4. Need for more investment in climate change mitigation, adaptation and resilience

Among the significant extreme hazards, flooding accounts for nearly 100% of the average annual loss associated with hazards.[56] Major flood events in Thailand have affected the entire economy in the past. For example, a single flood in 2011 caused a total loss and damages cost of THB1.43 trillion (USD46.5 billion), or equivalent to roughly a 1.1% loss in real GDP in 2011. Overall, the 2011 floods affected more than 13 million people and resulted in more than 680 deaths. The damage to buildings, equipment and machinery in the industry sector alone amounted to THB 513.9 billion.[57]

Storms and droughts have also caused some significant negative impacts on Thailand's economy. Droughts occur almost every year, affecting more than 10 million people, resulting in average economic damages of THB 0.6 billion (USD 20 million) annually and could cause financial losses of up to 0.1% of GDP. Thailand also incurs an average of THB 0.2 billion (USD 6 million) in damages annually from storms that lead to nationwide floods and landslides.[58] Apart from extreme events, Thailand also faces the effects of long-term incremental changes from climate change. For example, projections suggest that Thailand's agriculture sector could be significantly affected by a changing climate due to its location in the tropics, where agricultural productivity is particularly vulnerable to temperature rises, rice yields, and the eastern, south-central, and north-eastern areas are most likely to be negatively impacted.

[56] World Bank, Asian Development Bank. (2021). Climate Risk Country Profile Thailand

[57] World Bank. (2012). Thai Flood 2011 : Rapid Assessment for Resilient Recovery and Reconstruction Planning

[58] UNDP, Fiscal Policy Research Institute. (2022). Final Report: Conducting a Country Diagnostic on Inclusive Insurance and Risk Finance for Thailand

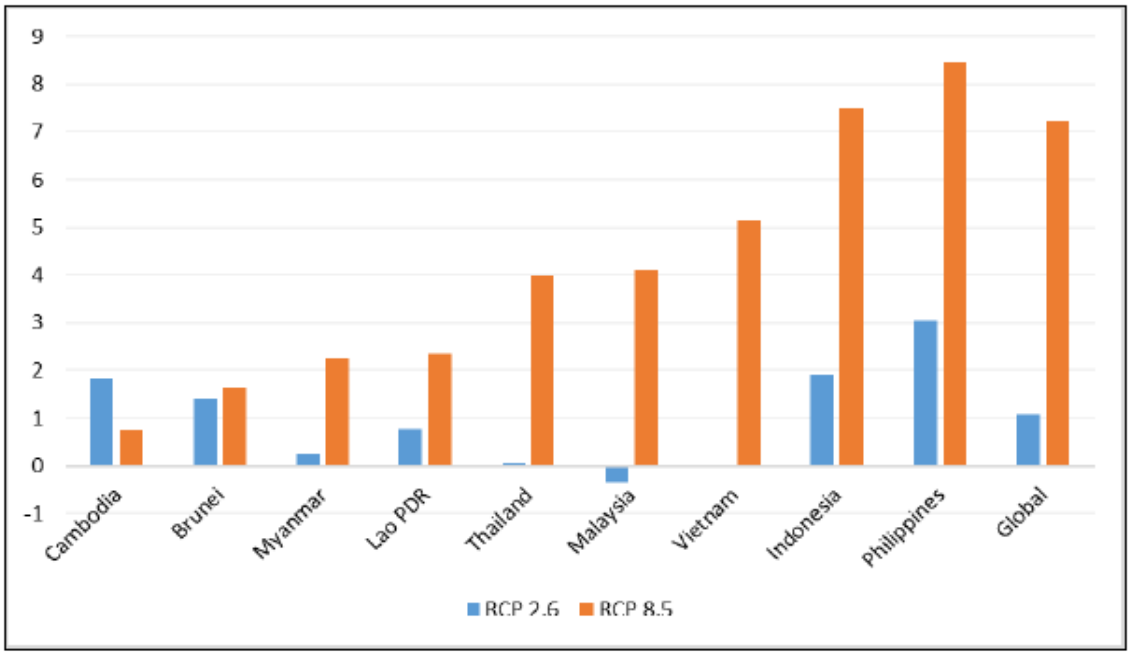
In term of sectoral impacts, given that around 47% of land use in Thailand is dedicated for agriculture and around 30% of the Thai labour force still participate in the agricultural sector, the vulnerability of the agricultural sector to climate change is a key concern. Apart from agricultural sector, other climate vulnerable sectors are water resource management, public health, tourism, natural resource management and human settlement and human security.

In terms of vulnerable groups, studies highlighted that climate change's highest economic and social impacts would likely fall disproportionately on the poorest and marginalised groups and regions. As Thailand is an aging society which projected to be a "super-aged society" by 2035, the country will be home a large segment of aged population who will be particularly vulnerable to the impacts of climate change. From the human health perspective, the effects of temperature rise and heat stress in urban areas, compounded by the phenomenon of Urban Heat Island, as well as the impacts of climate change on vector-borne diseases, food security, and nutrition, are also of particular concern. These climate change impacts on public health could negatively affect Thailand's economy through channels such as reduced labour productivity and human capital accumulation.

With accelerating global temperatures and the increased frequency of extreme events, future impacts from climate change on Thailand are likely to intensify. Therefore, more investments in adaptation and resilience are needed to address the effects of climate-related hazards on the Thai economy. Without adequate adaptation and resilience investments, Thailand could see severe dents to GDP per capita due to climate change, with potential losses up to 4% of GDP in the year 2100, depending on future emission scenarios and the breadth and depth of adaptation actions taken.

On the other hand, more investments adaptation and resilience could provide new economic opportunities for Thailand in the post-COVID era to attract new capital towards innovative projects, for examples, in smart water management, climate-smart agriculture, coastal rehabilitation and climate-resilient infrastructure. Apart from bringing new green jobs, these investments are consistent with Thailand's NDC, which emphasises the opportunity from pandemic recovery to "build back better" an ecosystem and economy that is climate-resilient and sustainable.

Figure 10. Thailand's potential loss in GDP per capita from climate change by 2100 compared to other ASEAN countries



***Source**: Anwar et al. (2020)*

Note: RCP 2.6 corresponds to the Paris Agreement's 2-degree goal achieved; RCP 8.5. is an unmitigated scenario in which emissions continue to rise throughout the 21st century.

Current efforts to accelerate the decarbonisation of the economy present both challenges and opportunities for Thailand. On the one hand, the country is facing key constraints and gaps in decarbonisation efforts, including high investment costs, particularly costs of technologies and infrastructure, and a high level of technical capacity and effective coordination needed across different sectoral agencies. Given these constraints, there has been concern about the potential impacts of GHG emission reduction actions on the country's economic growth, with some predicting slight GDP losses (-0.3 to -0.5%) from 25-40% GHG emission reductions compared to a BAU scenario.[59]

On the other hand, studies also highlighted the potential positive economic effects of transition to a net-zero economy. For example, a World Bank study predicts that a shift towards a circular economy could increase Thailand's GDP by about 1.2% and create nearly 160,000 additional jobs by 2030, representing approximately 0.3% of total employment.[60] A KPMG study also ranks Thailand among seven countries to watch globally regarding net-zero readiness, as Thailand has significant opportunities to decarbonise through large-scale projects and emerging initiatives, including green industry standards, public transport, and the manufacturing of electric vehicles.[61] In the long term, the net effects of the transition to

[59] Thammasart University. (2020). The revision and update of Thailand's Long-Term Low Greenhouse Gas Emission lopment Strategy (LT-LEDS) and Thailand's National Determined Contribution (NDC).
[60] World Bank. (2022). Thailand Economic Monitor June 2022: Building Back Greener: The Circular Economy
[61] KPMG. (2021). Net Zero Readiness Index 2021

net-zero on the Thai economy will likely depend, among others, on access to financing for green investments, the adoption of appropriate technologies across economic sectors, and the ability to create co-benefits from GHG reductions (such as green jobs, reduced public health burden from pollutions etc.).

5. Local environmental issues, causes, and mitigation

Thailand also faces multiple local environmental issues such as pollution, including air and water quality, waste management, and management and conservation of natural resources and biodiversity.

Air

- While overall air quality in the country was better in April 2020 than the previous year, there were critical areas where air pollution still caused problems. These include the problems of PM2.5 in Bangkok and its vicinity, of volatile organic compounds (VOCs) in industrial areas, and of haze in Northern provinces, resulting from agricultural burning in combination with dry weather leading to the rapid spread of forest fire.

Water

- Out of the water quality of 59 water sources and 6 still water resources, 2% was in excellent quality (equal to 2019), 37% was in good quality (9% increased from 2019), 43% was in fair quality (7% decreased from 2019), and 18% was in poor quality (equal to 2019).
- The overall coastal water quality was better in 2020 than in the past 10-year period, except in the Gulf of Thailand, which continues to face poor water quality problems.
- Key measures being implemented to address the water quality, air and pollution problems include improvements in guidelines and standards, inspection and enforcement of pollution sources, and incorporating of management standards as a criterion for business permits etc.[62]

Waste

- Waste generation in Thailand averages 1.13 kg. per capita per day, leading to 27.8 million tons of solid waste produced per year. In the Bangkok Metropolitan Region, plastic waste accounts for 20% of the total of 10,500 tons of waste per day, of which only 25% is recycled.[63]
- Thailand averages plastic waste generation of 74 kg. per capita per year, which is much higher than the world average of 29 kg. in 2018. In general, plastic waste is

[62] Pollution Control Department, Ministry of Natural Resources and Environment. (2021). Thailand State of Pollution 2020 (B.E. 2563) (Volume 26, 5 March 2021 (B.E. 2564)

[63] All Around Plastics. (2021). Exploring the Perspective: "Environmental Problems are Problems for Everyone" with Dr. Wijarn Simachaya, President of the Thailand Environment Institute

not fully and properly collected and managed. As result about 336,000 tons of plastics leak into the oceans annually, amounting to 4.8 kg. per capita per year.[64]

- Compared to energy, agriculture, and transport, the waste GHG emissions remained small but steadily increased from 10.83 tons of CO2 equivalent in 2010 to 12.58 tons of CO2 equivalent in 2016.
- The pandemic also created a new crisis of surging medical and plastic waste. The amount of plastic waste generated during pandemic was approximately 6,300 tons per day, equivalent to a 15% increase from regular periods with about 5,500 tons per day.[65]
- The Government of Thailand has considered environmental problems from solid waste generation more than ever before, especially as the country is adopting the circular economy approach. Recently, the Government has also approved the Roadmap on Plastic Waste Management 2018–2030 with an ambition to recycle all plastic waste by 2027.[66]

Thailand is endowed with rich ecosystems and biodiversity, but these resources face threats from unsustainable practices and inadequate conservation and management in some key respects.

Forests

- For example, while total forest area in Thailand has been recently relatively stable, accounting for 31.68%, 31.67%, and 31.63% of total country area in 2018, 2019 and 2020 respectively, deforestation and forest fires remain a problem.[67]
- To address this, the 5th strategy of the 20-Year National Strategy (2018-2037)—*environmentally growth for sustainable development*—aims to prevent deforestation and increase forest areas to 55% by 2037.
- In 2020, Thailand also expanded forest conservation from 105696 km^2 in 2006 to 116304 km2, equivalent to 23 % of the total land area, including 22 national parks extending across 6,416 km^2.

Coasts

- Coastal resource management and conservation are also key challenge for Thailand. The country's coastal resources and wetlands have degraded, with some 77% of the coral reefs being devastated by activities linked to tourism, rising from 30% a decade ago.[68]

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[64] UCN. (2020). Thailand

[65] Pollution Control Department, Ministry of Natural Resources and Environment. (2021). Thailand State of Pollution 2020 (B.E. 2563) (Volume 26, 5 March 2021 (B.E. 2564)

[66] Pollution Control Department, Ministry of Natural Resources and Environment. (2021). Thailand Roadmap on Plastic Waste Management 2018–2030

[67] UNFCCC, Office of Natural Resources and Environmental Policy and Planning, Ministry of Natural Resources and Environment. (2022). Thailand's Fourth National Communication

[68] UNDP. (2021). The Biodiversity Finance Plan – The Biodiversity Finance Initiative (BIOFIN) – Thailand

- In 2018, 30% of the coastlines were at critical levels of erosion, with more than 5 meters of erosion per year.[69] Land subsidence, land use change from aquaculture and residential expansion, and mass tourism are all driving coastal erosion in Thailand. Climate change is also exacerbating these erosions through its effects on sea level rise and intensified storms.

Mangroves

- Thailand has good achievements regarding mangrove conservation, but more resources are needed to sustainably manage these coastal resources. Even though Thailand had lost 56% of its mangrove cover during 1961–1996, the effects of coverage loss were mitigated by the government policy shift from mangrove exploitation towards mangrove conservation and restoration in 1998.[70]
- During 2002–2012, the rate of mangrove loss was significantly slower in Thailand[71] compared to other Southeast Asian countries. Thailand has also been uniquely successful in implementing community-based mangrove management, that can be primarily attributed to internal community capacity, government support, and promotion of community-based models.[72]
- While solid policy measures to expand mangrove restoration exist, there is still under-investment in sustainable coastal management projects involving nature-based solutions, particularly when compared to the extensive ecosystem benefits, they bring, especially in avoiding long-term physical and financial losses.[73]
- More investment in sustainable coastal management projects—particularly in the mangrove areas—presents a promising opportunity to promote green COVID-19 recovery with solid involvement from coastal communities while contributing to climate adaptation and mitigation goals under the NDC.

6. Vital national policies related to GHG reduction

Thailand's NDC has established the country's emission reduction targets. Thailand submitted its first NDC to the United Nations Framework Convention on Climate Change (UNFCCC) in 2016 and updated it in 2020. Through the NDC, Thailand was committed to reducing its GHG emissions by 20% compared to the projected business-as-usual by 2030, using 2005 as the baseline year.[74]

This contribution could be increased up to 25% through enhanced technology development and transfer access, more financial resources, and capacity-building support. The updated

[69] Nation Thailand. (2018). Experts Contradict Govt on Coastal Erosion

[70] Global Mangrove Alliance. (2018). Pakistan-Thailand-Vietnam

[71] Richards and Friess. (2016). Rates and drivers of mangrove deforestation in Southeast Asia, 2000–2012

[72] Poonsri Wanthongchai, Orathai Pongruktham . (2019). Mangrove Cover, Biodiversity, and Carbon Storage of Mangrove Forests in Thailand

[73] Global Mangrove Alliance. (2021). The State of the Worlds Mangroves

[74] UNFCCC, Office of Natural Resources and Environmental Policy and Planning, Ministry of Natural Resources and Environment. (2022). Thailand First NDC (Updated submission)

NDC highlights the need for financial support mechanisms for technical assistance for the energy sector.

Thailand has implemented through the NDC Roadmap on Mitigation 2021 – 2030 and the NDC Action Plan. It also submitted the Long-Term Low Greenhouse Gas Emission Development Strategy (LT-LEDS) to the UNFCCC at the end of October 2021, stating the country's aims to peak its GHG emissions in 2030, with the original ambition to move towards net-zero greenhouse gas emissions as early as possible within the second half of this century, and towards carbon neutrality by 2065.

However, the emission reduction target, as well as the carbon neutrality and net-zero GHG ambitions, were recently raised in November 2021. During COP26 in Glasgow, the Prime Minister announced that Thailand will now aim to achieve carbon neutrality by 2050 and net zero GHG emissions by 2065. With financial and technological support and capacity building, Thailand can increase emission reductions to 40% by 2030 under the new NDC commitments.

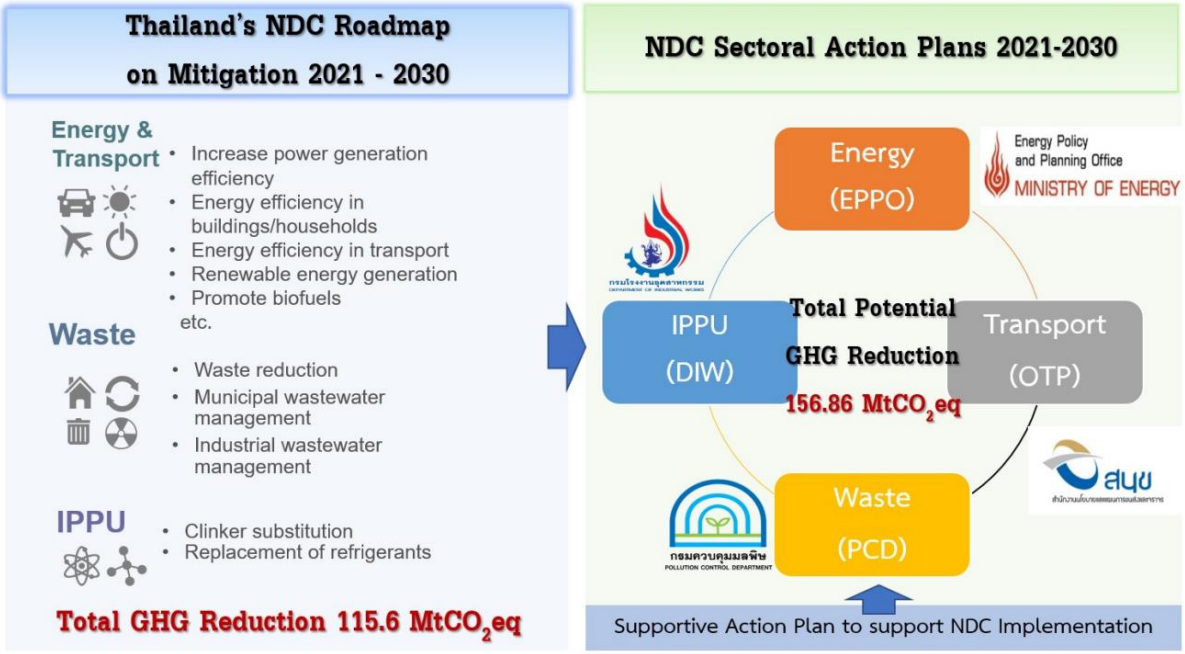
Following the Glasgow announcement, Thailand's Ministry of Natural Resources and Environment (MONRE) commissioned a study to inform the revision of the LT-LEDs[75] and the NDC, to submit both updated documents to the UNFCCC before the COP27 Conference in Egypt in November 2022. Initial study results suggest that Thailand could aim for 30% unconditional emission reductions and 10% conditional upon support. The long-term strategy to achieve carbon neutrality by 2050 and net zero GHG emissions by 2065 will also depend mainly on emission reductions in the energy sector, including using carbon capture, utilisation and storage (CCUS) technologies.

7. Thailand climate change mitigation strategies

Like other ASEAN countries, Thailand must engage in ambitious climate change mitigation actions commensurate with the scale of the climate threats facing the country and the region. To accelerate the decarbonisation of its economy, Thailand has identified a set of mitigation actions in the energy, transportation, IPPU and waste management sectors.

[75] UNFCCC, Office of Natural Resources and Environmental Policy and Planning, Ministry of Natural Resources and Environment. (2022). Thailand's Long-Term Low Greenhouse Gas Emission Development Strategy (Revised version)

Table 19. GHG emission reduction measures under Thailand's Nationally Determined Contribution (NDC) Action plan (2021-2030)



***Source**: ONEP. 2022. BUR4*

Given Thailand's emission profile, the energy transition will play a predominant role in Thailand's journey towards a net-zero economy in line with the Paris Agreement targets. While Thailand's overall GHG emissions represent less than 1% of global emissions and are lower than the world average, the country's key challenge in decarbonisation comes from its heavy reliance on fossil fuels to meet energy demand.

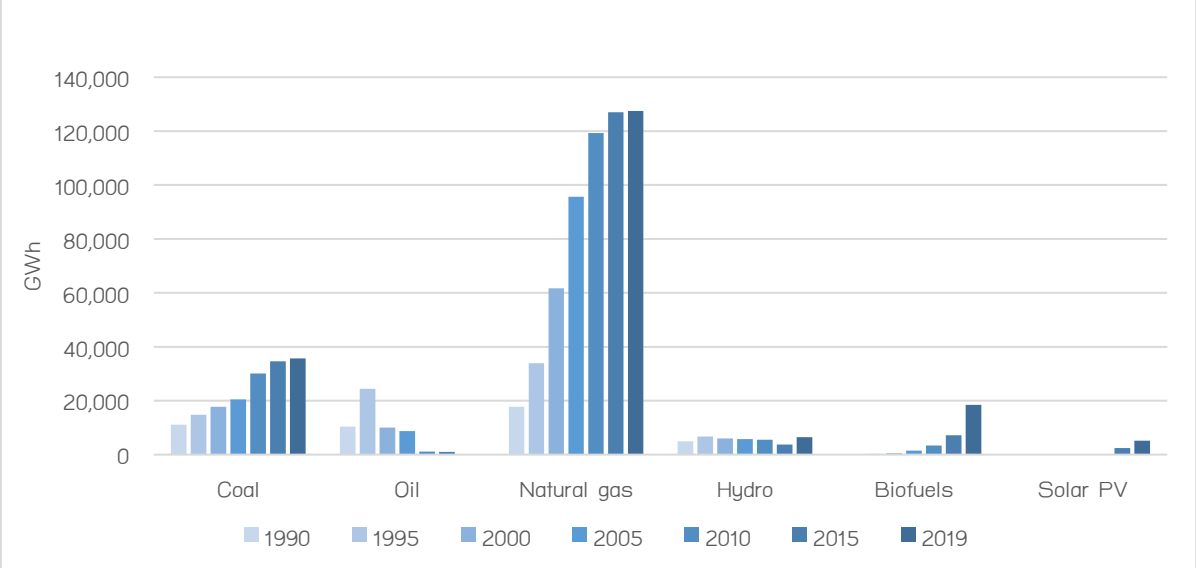
7.1. Energy

Specifically, fossil fuels have been the primary type of fuel used in electricity generation in Thailand in the past three decades (1990-2019). In the decade of 2011–2019, natural gas accounted for—on average—66% of electricity generation, followed by coal (18.6%) and oil (6.3%). Renewables—including hydropower, biofuels, and solar PV—occupied a small proportion, approximately 8%..[76] Over the years, Thailand has also relied on hydrocarbon imports in the context of declining domestic crude oil reserves..[77]

[76] IEA. Thailand

[77] EIA. Thailand

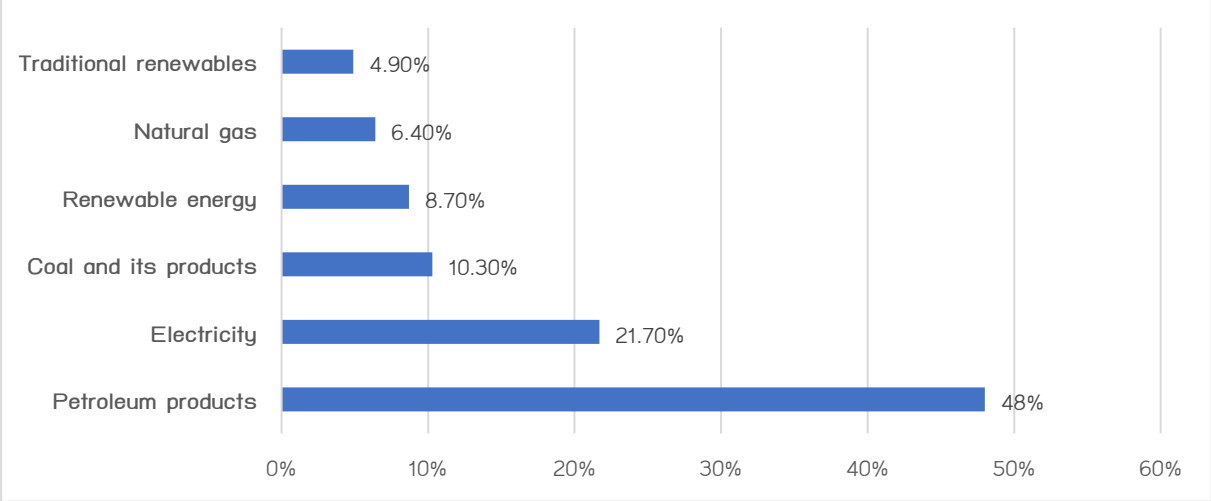
Figure 11. Thailand's Electricity Generation by Source of Energy (GWh), 1990–2019



***Source**: IEA, Key Energy Indicators*

The energy landscape remained broadly similar in 2020 to the historical picture, with natural gas accounting for the largest share (59.1%) of electricity generation, followed by coal/lignite (17.6%) and other types of fuels still account for a relatively small share (23.3%) of electricity generation in 2020. While Thailand's final energy consumption in 2020 (77,340 ktoe) decreased 9.8% from the previous year, consumption of petroleum products was still dominant, accounting for the most significant proportion (48%) of the total final energy consumption, followed by electricity (21.7%), coal and its products (10.3%), renewable energy (8.7%), natural gas (6.4%) and traditional renewable energy (4.9%).[78] [79]

Figure 12. Thailand's Final Energy Consumption by Fuel Type, 2020



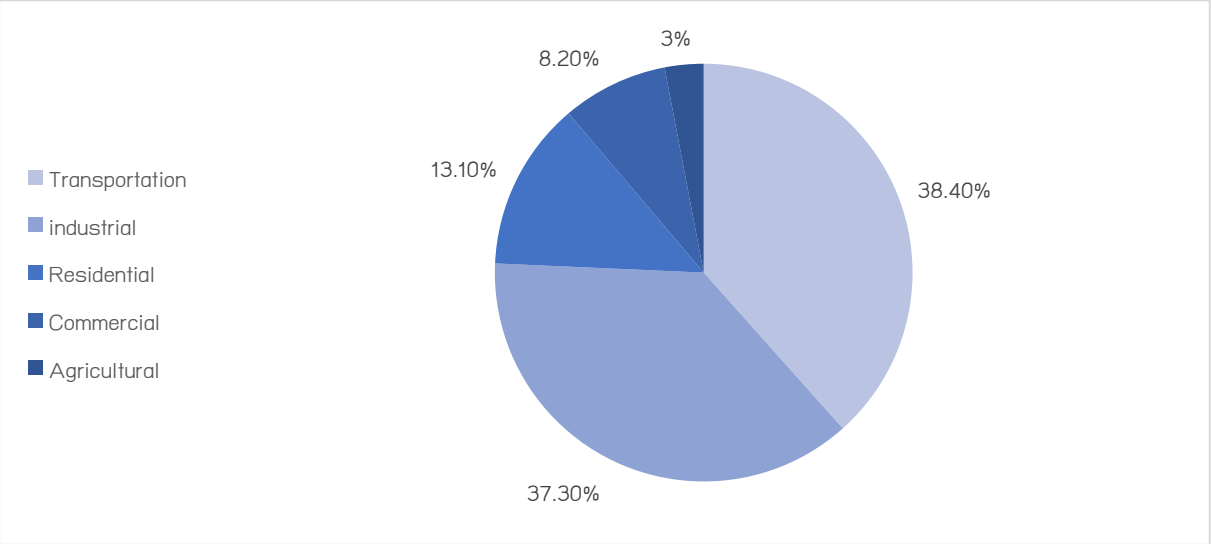
***Source**: Department of Alternative Energy Development and Efficiency (DEDE), 2020: Energy Balance of Thailand 2020*

[78] Defined as fuel wood, charcoal, paddy husk and agricultural waste.

[79] Department of Alternative Energy Development and Efficiency, Ministry of Energy. (2021). Energy Balance of Thailand 2020

In terms of economic sectors, the transport sector consumed in the largest share of energy (38.4%) in 2020 and followed by the industrial sector (37.3%), residential sector (13.1%), commercial sector (8.2%) and agricultural sector (3.0%), respectively.

Figure 13. Thailand's Final Energy Consumption by Economic Sector, 2020



***Source**: Department of Alternative Energy Development and Efficiency, 2020. Energy Balance of Thailand 2020*

Thailand's current energy policies and strategies include key priorities on energy security, alternative energy development to reduce reliance on natural gas, energy prices, and moves towards environmental sustainability. The Alternative Energy Development Plan encourages the development of renewable energy—for instance, from municipal waste, biomass, biogas, wind, and solar—while the Power Development Plan (PDP) 2018-2037 sets the target for power generation from renewable energy at 37% by 2037.

Since 2016, Thailand has set a policy objective of reducing reliance on fossil fuels and established several renewable energy and energy efficiency targets. The NDC Sectoral Action Plan for the Energy Sector 2021 – 2030 aims to reduce GHG emissions from sector by at least 82 million tCO_2 by 2030, compared to a business-as-usual case.[80] Furthermore, the Government of Thailand adopted the Energy 4.0 policy with Electricity 4.0, Fuel for Transportation 4.0, and Heat 4.0 components. This policy guides the transition to a low carbon economy by boosting renewable energy, energy efficiency, intelligent energy management, and energy storage capabilities. In recent years, the country has shifted policy focus towards energy efficiency and clean energy and made promising progress in decreasing energy and CO_2 emission intensity.[81]

[80] nergy Policy and Planning Office, Ministry of Energy. (2019). The NDC Sectoral Action Plan for the Energy Sector 2021 – 2030

[81] IEA. (2020). Putting a price on carbon – an efficient way for Thailand to meet its bold emission target

Figure 14 Thailand's energy-related objectives and targets under different plans

Power Development Plan 2018-2037 (PDP)

The PDP2018 projects that Thailand will reach power generation from renewable energy at 37% by 2037. The government is developing a new national power development plan to increase the proportion of renewable energy used to generate electricity to 50% of all energy types by 2050. The revised version which has been formulated and expected to open for public consultation in the first half of 2023.

Alternative Energy Development Plan 2018-2037 (AEDP)

The AEDP 2015 aims to increase the share of renewable energy consumption by considering the potential for renewable energy sources that can be developed in the form of electricity, heat, and biofuels, accounting for 30% of final energy consumption by 2036.

The Draft AEDP 2018 aims to achieve the following renewable power capacities by 2037: 15.6 GW for solar, 5.8 GW for biomass, 3 GW for wind, 3 GW for hydro including imports from Laos, 0.9 GW from waste. The aggregate target of 29.4 GW under the latest plan is a major leap from the earlier target of 19.7 GW by 2036. The Draft AEDP 2018 also increases power production capacity from bio-methane gas and includes the Community Power Plants for the Local Economy Project.

Energy Efficiency Plan 2018-2037 (EEP)

The EEP 2018 aims to reduce energy intensity (EI) by 30% in 2036 compared to 2010, which will be implemented in four economic sectors: industrial sectors, business and government buildings, residential sector, and transportation sector.

Gas Plan 2018-2037

The plan's targets include enhancing LNG importation and management; promoting LNG use in industrial and transportation sectors; developing capacity assessment and management system; and managing land-based and marine-based gas sources.

Oil Plan 2018-2037

The plan intends to improve the standard of an oil refinery to EURO 5 and 6 and LNG and NGV management; promote proper biofuel utilization in the transportation sector; develop an oil database and control system; reconstruct oil price and reduce biofuel cost; and manage oil industry to accommodate EV utilization.

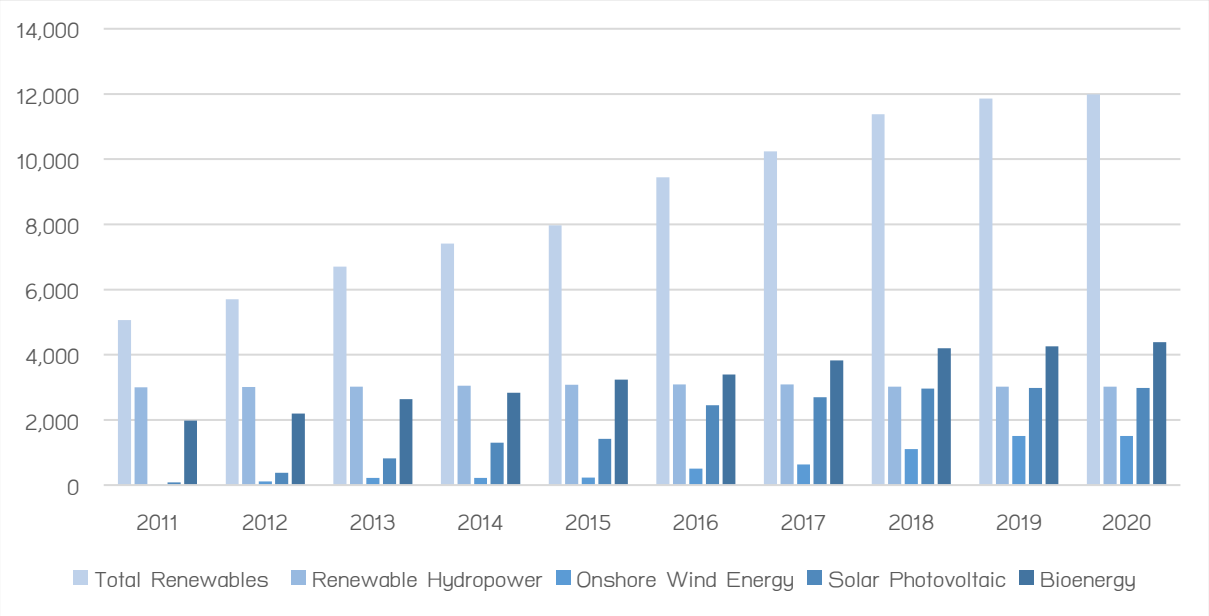
***Sources**: Thailand's Fourth National Communication, Thomson Reuters UK Practical Law, Alternative Energy Development Plan (2018–2037) Thailand (2019)*

Renewable energy

Reflecting the policy direction, installed power capacity from renewables continued to increase over the past ten years, from 5061 megawatts (MW) in 2011 to 11991 MW in 2020, compared with the broader renewable energy target of 19,684 MW by 2036 under the Alternative Energy Development Plan 2015. Bioenergy contributed 37.5% of the total power production, while the share of hydropower declined from 30% in 2011 to 25.3% in 2020. The shares of solar photovoltaic (PV) and wind power are smaller than bioenergy and hydropower,

but they began to catch up in 2020 with the development of 2,983 MW (solar PV) and 1,507 MW (onshore wind power)..[82]

Figure 15. Thailand's Renewable Power Installed Capacity, MW 2011–2020



***Source**: IRENA, Renewable energy statistics, 2021*

In practice, the PDP 2018 has opened more windows for the development of renewable energy in Thailand by promoting new business opportunities for private investment and leveraging modern technologies. With the cost reduction of various types of renewable technologies and supportive policies, Thailand's power generation has started to witness a gradual shift towards renewable energy. Key developments and trends in solar, wind, and waste to energy in the medium term are summarized below:

Solar.

Solar energy is the renewable energy source of which Thailand has the most comparative advantage. The northeast and central regions are well suited to develop solar PV systems with high irradiance levels all year round. Solar is the largest expected renewable energy source for electricity generation in the PDP 2018, with the target of 15,574 MW under the plan. The government subsidy to solar energy through the Feed-in Tariff (FiT) scheme started in 2014.

Wind.

Wind power has experienced steady growth over the past 5 years. In 2019, installed onshore wind capacity reached 1,507 MW, which is equivalent to 50% of the target set under the PDP 2018. According to Thailand Wind Energy Association, the sector could harness wind

[82] IRENA. (2021). Renewable Energy Statistics 2021

energy technologies to enable a potential installed capacity of 13,000–17,000 MW by 2037, subject to government wind energy development policy.[83]

For moving towards carbon neutrality in 2050, the Ministry of Energy is developing details in the National Energy Plan 2022, which has been referred in the Thailand's Long-Term Low Greenhouse Gas Emission Development Strategy (Thailand LT-LEDS). Overall, the policy direction of the new National Energy Plan is anchored around achieving four overarching goals:

1) Increasing renewable energy to at least 50%;
2) Transitioning the energy used in transportation to green energy by promoting electric vehicles (EV);
3) Increasing energy efficiency by 30% by utilizing technology and innovation
4) Modifying the energy business structure to embrace energy transition according to the 4D1E framework (Decarbonisation, Digitalisation, Decentralisation, Deregulation, and Electrification).

Legal framework

The energy sector in Thailand is governed by the Ministry of Energy and managed by the National Energy Policy Council (NEPC), with the Energy Policy and Planning Office (EPPO) as its secretariat. The sector is regulated by the independent Energy Regulatory Commission (ERC), which monitors energy market conditions, reviews tariffs, issues licenses, approves power purchases, and reviews development planning and investment in the electricity industry. The electricity industry is structured under an "enhanced single-buyer model", with the government-owned Electricity Generating Authority of Thailand (EGAT) being solely responsible for transmission system operation and electricity generation. EGAT also acts as the single buyer, purchasing bulk electricity from private power producers and sells wholesale electricity to Thailand's two distribution utilities, the Metropolitan Electricity Authority (MEA) and the Provincial Electricity Authority (PEA), as well as a small number of direct industrial customers and utilities in neighbouring countries.

The primary legislation governing the electricity sector is the Energy Industry Act B.E. 2550 (2007), which established the ERC. In addition, the Electricity Generating Authority of Thailand Act, B.E. 2511 (1968) permits the EGAT to promulgate regulations in accordance with its objectives, relating primarily to the purchase of electricity from independent producers and the operation of the transmission system network. The Thai government also promotes private investment in the electricity generation business through the independent power producer (IPP) program, which was set up in 1994 and allows private developers to build, own, and operate power plants with generating capacity greater than 90 megawatts (MW) and to enter long-term (20–25 years) power purchase agreements with the EGAT.

[83] Global Wind Energy Council. (2019). Wind industry calls for additional 7 GW of wind energy to be installed in Thailand by 2037

7.2. Transportation

Transport has been the dominant sector in the Infrastructure Development Master Plan (IDMP) 2015–2022, which prioritised five transport sectors: (1) inter-link railway network, (2) road networks, (3) mass transit in Bangkok and neighbouring cities, (4) enhancement for highway network to link with key areas in the country and with the regional countries in the Greater Mekong Subregion and ASEAN, and (5) water and air transport. The estimated Investment for the IDMP reached THB3.4 trillion (USD100 bn), of which planned spending on major projects on railway and mass transit networks in Bangkok are dominant.[84]

Sustainable transport

Environmental sustainability has become an increasingly important consideration in the transport sector in Thailand. Through a short-term programme (2013–2017), and a long-term plan (2018–2030), the Environmental Sustainable Transport Master Plan (2013) aims to reduce energy intensity, GHG emissions, and air pollution from transport, with the development of public transportation and mass rapid transit systems as one of the key implementation strategies. In 2019, the Ministry of Transport (MoT) published the 20-year Transport System Development Strategy (2018–2037), which includes green and safe transport as a key pillar.

The Thailand Transport Investment Action Plan 2017 has also prioritised sustainable transport projects. The Plan outlined (1) 10 projects for Double Track Rail Network (USD11.67 bn); (2) two projects for Commuter Train (USD4.78 bn); (3) six projects for Mass Transit Development (USD6.32 bn); and (4) one project for public bus procurement and stations (USD64.92 m). The Thai Board of Investment (BOI) offers tax and non-tax incentives to domestic and international investors to invest in sustainable transport in Thailand, including rail development.[85] The Government also implements a number of several public transportation development projects in provincial areas.

The NDC Sectoral Action Plan for Transport Sector 2021 – 2030 aims to reduce GHG emissions from the sector, with an emphasis on developing efficient and sustainable transportation systems to reduce energy consumption, lessen traffic congestion, and create liveable cities. Four key strategies include:

1. supporting and promoting the planned implementation of relevant agencies in the transport sector;
2. developing and improving laws supporting GHG reduction;
3. developing measurement, reporting and verification (MRV); and
4. engaging and strengthening the capacity of all agencies to reduce GHG emissions.

[84] Oxford Business Group. Infrastructure improvements aim to connect Thailand with the rest of Asia

[85] Thailand Board of Investment. (2019). Transport & Logistics

Figure 16. Thailand's key transport-related objectives and targets

- Reduce 31.0 $MtCO_2eq$ from mitigation measures in the transport sector (Thailand's NDC Roadmap 2021-2030), especially in energy efficiency in transportation
- The NDC Action Plan in the transport sector, 2021 – 2030 identifies measures of green transport, transport efficiency, and inclusive transport and is expected to contribute to the GHG emissions reduction of 35.42 $MtCO_2eq$ in 2030.[86]
- Increase to 1.2 million electric vehicles and 690 charging stations by 2036.[87]

Legal framework

All national transport-related agencies are under the control of the Ministry of Transport. The Department of Highways (DOH) is responsible for national roads and highways, while key local roads are the responsibility of the Department of Rural Roads. Around 365,000 km of other local roads are under municipal and district jurisdictions. The Expressway Authority of Thailand (EXAT) is responsible for urban express ways, presently confined to Bangkok Metropolitan Region (BMR) and its environs. Bangkok Metropolitan Administration (BMA) is responsible for urban road development in the BMR. The Office of Transport and Traffic Policy and Planning (OTP) is the national transport planning office.

Key transport-related laws include the Land Transport Act, B.E. 2522 (1979), which governs registration of vehicles, vehicle dimensions, operation of freight and passenger transport, and annual taxation and inspection; the Highway Act, B.E.2535 (1992), which governs road design, vehicle and axle weight regulations; and the Industrial Product Standards Act, B.E. 2511 (1968) which governs product standard regulations, and emission standard of vehicles (in compliance with the National Pollution Control Board's Order).

8. State of the local green finance market

Based on data sourced from International Monetary Fund (IMF) and the World Bank, Thailand has a deep, diverse, and inclusive financial sector, supported by strong regulation and supervision in addition to a high level of alignment with international standards. Financial sector assets grew to 271% of GDP at the end of 2017 from 183 percent in 2007, with assets of banks representing 46 percent of total financial sector assets at the end of 2017.

While banks continue to account for a sizable share of the financial sector, the role of Specialized Financial Institution (SFIs)[88], other deposit-taking institutions, and non-bank financial institutions (NBFIs) has grown. Financial inclusion has continually improved, with

[86] Office of Transport and Traffic Policy and Planning, Ministry of Transport. (2021). NDC Action Plan in the transport sector 2021 – 2030

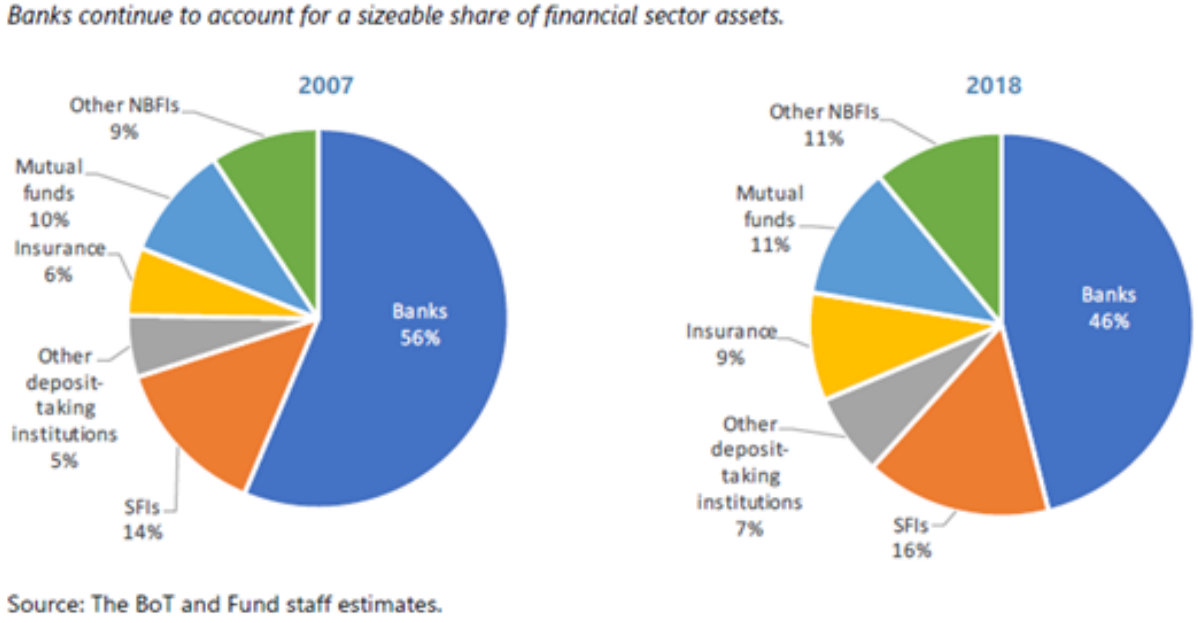
[87] Hanh, N. M. (2022). Thailand Issues New Incentive Package for Electric Vehicle Industry

[88] SFIs are government financial institutions that promote economic development and provide financing to specific sectors.

82% of adults in Thailand having a formal financial account as of 2017, compared with 71% in the East Asia and the Pacific region and 73% among upper middle-income countries.

There is also an active FinTech ecosystem, resulting in a proliferation of new payments companies and instruments, enabled by regulatory sandboxes that enable financial innovation. Despite relatively high household indebtedness and some signs of weaknesses in corporates and small-and-medium enterprises, the banking sector is resilient to potential shocks, including severe shocks.

Figure 17. Thailand's Financing System Structure (in percent of total financial assets)



Graphic source: IMF and World Bank. 2019

Thailand also has a rapidly growing sustainable finance markets, enabled by supportive financial sector policies and regulations that promote the channelling of capital flows in the real economy towards sustainable development. Cumulatively between 2016-2021, Thailand is the second largest issuer of green, social and sustainability (GSS) debts.[89] in ASEAN after Singapore, with the total GSS debt issuances from

Thailand in 2021 standing at USD 4.4 bn, dominated by the sustainability theme..[90] Thailand is also the ASEAN leader in the issuance of unlabelled climate-aligned bonds, and has witnessed a rapid growth of sustainability-linked bonds and loans (SLBs and SLLs). Private banks in Thailand have led on green finance by issuing green and sustainability bonds to fund and refinance green assets. Thai banks that have issued green and sustainability bonds are TMB Bank and Kasikorn Bank, for USD 160 m..[91]

[89] Green debts include bonds, loans, and social and sustainability debts/bonds

[90] Manuamorn, O., Nguyet, P.M., Tukiainen, K. (2022). ASEAN Sustainable Finance State of the Market 2021

[91] Data form CBI

Many banks are also providing green loans and other tools for green projects, i.e., renewable energy and energy efficiency. Since 2005, 11 banks have participated in the Energy Efficiency Revolving Fund (EERF), including Bangkok Bank, Bank of Ayudhya, CIMB Thai, TMB Bank, Siam City Bank, Siam Commercial Bank, Kasikorn Bank, Exim Thai Bank, SME Bank, and UOB. Another example is the "SME Go Green" scheme initiated by Siam Commercial Bank, which provides green loans to green SMEs to cover their long-term and working capital to finance clean energy and pollution management projects which will help to reduce energy consumption.

Building on the above momentum, the Sustainable Finance Initiatives for Thailand envision a commercially viable and sustainable Thai financial sector by 2025. As a key component of the sustainable finance ecosystem, the Thai Taxonomy can play instrumental roles in achieving this vision. In particular, the Thai Taxonomy will:

- Establish a common language among Thai financial institutions about the classification of green financial flows, thus facilitating the creation of green finance standards within the financial sector;
- Support better-informed and more efficient decision-making by financial institutions to respond to investment opportunities that contribute to achieving green and sustainable development objectives;
- Inform the development of new products and services such as green bonds, loans, and index-linked capital market investment products;
- Form the basis for the government to design incentive measures to further promote green finance;
- Create stronger awareness of green and sustainable economic activities among different stakeholders, which can further stimulate demand and supply for green and sustainable financial products.

Given its interoperability with other major international taxonomies, the Thai Taxonomy will also help raise the international profile of Thai green financial products, and could, therefore, help stimulate more inflows of international green and sustainable capital into the country.

Annex 2. Terms and definitions

The present taxonomy utilizes a lot of terms that don't have an agreed definition. In order to avoid confusion, the table is intended to provide all necessary terms and definitions for utility of its users.

Term	Definition
Green hydrogen	Green hydrogen is hydrogen generated by renewable or low-carbon energy. Any energy production activities that are eligible under the present taxonomy (except for the natural gas) can be used to produce green hydrogen.
Life-cycle assessment	Systematic analysis of the potential environmental impacts of products or services during their entire life cycle. For the purposes of the present Taxonomy life cycle assessment should follow the latest releases of ISO std (ISO 14040, ISO 14044).
Scope 1 emission	Direct emissions that a company causes by operating the things that it owns or controls. These can be a result of running machinery to make products, driving vehicles, heating buildings and powering computers.
Scope 2 emission	Indirect emissions created by the production of the energy that an organization buys. Installing solar panels or sourcing renewable energy rather than using electricity generated using fossil fuels would cut a company's Scope 2 emissions.
Scope 3 emission	Indirect emissions that cover those produced by customers using the company's products (downstream Scope 3 emissions emissions) or those produced by suppliers making products that the company uses (upstream Scope 3 emissions).
Bioenergy	Energy generated from the conversion of solid, liquid and gaseous products derived from biomass.
Biofuel	Liquid fuels derived from biomass. They include ethanol, a liquid produced from fermenting any biomass type high in carbohydrates, and biodiesel, a diesel-equivalent processed fuel made from both vegetable oil and animal fats.
New and existing facilities	For the purpose of the present taxonomy, existing facilities are the facilities that were operational or acquired the authorities' approval for construction of the facility before 1 January 2024. New facilities are the facilities where the authorities' approval for construction of the facility is acquired by its operator after 31 December 2023.
Waste heat	Heat from process outputs at high temperature. Waste heat may be extracted from sources such as hot flue gases from a diesel generator, steam from cooling towers, or even wastewater from cooling processes such as in steel cooling. Waste heat is never a direct product of an activity, but rather a byproduct that can be utilized. More on waste heat can be found in the article "Waste heat generations: a comprehensive review"
Waste-to-Energy (WtE)	WtE or energy-from-waste (EfW) is the process of generating energy in the form of electricity and/or heat from the primary treatment of waste, or the

Term	Definition
	processing of waste into a fuel source. Most WtE processes generate electricity and/or heat directly through combustion, or produce a combustible fuel commodity, such as methane, methanol, ethanol or synthetic fuels.
Product carbon footprint (PCF)	The PCF sums up the total greenhouse gas emissions generated by a product over the different stages of its life cycle. A cradle-to-grave PCF (i.e. PCF mentioned in the present Taxonomy) covers the complete life cycle of the product, including the emissions from the use phase and end-of-life of the product.
Marine energy	Marine energy, also known as marine and hydrokinetic energy or marine renewable energy, is a renewable power source that is harnessed from the natural movement of water, including waves, tides, and river and ocean currents.

Annex 3. Phases and Review of Thailand Taxonomy

The Thailand Taxonomy development is divided into phases. The initial phase focuses on 2 sectors: Energy and Transportation. The development of metrics and thresholds of other economic sectors (such as manufacturing, agriculture, and waste management) will be included in the next phase. The latter phase is expected to commence in the second half of 2023. In addition, the Thailand Taxonomy is recommended to be reviewed every 3 – 5 years in response to the new technologies, evolving scientific views, and national policies.

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