THAILAND TAXONOMY

Introduction

Conceptual Framework and Methodological Approach

May 2025

THAILAND TAXONOMY BOARD

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 as well as financial sector to ensure all sectors' views are reflected. The list of agencies is as follows:

1. Department of Climate Change and Environment (DCCE), Ministry of Natural Resources and Environment
2. Bank of Thailand (BOT)[1]
3. The Securities and Exchange Commission, Thailand (SEC)[1]
4. Stock Exchange of Thailand (SET)[1]
5. Department of Alternative Energy Development and Efficiency, Ministry of Energy
6. Thailand Greenhouse Gas Management Organisation (Public Organisation)
7. Office of Natural Resources and Environmental Policy and Planning, Ministry of Natural Resource and Environment
8. Energy Policy and Planning Office, Ministry of Energy
9. Office of Transport and Traffic Policy and Planning, Ministry of Transport
10. Department of Agriculture, Ministry of Agriculture and Cooperatives
11. Office of Agricultural Economics, Ministry of Agriculture and Cooperatives
12. Rice Department, Ministry of Agriculture and Cooperatives
13. Department of Livestock Development, Ministry of Agriculture and Cooperatives
14. Royal Forest Department, Ministry of Natural Resources and Environment
15. Department of National Parks, Wildlife and Plant Conservation, Ministry of Natural Resources and Environment
16. Department of Fisheries, Ministry of Agriculture and Cooperatives
17. Department of Marine and Coastal Resources, Ministry of Natural Resources and Environment
18. Department of Public Works and Town & Country Planning, Ministry of Interior
19. Department of Industrial Works, Ministry of Industry

[1] the BOT, SEC, and SET are representatives of the Working Group on Sustainable Finance (WG-SF), in collaboration with the Fiscal Policy Office (FPO) and the Office of Insurance Commission (OIC).

20. Thai Industrial Standards Institute, Ministry of Industry
21. Pollution Control Department, Ministry of Natural Resources and Environment
22. Department of Local Administration, Ministry of Interior
23. Energy Regulatory Commission
24. Bangkok Metropolitan Administration
25. Department of Health, Ministry of Public Health
26. Wastewater Management Authority, Ministry of Interior
27. Federation of Thai Industries
28. Renewable Energy Industry Club, Federation of Thai Industries
29. Thai Chamber of Commerce and Board of Trade of Thailand
30. Thai ESCO Association
31. Council of Engineers
32. Thai Condominium Association
33. Thai Green Building Institute
34. Industrial Estate Authority of Thailand
35. The Thai Bankers' Association (TBA)
36. Association of International Bank (Thailand) (AIB)
37. Government Financial Institutions Association (GFA)

In addition, Thailand Taxonomy was developed with the support of the International Financial Corporation (IFC), Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH (GIZ), and the Asian Development Bank (ADB). Meanwhile, various international and local consultants served as technical advisors during the development, including the Climate Bonds Initiative (CBI), DNV, the Creagy, the Carbon Institute for Sustainability (CBiS), and the Thailand Development Research Institute Foundation (TDRI).

More importantly, inclusive collaboration across various parties, including academia, industry associations, NGOs, and international organisations, helps to ensure that the Thailand Taxonomy aligns with international standards while reflecting the national context. Views and feedback, even from those not formally on the Thailand Taxonomy Board, also contributed significantly to the successful completion and future implementation of the Thailand Taxonomy.

Thailand Taxonomy Methodological Summary

This section provides a brief description of the methodology for developing the Thailand Taxonomy and the basic principles of its use.

Objectives of the Thailand Taxonomy

Based on an analysis of Thailand's national plans, strategies and policies, the following taxonomy objectives were identified:

1. Climate change mitigation;
2. Climate change adaptation;
3. Sustainable use and protection of marine and water resources;
4. Promotion of resource resilience and transition to a circular economy;
5. Pollution prevention and control;
6. Protection and restoration of biodiversity and ecosystems.

Selection of the activities for the inclusion into the Taxonomy

The Taxonomy is structured and designed to improve the ecological and climate credentials of the economy, and activities within each sector are selected on the basis of the following:

- **Substantial contribution** to the environmental objectives of the Taxonomy specified for each sector.
- **Existence of technological solutions for decarbonisation** for some climate-material activities, no such solution has yet been developed.
- **Inclusion into other taxonomies** to avoid global green market fragmentation and utilize research put into their development.

In addition, climate-material activities are selected on the basis of the ISIC (version 4) classification system. It is an international classification system of economic activities that has been adopted by the majority of other taxonomies as a common framework. Mapping against other types of classification (including TSIC) is included in the Thailand Taxonomy.

Although the economic materiality of certain activities is presented in this report, it does not serve as the primary criteria for the activity selection. This is because some economically significant activities may not, in themselves, exhibit direct climate materiality.

Classification of Activities

1. Traffic Light System

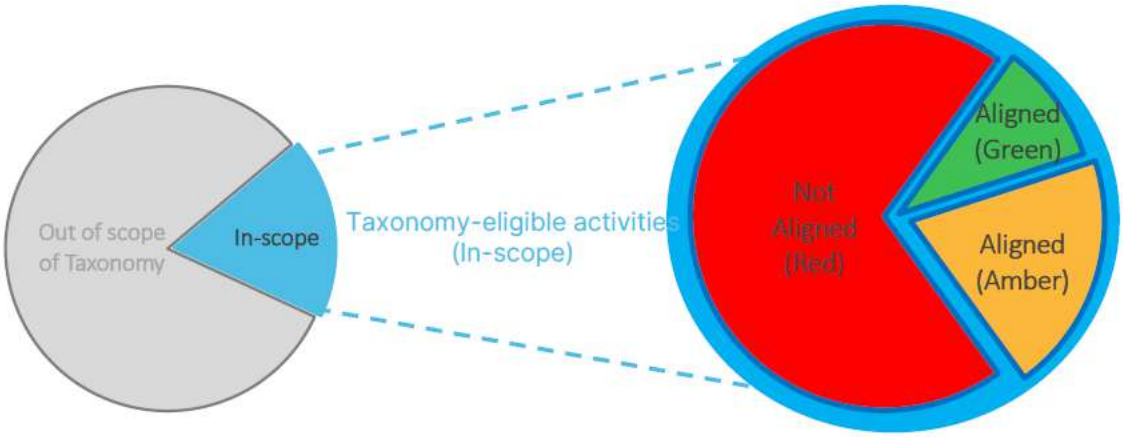
Thailand Taxonomy introduces a "traffic light system" classification—green, amber (transitional), and red—offering a more effective approach to evaluating economic activities. Unlike traditional binary taxonomies that categorize activities as either sustainable (green) or unsustainable (red), the traffic light system allows a greater flexibility and a broader range of pathways for decarbonizing the economy, thereby providing greater opportunities for funding access.

Traffic light	Description
Green	Substantially contributing to the goals of the taxonomy. This category includes: ● **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); ● **Clear pathway to zero activities**: activities that are not net-zero at the moment but have a clear Paris Agreement aligned decarbonisation pathway (e.g., shipping) that may be followed. This category can generally be applied to new facilities operating in compliance with the requirements of the taxonomy (e.g., construction of a steel mill producing steel in compliance with the green category for steel production) or to revenue that is generated through the sale of products that meet the requirements of the taxonomy.
Amber	This category includes activities that entail relatively high emissions but are: ● Facilitating significant emissions reductions in the short term with reliable decarbonisation pathways and prescribed sunset dates (2040 for Thailand Taxonomy); ● Enabling other green activities, even though they are not green themselves (e.g., grid infrastructure).

Traffic light	Description
	Thailand's national decarbonisation strategies and Nationally Determined Contribution (NDC) were taken into account when developing criteria for this category. Amber activities may have the criteria in the form of: ● **decarbonisation pathway** (e.g. in the energy sector) that the activity must follow in order to be considered transitional. In order to attract transition financing, the changes implemented in the enterprise must lead to a decrease in the emission intensity according to this pathway. ● **relative performance improvement requirements** (e.g. in the construction and real estate sector). This format involves the introduction of a certain percentage of improvement over the baseline that must be achieved in order for the financing raised this way to be considered transition financing. ● **list of applicable measures** (e.g. in the Manufacturing sector) which refer to the individual technologies that can be applied to improve the climate and environmental credentials of the activity. Funds raised for the implementation of these measures will be considered transition funding. If this category features N/A, it means that no transitional option is available, and only green category is available to those who want to align their activity of this kind with the Taxonomy.
Red	Currently not compatible with net-zero trajectory and are not going to become compatible anytime soon. These activities should therefore be phased out (e.g., electricity generation from coal) if the country wants to achieve the goals of the Paris Agreement. If this category features N/A, it means the activity cannot deal significant damage to the environment and thus all activities of this type that are not aligned with green or amber category are simply out of scope of the taxonomy.
Out of the scope of the taxonomy	If the activity is not present in the taxonomy, it does not mean that this activity is harmful to its objectives. It is simply considered "out of the scope" due to its low climate materiality or lack of science-based criteria. The taxonomy does not make any decision about it, and it should be reported in disclosure documents as "out of scope".

However, development of the agricultural taxonomy employs a practice-based approach due to data limitations in directly measuring greenhouse gas (GHG) emissions. This method relies on internationally recognized best practices that are widely accepted for their effectiveness in reducing GHG emissions within the agricultural sector.

Figure 1 Example of Activity Classification under the Taxonomy



Source: The Creagy

2. Essential criteria

The principles of **Do No Significant Harm (DNSH)** and **Minimum Social Safeguards (MSS)** serve as the essential criteria within the Thailand Taxonomy framework. DNSH ensures that economic activities do not adversely impact other environmental objectives, while MSS aims to prevent negative social consequences. These principles are essential to maintaining the integrity of the taxonomy and mitigating risks such as greenwashing.

In cases where an activity does not meet these principles, the responsible entity must develop and implement a remediation plan that has undergone evaluation against relevant standards, includes stakeholder consultation, and ensures public disclosure. The plan must be fully executed within a three-year timeframe. If the activity fails to achieve compliance within this timeframe, it will result in the activity being reclassified as non-compliant (red category).

It is very important to note that all entities adhere to the applicable legal and regulatory frameworks of Thailand or the jurisdiction in which the activity is conducted, as a prerequisite for alignment with the taxonomy.

The implications of aligning capital expenditures, revenue, or financial instruments with the Taxonomy

The most popular use of taxonomies worldwide is to evaluate various financial flows for alignment with it. Any business can be divided into various economic activities in accordance with the ISIC classification (this is why activity serves as the basis for the Taxonomy). Each of these activities can either generate revenue, or financial instruments can be issued with their backing, or it can be changed in some way with the help of capital expenditures:

- **Capital expenditure**, refers to the money an entity raises through debt instruments (bonds, loans) and that is used to buy, maintain, or improve its fixed assets. By meeting the relevant Taxonomy criteria, entities can issue Taxonomy-aligned[2] green- or transition-labelled bonds or loans to raise sustainable financing for Taxonomy-eligible[3] activities.
- **Revenue** refers to the total income of an organisation or corporate entity that is derived from the sale of products or services. By meeting the relevant Taxonomy criteria, corporates can report and disclose the proportion of business that is aligned with green or transition as defined by the Taxonomy. The products that are produced through the Taxonomy-aligned activities can also be considered Taxonomy-aligned.
- **Financial instruments** can be aligned with the Taxonomy if they are derived from a business whose revenue aligns with the Taxonomy. In this case, the financial instrument can be called “green” or “amber (transitional)”, depending on the revenue alignment category.

Please note that these are general application rules, and more detailed guidance must be provided separately by relevant national authorities.

Living Document

Thailand Taxonomy is designed as a living document, subject to review every 3–5 years. Earlier revisions may be undertaken in response to significant technological advancements or newly available data that impact its criteria and thresholds, ensuring continued alignment with evolving scientific knowledge, innovation, and policy developments.

[2] “Aligned” means that the activity in question is fully compliant with all relevant criteria of the taxonomy.

[3] “Eligible” refers to the activities that are included in the taxonomy without assessing their compliance with the criteria.

Table of Contents

List of Tables

List of Figures

List of abbreviations

ADB	Asian Development Bank
AER	Annual Efficiency Ratio
ANDBI	Activities Not Defined by ISIC
ASEAN	Association of Southeast Asian Nations
ATTRIC	Automotive and Tyre Testing, Research, and Innovation Center
AWD	Alternative wetting and drying
BAU	Business-as-usual
BEC	Building Energy Code
BF	Blast furnace
BF-BOF	Blast furnace – basic oxygen furnace
BOT	Bank of Thailand
BUR4	Thailand's Fourth Biennial Update Report
CapEx	Capital expenditure
CBAM	Carbon border adjustment mechanism
CCAPA	Climate Change Action Plan for Thai Agriculture
CCMP	Climate Change Master Plan
CCS/CCUS	Carbon capture and storage/ Carbon capture, utilisation and storage
CHP	Combined heat and power
CRVA	Climate risk vulnerability assessment
CSP	Concentrated solar power
DCCE	Department of Climate Change and Environment
DCS	Fuel Oil Data Collection System
DEDE	Department of Alternative Energy Development and Efficiency
DIW	Department of Industrial Works
DRI	Direct reduced iron
DSR	Direct dry rice seeding
EAF	Electric arc furnace
EDGE	Excellence in Design for Greater Efficiencies
EU	European Union

EUI	Energy use intensity
FDI	Foreign direct investments
FSC	Forest Stewardship Council
FTI	Federation of Thai Industries
GBCA	Green Building Council Australia
GDP	Gross domestic product
GFA	Gross floor area
GHG	Greenhouse gas
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
GWP	Global warming potential
HDPE	High-density polyethylene
ICMA	International Capital Market Association
IEA	International Energy Agency
IFMP	Integrated Farm Management Plan
IFC	International Finance Corporation
IFMP	Integrated Farm Management Plan
IGBC	Indian Green Building Council
IMO	International Maritime Organisation
IPCC	Intergovernmental Panel on Climate Change
IPHE	International Partnership for Hydrogen and Fuel Cells in the Economy
IPPU	Industrial processes and products use
IRENA	International Renewable Energy Agency
ISIC	International Standard Industrial Classification
ISO	International Organisation for Standardization
LCA	Life cycle analysis
LDPE	Low density polyethylene
LEED	Leadership in Energy and Environmental Design
LLDPE	Linear low-density polyethylene
LPG	Liquefied petroleum gas
LT-LEDS	Long-Term Low Emissions and Development Strategy
LULUCF	Land use, land-use change, and forestry

MEPS	Minimum Energy Performance Standard
MOE	Ministry of Energy
MIND	Ministry of Industry
MOT	Ministry of Transport
MOU	Memorandum of understanding
MRV	Monitoring, reporting and verification
NDC	Nationally Determined Contribution
NESDC	National Economic and Social Development Council
OpEx	Operating expenditure
PED	Primary energy demand
PEFC	Programme for the Endorsement of Forest Certification
PET	Polyethylene terephthalate
PM 2.5	Particulate matter 2.5
PP	Polypropylene
PW	Photovoltaic
QoQ	Quarter-on-Quarter
RCP	Representative Concentration Pathway, a greenhouse gas concentration trajectory adopted by the IPCC
SCM	Substitute cementitious material
SDG	Sustainable Development Goals
SEC	Securities and Exchange Commission
SET	Stock Exchange of Thailand
TCMA	Thailand Cement Manufacturers Association
TPI	Transition Pathway Initiative
TTB	Thailand Taxonomy Board
TEI	Thailand Environment Institute
TFCC	Thai Forest Certification Council
TSIC	Thailand Standard Industrial Classification
WG-SF	Working Group on Sustainable Finance
XRD	X-ray diffraction
YoY	Year-on-year

ZEV	Zero emission vehicles

List of Metrics Abbreviations

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
GgCO2eq	Gigagrams of carbon dioxide equivalent, Greenhouse gases in carbon dioxide equivalent
ktoe	Thousand tons of oil equivalent
Mha	Megahectare
MtCO2e/year	Gross emission calculated as metric tons of carbon dioxide equivalent emitted per year
MW	Megawatt
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
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

1. Thailand Taxonomy Development Project Background

The Working Group on Sustainable Finance (WG-SF), consisting of the Fiscal Policy Office (FPO), the Bank of Thailand (BOT), the Securities and Exchange Commission (SEC), the Office of Insurance Commission (OIC), and the Stock Exchange of Thailand (SET), has joined forces to steer and align the direction of Thailand's sustainable finance policies to support the country's development objectives. Developing a practical national sustainable finance taxonomy to promote inward investment flows across Thailand's financial sectors from domestic and international investors is one of the key strategic initiatives identified by the Thailand Sustainable Finance Initiatives Roadmap published in 2021.[4] A well-defined and structured taxonomy is intended to support better-informed and more efficient decision-making and responses to investment opportunities that contribute to achieving national climate development objectives as defined by the Government of Thailand.

As an institution leading the Thailand Taxonomy (hereinafter – the Taxonomy) development process, the Thailand Taxonomy Board defined the following list of objectives for the Taxonomy document:

1. To provide a standard practice to the financial sector and other related sectors;
2. To enable data disclosure and encourage financial institutions and other sectors to integrate environment-related risks and opportunities into their operations by providing incentives;
3. To provide alignment with internationally recognized taxonomies such as ASEAN Taxonomy, EU Taxonomy, Singapore Taxonomy and Climate Bonds Taxonomy.

In June 2023, the Thailand Taxonomy Board launched the Thailand Taxonomy Phase I as a reference tool for standardized classification of economic activities deemed low-carbon and climate-friendly. While recognizing multiple priority environmental objectives for Thailand, the Thailand Taxonomy Phase I develops a classification system for the objective of climate change mitigation (i.e., the reduction of greenhouse gas (GHG) emissions) and covers economic activities in energy and transportation sectors, which are the two economic sectors that contribute the highest proportions of Thailand's total GHG emissions. The Thailand Taxonomy

[4] Bank of Thailand [BOT], "Joint Statement Sustainable Finance Initiatives for Thailand," Press release, August 18, 2021, https://www.bot.or.th/en/news-and-media/news/news-20210818.html.

Phase I was developed with the support of the International Financial Corporation (IFC), with Climate Bonds Initiative as the technical advisor.

In May 2025, the Thailand Taxonomy Board for Phase II - co-led by Department of Climate Change and Environment (DCCE), BOT, SEC, and SET - launched the Thailand Taxonomy Phase II. This phase marks a significant expansion, incorporating four additional sectors that are critical to achieving the country's environmental objectives: agriculture (including forestry), construction and real estate, manufacturing, and waste management.

2. Thailand General Climate Policy Background

Thailand has progressively strengthened its climate commitments under the United Nations Framework Convention on Climate Change (UNFCCC). The country submitted its first Nationally Determined Contribution (NDC) in 2016, committing to a 20% reduction in greenhouse gas (GHG) emissions from the projected business-as-usual (BAU) level by 2030, with the potential to increase this to 25% conditional on international support.

The First Updated NDC (2020) emphasized the need for financial and technical support, particularly in the energy sector. This was operationalized through the NDC Roadmap on Mitigation (2021–2030) and the NDC Action Plan.

In 2021, Thailand submitted its Long-Term Low Greenhouse Gas Emission Development Strategy (LT-LEDS), aiming to peak GHG emissions by 2030, achieve carbon neutrality by 2065[5], and move toward net-zero emissions in the latter half of the century. At COP26 in Glasgow, the Prime Minister announced an enhanced target of carbon neutrality by 2050 and reaffirmed the net-zero goal by 2065, with the potential to raise emission reductions to 40% by 2030, contingent on adequate international support[6].

In November 2022, Thailand Second Updated NDC[7] and the revised LT-LEDs[8], committing to a 30% GHG reduction by 2030, with an enhanced ambition of up to 40% under favorable conditions. The revised LT-LEDS outlines key mitigation strategies, including a significant scale-up of renewable energy deployment. According to the draft National Energy Plan, at least 50% of new power generation will be renewable by 2050, with solar and wind projected to contribute 65% of total electricity generation by 2060.

---

[5] Office of Natural Resources and Environmental Policy and Planning [ONEP] and Climate Change Management and Coordination division [CCMP], "Mid-century, Long-term Low Greenhouse Gas Emission Development Strategy THAILAND," UNFCCC (MINISTRY OF NATURAL RESOURCES AND ENVIRONMENT, October 2021, https://unfccc.int/sites/default/files/resource/Thailand_LTS1.pdf.

[6] Mintra Adair, "Thailand Vows to Reach Net Zero Carbon Emissions by 2065 at COP26," Thai PBS World, November 2, 2021, https://www.thaipbsworld.com/thailand-vows-to-reach-net-zero-carbon-emissions-by-2065-at-cop26/.

[7] Office of Natural Resources and Environmental Policy and Planning [ONEP], "Thailand's 2nd Updated Nationally Determined Contribution," UNFCCC NDC Registry, September 2, 2022, https://unfccc.int/sites/default/files/NDC/2022-11/Thailand%202nd%20Updated%20NDC.pdf.

[8] UNFCCC, "Thailand's Long-term Low Greenhouse Gas Emission Development Strategy (Revised Version)," November, 2022, https://unfccc.int/sites/default/files/resource/Thailand%20LT-LEDS%20%28Revised%20Version%29_08Nov2022.pdf

To fulfil country's commitments, Thailand established the Department of Climate Change and Environment (DCCE) in August 2023. This dedicated department will lead the country's efforts in responding to climate change and implementing necessary measures. In March 2025, the DCCE presented the research, targets, strategies, and measures for Thailand's GHG reduction under its Third Updated NDC, "NDC 3.0", also referred to as Thailand's Second GHG Reduction Target. This updated version shifts from a BAU model to an absolute emissions reduction target, using 2019 as the base year. As a result, this enhanced target applies across all economic sectors and aims to limit Thailand's net GHG emissions to 152 million tonnes of CO_2 equivalent ($MtCO_2e$) by 2035, with at least 118 $MtCO_2e$ expected to be absorbed through forestry and land use (LULUCF). The domestic mitigation efforts (unconditional target) are expected to reduce emissions by 76.4 $MtCO_2e$, while an additional 32.8 $MtCO_2e$ reduction is anticipated through international support (conditional target), totaling 109.2 $MtCO_2e$ in reductions. With full support, this would represent a 60% reduction from 2019 levels, potentially aligning Thailand with a pathway to limit global temperature rise to 1.5°C. Thailand plans to submit NDC 3.0 to the UNFCCC Secretariat by September 2025, ahead of 30th Conference of the Parties (COP30) in November 2025.[9]

Thailand is also in the process of developing its first Climate Change Act, which aims to increase the efficiency of climate change mitigation and adaptation actions and facilitate the transition to a net zero economy. Some of the key elements of the draft Climate Change Act are the provisions on mandatory GHG reporting at the corporate level, the application of carbon pricing mechanisms such as the Emission Trading Scheme (ETS) and carbon tax, and the use of Thailand Taxonomy as a reference tool for various contexts. It is expected that the Act will be enacted within 2025.

[9] DCCE, "DCCE has a public hearing on the 'NDC3.0' target for reducing GHG emissions to 109.2 million tons of CO2 equivalent by 2035", March 2025, https://www.dcce.go.th/4537/

3. Thailand Taxonomy Development Framework

3.1 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 recognized 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.

3.2 The world of green taxonomies

The concept of green taxonomy was introduced in 2012 by the CBI as a voluntary guideline for the green bond market[10]. 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[11]. These include the European Union (EU)[12], ASEAN[13], China[14], Singapore[15] 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.

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

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

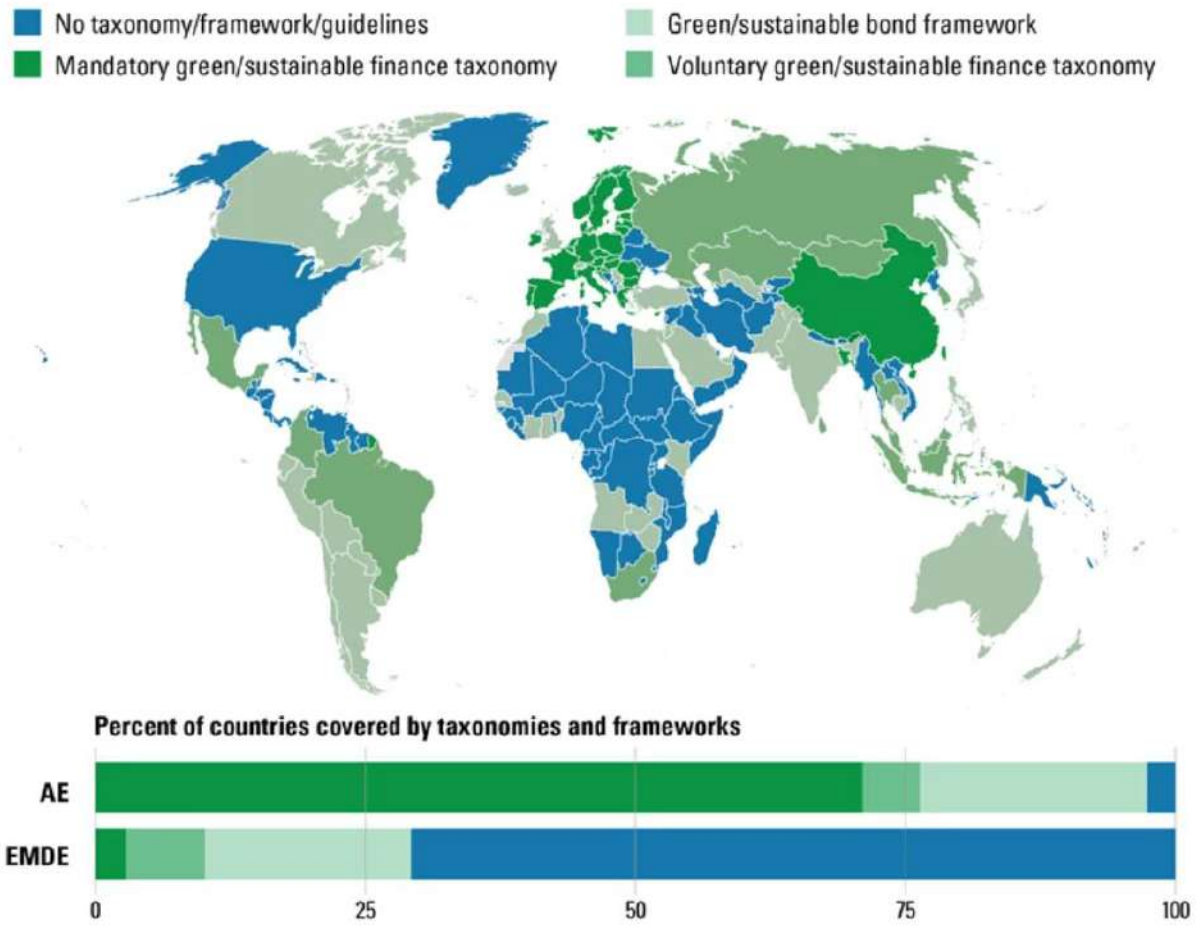
[12] European Commission. EU Taxonomy Navigator

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

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

[15] Monetary Authority of Singapore. (2023). Singapore-Asia Taxonomy for Sustainable Finance

Figure 2 Countries covered by Taxonomy and green/sustainable frameworks



Source: Finance & Prosperity (World Bank 2024)

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 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 (1) the EU and China and (2) the EU, China, and Singapore by the International Platform on Sustainable Finance (IPSF).

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 such as China, Russia, and Mongolia

- **Technical screening criteria-based taxonomies**, which define quantitative thresholds and screening criteria for economic activities and their compliance with the specific objectives such as EU, Colombia, South Africa, ASEAN, and Singapore
- **Principle-based taxonomies**, which define a set of core principles for the market without specifying compliant activities or thresholds such as Malaysia, ICMA, and ASEAN

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. 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.

3.3 Key reference taxonomies

There are four key reference taxonomies that serve as the foundation for developing the Thailand Taxonomy.

1. EU Taxonomy

The EU Taxonomy has emerged as the global benchmark for taxonomies worldwide, given the large number of investors in the EU as well as its leadership in sustainable finance. Its comprehensive and technically advanced screening criteria, despite being rooted in EU-specific regulations, are widely referenced by other jurisdictions including Singapore, South Africa, Russia, and Colombia. The EU Taxonomy also plays a central role in the International Platform on Sustainable Finance's (IPSF) efforts to develop a Common Ground Taxonomy.

2. China Taxonomy

In Asia, the Chinese Green Bond Endorsed Project Catalogue and the ASEAN Taxonomy are key regional frameworks guiding sustainable investment. China's green bond market, previously fragmented across multiple regulators, took a major step toward harmonization with the release of the unified Green Bond Endorsed Project Catalogue in May 2020—referred to here as the Chinese Taxonomy. Unlike the EU's threshold-based approach, the Chinese Taxonomy uses a whitelist model, broadly defining eligible green activities without strict

performance criteria. While its definitions are generally more flexible than those of the EU or Climate Bonds Taxonomy, alignment with the EU framework typically ensures compliance with the Chinese one. However, its reliance on domestic legal references limits its applicability outside China.

3. ASEAN Taxonomy

The ASEAN Taxonomy serves as a foundational reference for the development of the Thailand Taxonomy, offering both guiding principles and sectoral screening criteria to support decarbonisation and environmental objectives. Its two-tiered structure—comprising the Fundamental Framework Tier[16] and the Plus Standard Tier[17]—accommodates the diverse economic contexts of ASEAN member states, enabling differentiated pathways toward sustainability. A key feature is its "traffic light" classification system, which categorizes activities as green, amber (transitional), or red based on their climate mitigation potential. 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.

4. Climate Bonds Taxonomy

The Climate Bonds Taxonomy, first published in 2013, is widely integrated into global sustainable finance frameworks due to its science-based, politically neutral, and internationally applicable criteria. As the first international taxonomy, it offers a foundational structure for developing national taxonomies. Key strengths include its focus on transitional activities, regular updates aligned with the latest climate science from bodies like the Intergovernmental Panel on Climate Change (IPCC) and the International Energy Agency (IEA), and its independence from national legislation, making it suitable for global adoption.

Therefore, the current taxonomy is broadly compatible with all above-mentioned taxonomies although there are some differences as the granular level.

---

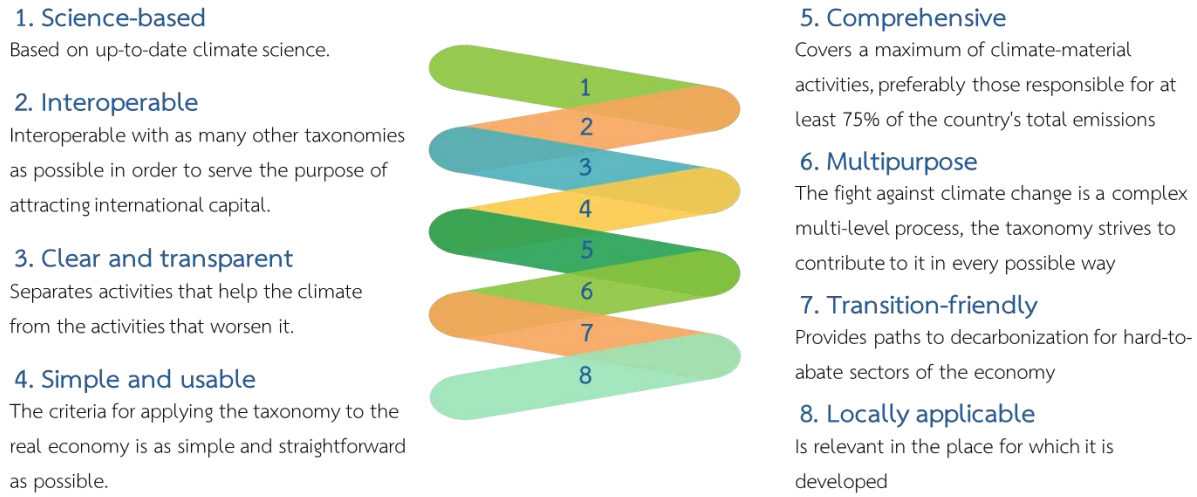
[16] The Foundation Framework tier of the ASEAN Taxonomy is a single sector-agnostic decision tree to classify activities into three categories: green, amber (transitional), or red. It is intended to be a simple one-dimensional tool for countries that consider it sufficient to only have an overarching guiding framework from the point of view of their capabilities and level of economic development.

[17] The Plus Standard tier enables users to evaluate economic activities against specific threshold criteria, aligning more closely with international best practices.

3.4 Thailand Taxonomy development principles

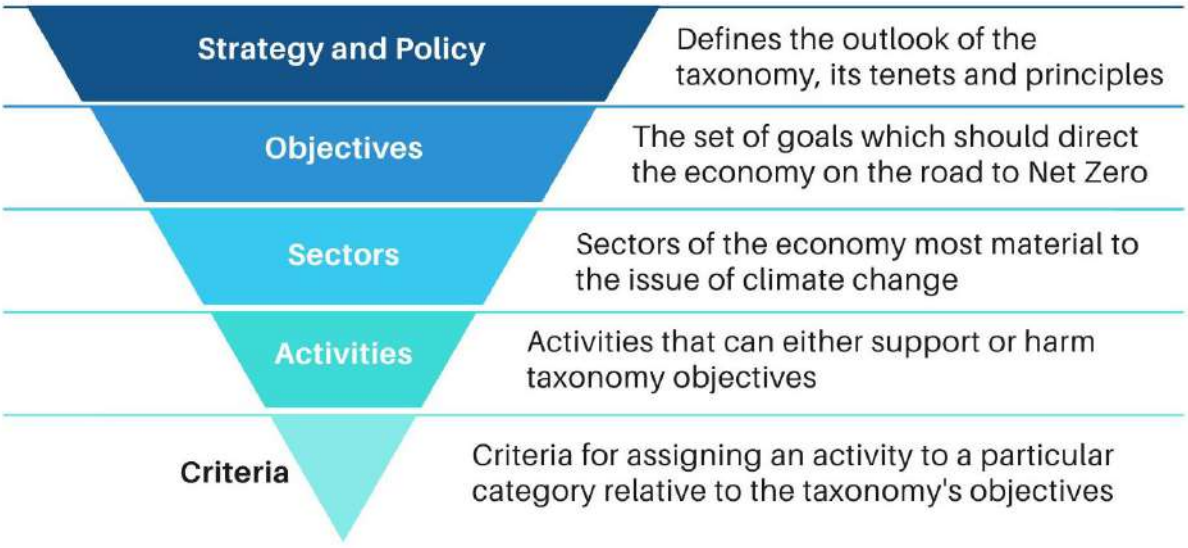
Based on G20 principles and in order to be credible, interoperable and usable. Therefore, Thailand taxonomy should be built up on the following premises:

Figure 3 Thailand Taxonomy development principles



Source: Climate Bonds Initiative

Figure 4 Thailand Taxonomy development pyramid



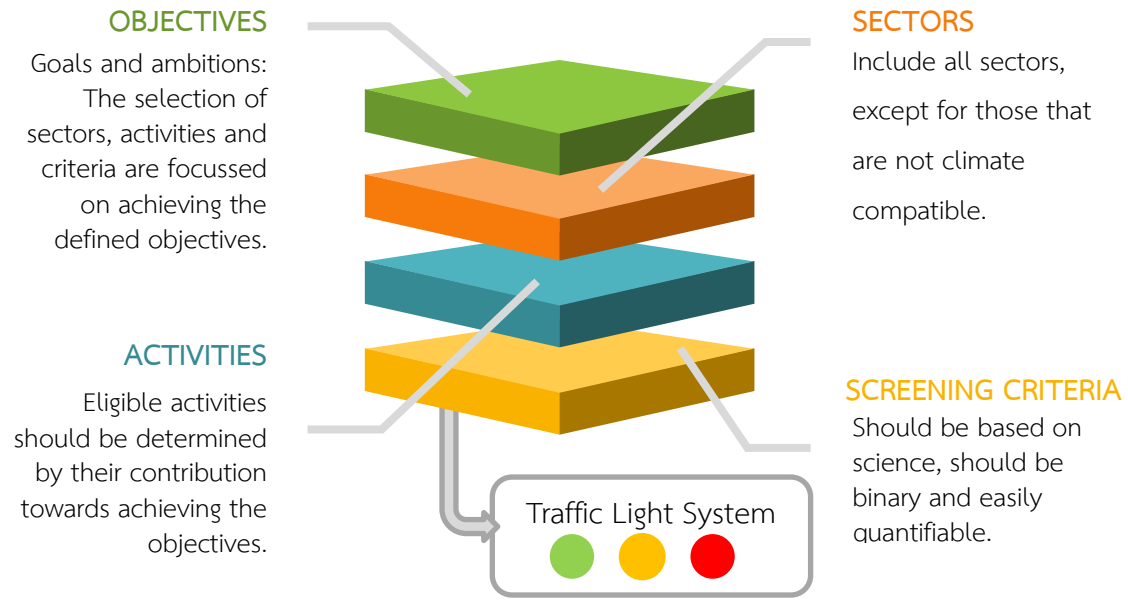
Source: Climate Bonds Initiative, 2023

4. Thailand Taxonomy structure

4.1 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 5 Key elements involved in taxonomy development



Source: Climate Bonds Initiative, 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.

4.2 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 following are the fundamental guiding principles for defining the objectives of the Thailand Taxonomy:

- **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 Thailand Taxonomy is considered a living document, meaning it must be regularly updated to remain current and relevant. This ensures alignment with the evolving landscape of climate science and climate-related technologies.

In addition, two significant aspects must be considered when outlining the Thailand Taxonomy objectives. **First, these objectives must reflect international obligations and national strategic documents. Second, they must be compatible with existing taxonomies to avoid market fragmentation**.

4.2.1 National Climate Strategies and Action Plans

Thailand's NDC Action Plan on Mitigation 2021–2030[18] outlines the country's strategy to achieve its climate goals under the Paris Agreement, focusing on reducing GHG emissions while balancing economic growth. It focuses on the following:

- **Emission reduction**: Thailand aims to reduce GHG emissions by 30–40% below the Business-as-Usual scenario by 2030, up from the initial target of 20–25%. This aligns with its long-term goals of carbon neutrality by 2050 and net-zero emissions by 2065.

[18] กรมการเปลี่ยนแปลงสภาพภูมิอากาศและสิ่งแวดล้อม. *แผนปฏิบัติการด้านการลดก๊าซเรือนกระจกของประเทศ ปี พ.ศ. 2564 – 2573* (NDC Action Plan on Mitigation 2021 - 2030). กรุงเทพมหานคร: กระทรวงทรัพยากรธรรมชาติและสิ่งแวดล้อม, พฤศจิกายน 2566. https://www.thai-german-cooperation.info/wp-content/uploads/2024/12/TH-The-drafted-NDC2035-Action-Plan_Public-Hearing-version.pdf.

- **Sectoral Contributions**: The plan targets a total reduction of 184.8 million tons of CO_2 equivalent ($MtCO_2eq$) through domestic efforts, with an additional 37.5 $MtCO_2eq$ contingent on international support

The action plan prioritizes five key sectors:

1. **Energy**: Promoting renewable energy (e.g., solar, wind) and energy efficiency measures.
2. **Transport**: Increasing rail and public transport usage, adopting electric vehicles (EVs), and targeting a 30–40% reduction in transport-related emissions compared to BAU.
3. **Agriculture**: Integrating sustainable practices, such as methane reduction in rice farming and promoting agroforestry.
4. **Industry**: Improving energy efficiency in manufacturing and reducing emissions from industrial processes.
5. **Waste Management**: Enhancing waste-to-energy projects and landfill gas capture.

As of March 2025, Thailand is in the process of developing the next NDC, NDC 3.0, which will have more ambitious targets and a target year of 2035, with the base year adjusted to 2019.

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
- **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)**[19], **mitigation** is a key priority. It is noted, however, that "*Thailand places high priority on addressing impacts and vulnerabilities of the sector* such as the agricultural sector, *through*

[19] UNFCCC, Office of Natural Resources and Environmental Policy and Planning, Ministry of Natural Resources and Environment. (2022). Mid-century, Long-term Low Greenhouse Gas Emission Development Strategy: Thailand

adaptation *measures, as climate impacts, including shifting temperatures, more unpredictable rainfalls and extreme floods and drought have been widely experienced in the country, affecting the yields of major crops, such as rice, maize and sugarcane*".

The country's Second Updated NDC (2022) also states that "*in addition to its* ***mitigation*** *efforts, Thailand has treated* ***adaptation*** *as equally important*".

In addition, **Thailand's National Strategy (2018-2037)**[20] puts forward the 33 environment-related goals (see *Thailand Background*). 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 1 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 2 below.

Table 2 Environmental objectives in Thailand's strategic plans

National Strategy (thematical grouping)	CCMP	LT-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		

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

National Strategy (thematical grouping)	CCMP	LT-LEDS	NDC
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 objectives of EU Taxonomy and key ASEAN strategic documents apart from the ASEAN Taxonomy. According to the ASEAN Socio-Cultural Community Blueprint 2025[21], ASEAN member states need to identify individual as well as common climate and environment goals[22]. However, it must be recognised that the ASEAN Taxonomy does not have any specific objectives for pollution prevention and water/marine resources management. As a result, those can be partially aligned with the existing objectives of resource resilience and the protection of ecosystems.

In conclusion, as per Table 3 below, 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.

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

[22] Overall regional priorities include: (1) 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, (2) To protect, restore, promote sustainable use of terrestrial ecosystem sources, halt biodiversity loss and reserve land degradation, (3) Sustainable forest management in the context of forest fire prevention and control, (4) 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, and (5) To conserve, develop and sustainably manage marine wetlands, peatlands, biodiversity and land, and water resources

Table 3 Thailand Taxonomy objectives alignment

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	+	+	+\-[23]
Resource resilience and transition to a circular economy	+	+	+
Pollution prevention and control	+	+	+\-
Protection and restoration of biodiversity and ecosystems	+	+	+

4.2.2 International Taxonomies comparison

Thailand Taxonomy is structured to support the nation's decarbonization agenda while aligning with the overarching objectives of established international and regional taxonomies. Table 4 presents a comparative analysis of the environmental objectives outlined in various taxonomy frameworks.

Table 4 The objectives from international and national taxonomies

EU Taxonomy	China Taxonomy	ASEAN Taxonomy	Singapore Taxonomy	Climate Bonds Taxonomy
Climate change mitigation	Addressing climate change	Climate change mitigation	Climate change mitigation (current version)	Climate change mitigation
Climate change adaptation		Climate change adaptation	Climate change adaptation*	Climate change adaptation

[23] Means the objective is partially aligned

EU Taxonomy	China Taxonomy	ASEAN Taxonomy	Singapore Taxonomy	Climate Bonds Taxonomy
Sustainable use and protection of water resources				
Transition to a circular economy	More efficient resource utilisation	Promote resource resilience & transition to a circular economy	Promote resource resilience and circular economy*	
Pollution prevention and control			Pollution prevention and control*	
Protection and restoration of biodiversity and ecosystems	Environmental improvement	Preservation of healthy ecosystem & biodiversity	Protect healthy ecosystems and biodiversity*	

*Note: not covered in the current version

4.2.3 The list of the objectives for Thailand Taxonomy

Based on the analysis in the previous section, the Thailand Taxonomy is designed to cover the following six environmental objectives:

1. **Climate change mitigation**

This objective 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.

2. **Climate change adaptation**

This objective 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 country's resilience to the adverse physical impacts of current and future climate changes and/or capture new economic opportunities from climate change.

3. **Sustainable use and protection of marine and water resources**

This objective deals with a broad range of issues important to Thailand, from sustainable development of coastal areas to retrofitting of water treatment facilities.

4. **Promote resource resilience and transition to a circular economy**

This objective 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.

5. **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.

6. **Protection and restoration of biodiversity and ecosystems**

This objective 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.

4.3 Sectoral assessment

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 and is largely compatible with other international frameworks, while providing a sufficient degree of granularity. There is 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 sufficiently 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. Sectors and activities covered by the taxonomy must be prioritised based on:

- **The substantial contribution** to the key objectives of the taxonomy, which comprises 6 environmental objectives.
- **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. It is important to note 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.

Table 5 Thailand's GHG emissions (exclude sinks) by category in 2022

Economic Sector	Sector (IPCC 2006 classification)	GHG Emission, total in ktCO2eq, 2022	% of Total GHG Emission
	1 Energy	**254,307.21**	**65.9%**
	1A Fuel combustion activities	**245,812.43**	**63.7%**
Energy	**1A1 Energy industries**	**92,222.65**	**23.9%**
	1A1a Electricity and Heat Production	82,615.97	21.4%
	1A1b Petroluem Refining	9,606.68	2.5%
Manufacturing and Construction	**1A2 Manufacturing industries and construction**	**62,578.28**	**16.2%**
Transport	**1A3 Transport**	**77,021.31**	**20.0%**
	1A3a civil aviation	1,738.51	0.5%

Economic Sector	Sector (IPCC 2006 classification)	GHG Emission, total in ktCO2eq, 2022	% of Total GHG Emission
	1A3b Road transportation	74,435.79	19.3%
	1A3c Railways	228.24	0.1%
	1A3d Water-borne navigation	618.76	0.2%
All sectors	**1A4 Other sectors**	**13,990.18**	**3.6%**
	1A5 Non-specified	NO	NO
Mining	**1B Fugitive emissions from fuels**	**8,494.78**	**2.2%**
	1B1 Solid fuels	563.00	0.1%
	1B2 Oil and natural gas	7,931.78	2.1%
	1B3 Other emissions from energy production	NO	NO
Manufacturing	**1C Carbon dioxide transport and storage**		**0.0%**
	1C1 Transport of CO2	NO	NO
	1C2 Injection and storage	NO	NO
	1C3 Other	NO	NO
Manufacturing	**2. Industrial Process and Product Use**	**40,527.22**	**10.5%**
	2A Mineral Industry	**17,001.61**	**4.4%**
	2A1 Cement Production	15,803.16	4.1%
	2A2 Lime Production	124.67	0.0%
	2A3 Glass Production	334.12	0.1%
	2A4b Other Uses of Soda Ash	298.86	0.1%
	2A4d Other	440.80	0.1%
	2B Chemical Industry	**11,668.31**	**3.0%**
	2B2 Nitric Acid Production	177.16	0.0%
	2B4 Caprolactam, Glyoxal	246.05	0.1%
	2B8b Ethylene	10,582.08	2.7%
	2B8c Ethylene Dichloride and Vinyl	528.38	0.1%
	2B8e Acrylonitrile	141.96	0.0%
	2B8f Carbon Black	7.87	0.0%
	2C Metal Production	**425.32**	**0.1%**
	2C1 Iron and Steel Production	425.32	0.1%
	2D Non-Energy Products from Fuels and Solvent Use	**292.74**	**0.1%**

Economic Sector	Sector (IPCC 2006 classification)	GHG Emission, total in ktCO2eq, 2022	% of Total GHG Emission
	2D1 Lubricant Use	292.74	0.1%
	2F Product Uses as Substitutes for Ozone Depleting Substances	**10,383.15**	**2.7%**
	2F1 Refrigeration and Air Conditioning	10,383.15	2.7%
	2G Other Product Manufacture and Use-Industrial Processes	**756.09**	**0.2%**
	2G1 Electrical Equipment	756.09	0.2%
Agriculture	**3. Agriculture**	**68,933.74**	**17.9%**
	3A Enteric Fermentation	18,347.24	4.8%
	3B Manure Management	3,730.02	1.0%
	3C Field Burning of Agricultural Residues	1,688.75	0.4%
	3D Liming	16.02	0.0%
	3E Urea Fertilization	1,110.89	0.3%
	3F Direct N2O Emission from Managed Soils	7,349.27	1.9%
	3G Indirect N2O Emission from Managed Soils	2,711.33	0.7%
	3H Indirect N2O Emission from Manure Management	667.90	0.2%
	3I Rice Cultivation	33,886.79	8.8%
Waste	**5. Waste**	**22,172.97**	**5.7%**
	5A Solid Waste Disposal	**9,988.82**	**2.6%**
	5A1 Managed Waste Disposal Sites	6,386.24	1.7%
	5A2 Unmanaged Waste Disposal Sites	3,602.58	0.9%
	5B Biological Treatment of Solid Waste	**202.29**	**0.1%**
	5C Incineration and Open Burning of Waste	**179.69**	**0.0%**
	5D Wastewater Treatment and Discharge	**11,802.17**	**3.1%**

Economic Sector	Sector (IPCC 2006 classification)	GHG Emission, total in ktCO2eq, 2022	% of Total GHG Emission
	5D1 Domestic Wastewater Treatment and Discharge	2,707.83	0.7%
	5D2 Industrial Wastewater Treatment and Discharge	9,094.34	2.4%
Total in GHG Inventory of Thailand		**385,941.14**	**100%**
Total in GHG emissions covered in Thailand Taxonomy (approximation)		**363,456.17**	**94.2%**

Source: Thailand Biennial Transparency Report (DCCE, 2024)

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 economic activities. 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 FDI plays an important role, or where there is potential to attract more FDI, particularly for sectors that are essential to accelerate the country's decarbonization pathway.

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

Year	Agriculture, forestry and fishing	Manufacturing of chemicals and chemical products	Manufacturing of electronics	Manufacturing of automotives and parts	Transportation and storage	Construction	Electricity, gas, steam and air conditioning supply
Volume and share of FDIs for Taxonomy-relevant sectors, million USD (% of total FDI for a given year)							
2020	16.71 (0.03%)	927.25 (1.87%)	-266.75 (-0.54%)	-565.02 (-1.14%)	64.03 (0.13%)	196.83 (0.40%)	74.78 (0.15%)
2024	-26.27 (-0.036%)	559.25 (0.76%)	1,665.18 (2.27%)	1,326.59 (1.81%)	225.78 (0.31%)	179.27 (0.24%)	155.38 (0.21%)
Volume and share of GDP for Taxonomy-relevant sectors, trillion baht (% of total GDP for a given year)							
2020	1.32 (8.41%)	0.63 (4.01%)	4.40 (28.03%)		1.26 (8.03%)	0.68 (4.33%)	0.39 (2.48%)
2024	1.57 (8.49%)	0.74 (4.00%)	5.37 (29.03%)		1.57 (8.49%)	0.80 (4.32%)	0.54 (2.92%)

Source: Bank of Thailand data; The Office of the National Economic and Social Development Council data

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), transportation, agriculture, and industrial production. As shown in Table 5-6, these sectors combined encompass the majority of the country's GHG emissions around 95% of GHG emissions and more than 40% of its economic activities. 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 reflects that the hard-to-abate industries should be decarbonized first to achieve maximum results in terms of climate change mitigation.

It should be noted that the sectors that are in the list above appear differently in the sector list of individual official documents because they use different sector classification systems. More specifically, Thailand's Second Updated 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 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 group with the others.

It is important to note that this prioritization exercise is based on both an expert assessment and quantitative measures, while taking into account technological viability of decarbonisation. Accordingly, the Thailand Taxonomy develops sectoral prioritization as outlined below:

Table 7 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 flow in the right direction.

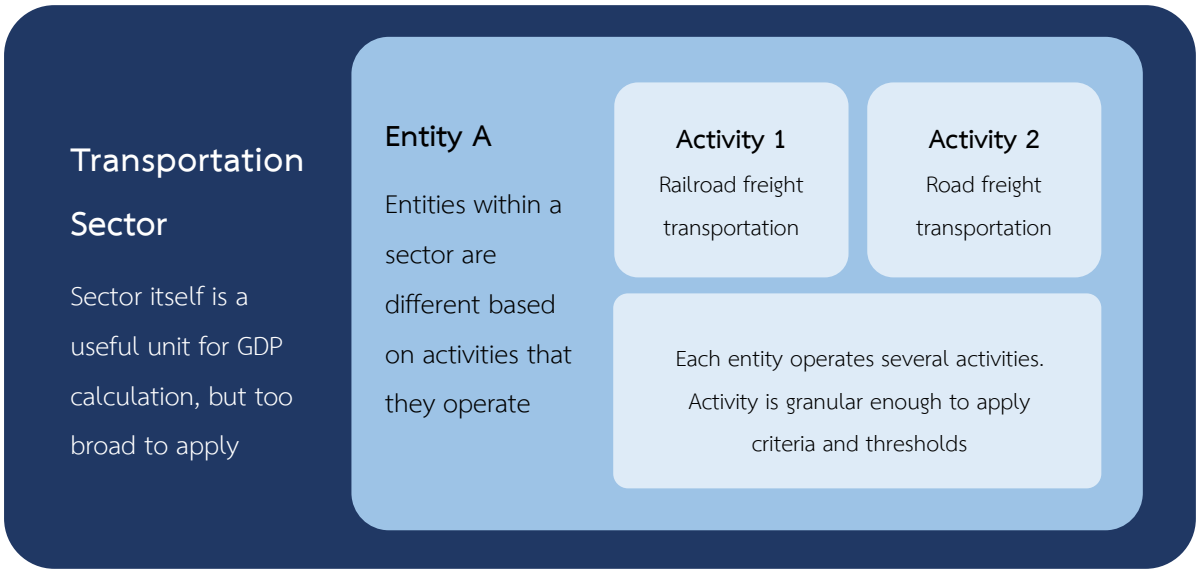
Sector	Rationale
Transportation	The sector is the second biggest in terms of emissions and prioritized by the Government of Thailand decarbonisation policies, but it is underinvested, both generally and from the point of view of green transition. The sector is well-researched and provides numerous technological opportunities for GHG emissions abatement, from electric cars to sustainable fuels
Agriculture	Agriculture is one of the hardest sectors to decarbonize because of its diversity and complexity. In particular, the units where activities are carried out are generally small and are not always able to get access to the latest innovations. Nevertheless, thanks to low-carbon farming technologies, the science-based approach to decarbonizing the sector can help to strengthen its component as a carbon sink.
Construction and Real Estate	Although direct information about sector-related GHG data is not available, its proportion of GDP and importance for the Thai economy makes it a natural target for decarbonization through the construction of green buildings and incremental introduction of new materials that can reduce long-term carbon footprint.
Manufacturing	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
Water and Wastewater Supply, Processing and Remediation	Although small on a 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

4.4 Methodology for Activities Selection

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.).

Figure 6 Example of the relationship between sectors, entities and activities



Source: Climate Bonds Initiative

The proposed methodology for the inclusion of activities in the Taxonomy involves an assessment of activities against the following eligibility criteria:

- **Substantial contribution** to the environmental objectives of the Taxonomy specified for each sector. This criterion addressed the issue of the climate materiality of the activity. In the case of climate change mitigation, criteria are typically defined as the potential to emit or absorb large amounts of GHGs that can, in turn, affect the climate. Some of the activities, however, concurrently contribute to other objectives of the Taxonomy, such as climate change adaptation, sustainable use and protection of marine and water resources, resource resilience and promotion of circular economy, pollution prevention and control, and protection and restoration of biodiversity and ecosystems.
- **Availability of verified decarbonisation techniques and methodology**. To date, decarbonisation pathways have been developed for a significant number of climate-material activities, but for some hard-to-abate activities, such as the manufacturing of cement or aviation, it is not possible to wholly decarbonize using existing technologies.

Therefore, for those sectors where decarbonisation is not entirely possible, the Taxonomy will incorporate a methodological approach based on transition and measures that allow significant decarbonisation efforts.

- **Existence in other taxonomies (especially reference taxonomies)**. Matching the list of activities with similar lists in other taxonomies is important in terms of interoperability, facilitating international trade and financial transactions and preventing fragmentation of global trade flows. Compatibility is usually provided through the matching codes in the International Standard Industrial Classification (ISIC) of economic activities, which was selected as a general framework for classifying all sector-specific activities.

4.4.1 Environmental materiality assessment

The first and most important parameter that must be considered is the climate materiality of the proposed activities. As shown in Table 5: GHG emissions and sinks by category in 2022, which covers the top 20 most climate-material categories in Thailand (both in terms of emissions or in terms of their ability to act as carbon sinks[24]), agriculture, buildings-related and manufacturing-related activities occupy the top positions by volume in Thailand's GHG emission inventory ranking. Regarding to Table 5: GHG emissions and sinks by category in 2022, the majority of climate-material activities in Thailand will be covered by the Taxonomy.

In addition to Climate Change Mitigation, it is crucial to underline that other environmental objectives can also be material in certain sectors, particularly in waste management and agriculture. In the context of waste management, while some activities can contribute to Climate Change Mitigation by mainly enabling other sectors of the economy to reduce GHG emissions through waste prevention, waste separation, reuse and recycling, the majority of waste management activities can also contribute significantly to other environmental objectives, especially Resource Resilience and transition to Circular Economy and Pollution Prevention and Control.

Similarly, in agricultural and forestry sectors, it is equally important to consider other environmental objectives such as climate adaptation and protection and restoration of

[24] Carbon sink is any process, activity or mechanism which removes a greenhouse gas, an aerosol or a precursor of a greenhouse gas from the atmosphere (IPCC Glossary definition). Economic activities work as carbon sinks when they remove more GHGs from the atmosphere that they produce. They are marked in the table as negative values.

biodiversity and ecosystems, aspect. Given the sector's inherent vulnerability to the physical risks posed by climate change, addressing adaptation is crucial for ensuring the resilience of agricultural practices.

4.4.2 Technological feasibility [25] assessment and comparison with other taxonomies

International climate science has come quite far in finding technical options for decarbonisation. Decarbonisation trajectories and technical solution guides have been developed for most high-emitting sectors, such as energy, industry, and transportation. Organisations such as the Climate Bonds Initiative, Science-Based Targets Initiative, International Energy Agency, and many others are developing technical solutions in this area. The results of the work of these organisations have been transformed into criteria that are either already used in other taxonomies or described and operationalized in the sectoral studies of the Climate Bonds Initiative. This section compiles references to credible and scholarly sources of technical criteria and other taxonomies that are used in the development of Thailand Taxonomy.

This approach, which builds on the best practices of other taxonomies, also provides Thailand Taxonomy with the necessary level of credibility and interoperability with other national and international taxonomies. Ensuring the interoperability of Thailand Taxonomy with benchmark taxonomies is one of the critical design features to establish Thailand as a major destination of international green capital. Interoperability will facilitate the flow of cross-border capital by reducing the costs of climate due diligence and reporting for investors (see Annex: Thailand Taxonomy and other taxonomies mapping)

4.4.3 Economic relevance of the proposed activities

Climate-material activities are among the most important to Thailand's economy. Many activities important to the Thai economy may not have any climate materiality and cannot, therefore, be included in the taxonomy. The table below is intended to give an indication of what proportion of each sector's output is accounted for by the activities covered by the taxonomy.

[25] In the context of taxonomies, technological feasibility assessment means analyzing the technical feasibility of decarbonizing selected sectors and activities

Several important factors should be considered when examining the table:

- The economic categories that a government tracks in such statistics are often broader in scope than the activities included in the taxonomy. For example, the economic category "Manufacture of basic precious and other non-ferrous metals" is included in this table, but only aluminum production is actually included in the Taxonomy. Therefore, the table should be considered as an indicative reference tool rather than a precise description of the correspondence of the Taxonomy's activities to their share in the country's GDP.
- Many of the activities included in the Taxonomy (Manufacturing of renewable energy technologies and products; Manufacturing of energy efficiency equipment for buildings; Manufacturing of other low-carbon technologies) essentially include production activities belonging to different economic codes. For this reason, the overlap between economic and taxonomic activities cannot be full and complete, but the main economic categories important to the taxonomy have been taken into account.

Table 8 Economic materiality of selected activities

Economic activity title	Volume in current market price, 2022, % from total relative to sectoral GDP	Economic activity title	Volume in current market price, 2022, % from total relative to sectoral GDP
Agricultural sector			
Growing cereals (except rice), leguminous crops and oil seeds	0.31	Growing spices, aromatic, drug, and pharmaceutical crops	0.68
Growing of rice	18.78	Growing other perennial crops	11.9
Growing vegetables and melons, roots, and tubers	17.65	Raising of cattle and buffaloes	4.42
Growing sugar cane	2.35	Raising of sheep and goats	0.14
Growing of tobacco	0.07	Raising of swine/pigs	5.04
Growing fibre crops	0	Raising of poultry	3.83
Growing of other non-perennial crops	2.63	Raising of other animals	0.32

Economic activity title	Volume in current market price, 2022, % from total relative to sectoral GDP	Economic activity title	Volume in current market price, 2022, % from total relative to sectoral GDP
Growing of tropical and subtropical fruits	13.69	Support activities for crop production	1.73
Growing oleaginous fruits	6.28	Silviculture and other forestry activities	0.11
Growing beverage crops	0.03	Logging	0.71
Share of sectoral GDP covered by the taxonomy		**90.67%**	
Building and real estate sector			
Construction of buildings	38.5		
Share of sectoral GDP covered by the taxonomy		**38.5%**	
Manufacturing sector			
Manufacture of basic chemicals	1.9	Manufacture of motorcycles	1.01
Manufacture of plastics and synthetic rubber in primary forms	5.05	Manufacture of bicycles and invalid carriages	0.19
Manufacture of cement, lime, and plaster	0.95	Repair of transport equipment, except motor vehicles	0.04
Manufacture of basic iron and steel	0.91	Manufacture of bodies (coachwork) for motor vehicles; manufacture of trailers and semi-trailers	0.24
Manufacture of basic precious and other non-ferrous metals	0.74	Manufacture of parts and accessories for motor vehicles	1.26
Manufacture of batteries and accumulators	0.28	Building of ships and floating structures	0.98
Manufacture of domestic appliances	2.53	Manufacture of railway locomotives and rolling stock	0.01
Manufacture of motor vehicles	6.12	Manufacture of electric lighting equipment	0.13

Economic activity title	Volume in current market price, 2022, % from total relative to sectoral GDP	Economic activity title	Volume in current market price, 2022, % from total relative to sectoral GDP
Manufacture of measuring, testing, navigating and control equipment	0.71		
Share of sectoral GDP covered by the taxonomy		**23.05%**	
Waste management sector			
Water supply, sewerage, waste management and remediation activities	0.4		
Share of sectoral GDP covered by the taxonomy		**0.4%**	

Source: National Economic and Social Development Council (NESDC)

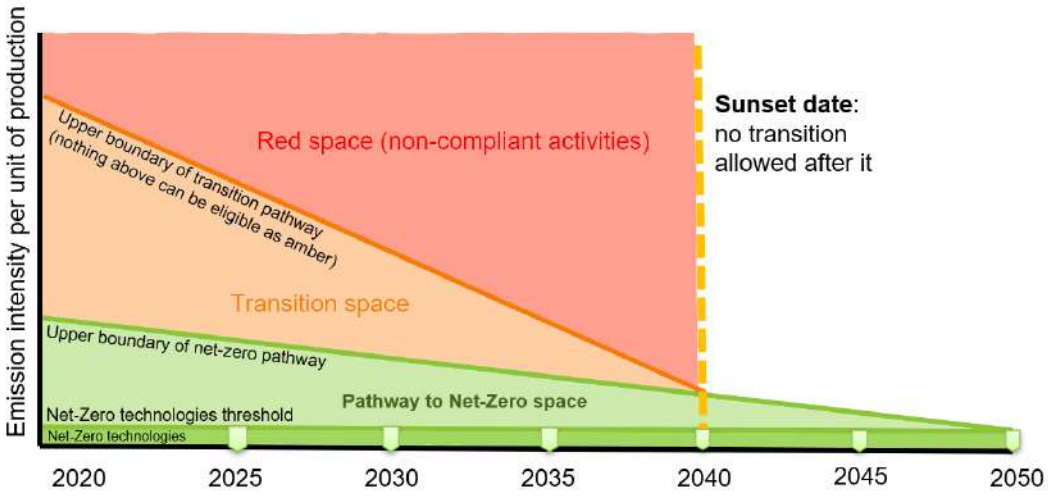
4.4.4 Out of scope

If the activity is not present in the taxonomy, it does not mean that this activity is harmful to its objectives. It is simply considered "out of the scope" due to its low climate materiality or lack of science-based criteria. The taxonomy does not make any decision about it, and it should be reported in disclosure documents as "out of scope".

4.5 Model for criteria and thresholds 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 transitional (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 7 A practical meaning and graphic representation of green, transition and red spaces



Source: Climate Bonds Initiative

For modelling credible transition pathways for the activities of this taxonomy, the Sectoral Decarbonization Approach (SDA) is applied, which is a widely adopted methodology used by the Transition Pathway Initiative (TPI) and the Science Based Targets Initiative (SBTi).[26]. The SDA utilises data and scenarios developed by international organizations, such as IEA, IPCC, and International Institute for Applied System Analysis (IIASA). The present model includes 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)
- 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.

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

The Taxonomy's activity thresholds are 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[27].
- **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.

4.5.1 Scope of emissions

For all activities, emissions include only scope 1 and 2 emissions unless stated otherwise. For instance, activities such as bioenergy production and hydrogen manufacturing are recommended for Life Cycle Assessment (LCA), particularly where emissions are most concentrated along the value chain.

4.5.2 Relevant decarbonisation measures

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

[27] 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".

4.5.3 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 are calculated based on the best available sectoral data, published in the Thailand's Long-Term Low Greenhouse Gas Emission Development Strategy (Revised Version November 2022), which are generally more precise than those calculated on "best-in-class" principle.

However, like most countries, the NDC is not aligned with a 1.5-degree trajectory. According to Climate Tracker, the current Thailand's conditional NDC target aligns with less than 3 degrees of warming and, global climate breakdown, which is challenging for Thailand and 195 other countries to align with the Paris Agreement..[28]

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.

4.5.4 Traffic light system for Thailand Taxonomy

1. 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).

2. Amber activities (transitional) are facilitating significant emissions reductions in the short term with reliable decarbonisation pathways and prescribed sunset dates. The activities have not yet reached net zero emissions but can still be improved with viable technologies. In most

[28] Climate Action Tracker, 2022, Thailand, https://climateactiontracker.org/countries/thailand/

cases, 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, e.g. NDC, into account.

An activity is be considered transitional if it meets the following criteria:

- 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.[29]
- **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%.

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

Transition as a concept

The concept of "transition" refers to **the time-bound shift toward a green economy, with the global goal of achieving net-zero emissions by 2050**, as recommended by the IPCC. While all sectors must contribute to this transition, **some sector face greater technological and economic challenges and are often referred to as "hard-to-abate" or "transitional" sectors**. These sectors are integral to modern economies like Thailand's and require tailored criteria within the Thailand Taxonomy. According to the white paper "Financing Credible Transitions" from CBI, transitional activities may include interim investments that significantly reduce emissions by 2030, even if they do not play a long-term role post-2050. As such, incorporating clear guidance for hard-to-abate sectors is essential for a credible and inclusive taxonomy framework.

Therefore, green activities are already aligned with the 1.5°C climate goal, though they may not yet achieve near-zero emissions. Amber activities, on the other hand, are on a defined trajectory toward alignment with this target. The amber category represents a transitional phase—an essential, time-bound pathway toward full decarbonisation. In addition, aligning with the Paris Agreement targets demands a fundamental shift in the global economy, requiring deep, and in some cases, transformative change across sectors and activities.

3. Red activities are the ones that are currently not compatible with net-zero trajectory and are not going to become compatible in the future. 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.

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.

For practical application of the Taxonomy, color codes in the activity cards mean the following:

- **Green activities:** compliance with the criteria means substantial contribution to one or more of primary taxonomy objectives. These activities can be financed through green financial instruments.
- **Amber activities**: compliance with the criteria means that the activity is in transition from the current state to the future sustainable state (green activity). Transition finance may be solicited for such activities or projects. If the section features N/A, it means that no amber category is available as the activity can be decarbonised quickly using the existing technological solutions.
- **Red activities**: compliance with the criteria mean that in activity in its stated form is exceptionally harmful to the objective of climate change mitigation. No sustainable financing (green, transition, sustainability-linked or any other type) can be solicited to implement it (it can still solicit traditional financing). If this section features N/A, it means that this activity does not have a mode of operation that makes it exceptionally harmful to climate change mitigation.

4.5.5 Practice-based approach

A practice-based framework is employed for the agricultural sector—specifically in crop cultivation, livestock, and aquaculture—where only taxonomy-aligned or "green" activities are identified, without explicitly designating non-aligned activities. This approach addresses the inherent challenges in accurately quantifying GHG emissions, which are highly variable depending on geographic conditions and the specific species of crops and livestock involved. Consequently, the taxonomy emphasizes internationally recognized best practices that are empirically associated with GHG emission reductions. These practices are categorized into three tiers, reflecting varying levels of technological complexity and capital investment requirements. This tiered structure is designed to ensure that the taxonomy remains inclusive and does not impose additional adaptation burdens on smallholder farmers.

Annex 1: Thailand Taxonomy Activities, ISIC, ANDBI, and TSIC Mapping

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 Section 4 of this Thailand Taxonomy with those in the ASEAN Taxonomy.

Table 9 List of Thailand Taxonomy activities and their corresponding ISIC, ANDBI, and TSIC

Thailand Taxonomy activities	ISIC Code	ANDBI	TSIC
Energy sector			
Solar energy generation	D351 - Electric power generation, transmission, and distribution	D35104 Solar power gen generation	D351 - Electric power generation, transmission, and distribution
Wind energy generation		D35105 Wind power generation	
Hydropower generation		D35106 Hydro power generation (incl. pump storage)	
Geothermal power generation		D35107 Geothermal power generation	
Bioenergy generation and production		D35108 Bio power generation	
Energy production from natural gas		D35101 Gas power generation	
Marine energy generation		D35109 Marine power generation	
Electricity generation from renewable non-fossil gaseous and liquid fuels		N/A	
Storage of electricity and thermal energy		D35111 Energy storage (not incl. pump storage)	
Transmission and distribution of energy		D35110 Transmission and distribution (incl.	

Thailand Taxonomy activities	ISIC Code	ANDBI	TSIC
		ICT and smart technology)	
Cogeneration of heating/cooling and power using renewable sources of energy		N/A	
Transmission and distribution networks for renewable and low-carbon gases	D352 - Manufacture of gas; distribution of gaseous fuels through mains	D35110 Transmission and distribution (incl. ICT and smart technology) D 35203 Gas distribution	D352 - Manufacture of gas; distribution of gaseous fuels through mains
Production of heating and cooling using waste heat	D353 - Steam and air conditioning supply	D35302 Provision of steam / air conditioning (renewable production)	D353 - Steam and air conditioning supply
Installation and operation of electric heat pumps			
Heating and cooling distribution			
Transportation sector			
Transport via railways	H491 - Transport via railways	H49101 Electrified rail and associated infrastructure	H491 - Transport via railways
		H49102 Low emission rolling stock	
		H49103 Improved railway efficiency measures	
Other passenger land transport	H492 - Other land transport	N/A	H492 - Transport via buses

Thailand Taxonomy activities	ISIC Code	ANDBI	TSIC
Urban and suburban passenger land transport			H493 - Other land transport (including 4931, 4932, 4933)
Freight transport by road			
Transmission and distribution networks for renewable and low-carbon gases	H493 - Transport via pipeline	H49302 Gas transport (gas from renewable production)	H 494 - Transport via pipeline
Sea and coastal water transport	H501 - Sea and coastal water transport	H50101 Low emission fossil powered vessels	H501 - Sea and coastal water transport
		H50102 Electric vessels	
		H50103 Other low-emissions vessels	
Inland water transport	H502 - Inland water transport	H50201 Low emission fossil powered vessels	H502 - Inland water transport
		H50202 Electric vessels	
		H50203 Other low-emissions vessels	
Retrofitting of sea and coastal freight and passenger water transport	C3312 - Repair of machinery.[30]	N/A	C3312 - Repair of machinery
Passenger and freight air transport	H51 – Air Transport	N/A	H51 – Air Transport
Enabling infrastructure for low-emission transport	Non-ISIC Transport Activities.[31]	N/A	Non-ISIC Transport Activities.

[30] An activity outside of chosen sectors is added due to its paramount importance to all other activities in the sector

[31] An activity outside of ISIC is added due to its paramount importance to all other activities in the sector

Thailand Taxonomy activities	ISIC Code	ANDBI	TSIC
Agricultural sector			
Growing of perennial and non-perennial crops	A011 - Growing of Non-Perennial Crops; A012 - Growing of Perennial Crops	N/A	A011 - Growing of non-perennial crops; A012 - Growing of perennial crops
Sustainable sugarcane production	A012 - Growing of Perennial Crops		A0114- Growing of sugar cane
Sustainable rice production	A013 - Plant Propagation A011 - Growing of Non-Perennial Crops		A013 - Plant propagation A0112 - Growing of rice
Sustainable rubber trees production	A012 - Growing of Perennial Crops		A01291 - Growing of rubber trees
Sustainable oil palm production	C104 - Manufacture of Vegetable and Animal Oils and Fats		A01261 - Growing of oil palms
Sustainable cassava production			
Livestock production	A014 - Animal Production		A014 - Animal production
Sustainable aquaculture production	A032 - Aquaculture		A032 - Aquaculture
Sustainable forest management	A021 - Silviculture and Other Forestry Activities		A02 - Forestry and logging
Forestry plantation	A020 - Forestry and logging		A021 - Silviculture and other forestry activities
Conservation, restoration, and maintenance of natural forests	A024 - Support Services to Forestry		A024 - Support Services to Forestry
Construction and real estate sector			
Construction of new buildings	F410 - Construction of Buildings;	410[001] Construction of new buildings;	F41 - Construction of Buildings;

Thailand Taxonomy activities	ISIC Code	ANDBI	TSIC
Renovation of the existing buildings	F433 - Building Completion and Finishing; F439 - Other Specialised Construction Activities	410[002] Renovation of existing buildings;	F433 - Building Completion and Finishing; F439 - Other Specialised Construction Activities
Acquisition or ownership of buildings	L681 - Real Estate Activities with Own or Leased Property; L682 - Real Estate Activities on a Fee or Contract Basis	681[001] Acquisition and ownership of buildings	L681 - Real Estate Activities with Own or Leased Property; L682 - Real Estate Activities on A Fee or Contract Basis
Installation, maintenance, and repair of special-purpose building equipment	F432 - Electrical, Plumbing and Other Construction Installation Activities	68[001] Electric vehicle charging stations 68[002] Energy efficient equipment 68[003] Energy performance measurement, regulation, control 68[004] Renewable Technologies	F432 - Electrical, Plumbing and Other Construction Installation Activities
Early warning systems	F432 - Electrical, Plumbing and Other Construction Installation Activities	68[005] Early Warning Systems	F432 - Electrical, Plumbing and Other Construction Installation Activities
Demolition and site preparation	F431 – Demolition and Site Preparation	431[001] Demolition and site preparation	F431 – Demolition and Site Preparation
Manufacturing sector			
Manufacturing of cement	C239 - Manufacture of Non-Metallic Mineral Products Not Elsewhere Classified	N/A	C2394 - Manufacture of Cement, Lime, and Plaster

Thailand Taxonomy activities	ISIC Code	ANDBI	TSIC
Manufacturing of aluminum	C242 - Manufacture of Basic Precious and Other Non-Ferrous Metals; C243 - Casting Of Metals		C24202 - Manufacture of basic aluminium and aluminium products C2432 - Casting of Non-Ferrous Metals
Manufacturing of iron and steel	C241 - Manufacture of Basic Iron and Steel; C243 - Casting Of Metals		C241 - Manufacture of Basic Iron and Steel; C2431 - Casting of Iron and Steel
Manufacture of basic chemicals, e.g., carbon black, soda ash, chlorine, ethylene, propylene, butadiene, aromatics (acetylene, benzene, xylene, and toluene), nitric acid, methanol, anhydrous ammonia	C201 - Manufacture of Basic Chemicals, fertilisers and Nitrogen Compounds, Plastics, and Synthetic Rubber in Primary Forms		C201 - Manufacture of basic chemicals, fertilisers and nitrogen compounds, plastics, and synthetic rubber in primary forms
Manufacturing of hydrogen			
Manufacturing of plastics in primary form			
Manufacturing of batteries	C272 - Manufacture of batteries and accumulators		C272 - Manufacture of batteries and accumulators
Manufacturing of renewable energy technologies and products	Various codes		Various codes
Manufacture of low-carbon technologies for transport	Various codes		Various codes

Thailand Taxonomy activities	ISIC Code	ANDBI	TSIC
Manufacturing of energy efficiency equipment for buildings	Various codes		Various codes
Manufacturing of other low-carbon technologies	Various codes		Various codes
CCS/CCUS: Point-source capture of CO2	No code	X01 Carbon Capture, Utilisation and Storage (CCUS)	No code
Transportation of captured CO2	No code		No code
Permanent sequestration of captured CO2	No code		No code
Utilisation of captured CO2	No code	N/A	No code
Auxiliary transitional activity	No code	N/A	No code
Waste management sector			
Anaerobic digestion of sewage sludge	E370 - Sewerage	N/A	E370 - Sewerage
Anaerobic digestion or composting of bio-waste	E3821 - Treatment and disposal of non-hazardous waste		E3821 - Treatment and disposal of non-hazardous waste
Collection and transport of waste	E381 - Waste collection		E381 - Waste collection
Depollution and dismantling of end-of-life products	E383 - Materials recovery		E383 - Materials recovery
Waste to Energy	E382 - Waste treatment and disposal		E382 - Waste treatment and disposal
Landfill gas capture and utilisation	E3821 - Treatment and disposal of non-hazardous waste		E3821 - Treatment and disposal of non-hazardous waste

Thailand Taxonomy activities	ISIC Code	ANDBI	TSIC
Remediation of contaminated sites and areas	E390 - Remediation activities and other waste management services, C332 - Installation of industrial machinery and equipment, F431 - Demolition and site preparation, M711 - Architectural and engineering activities and related technical consultancy		E390 - Remediation activities and other waste management services, C332 - Installation of industrial machinery and equipment, F431 - Demolition and site preparation, M711 - Architectural and engineering activities and related technical consultancy
Remediation of legally non-conforming landfills and abandoned or illegal waste dumps	E390 - Remediation activities and other waste management services, E382 - Waste treatment and disposal, E3822 - Treatment and disposal of hazardous waste		E390 - Remediation activities and other waste management services, E382 - Waste treatment and disposal, E3822 - Treatment and disposal of hazardous waste
Sorting and material recovery from non-hazardous waste	E383 - Materials recovery		E383 - Materials recovery
Treatment of hazardous waste	E3822 - Treatment and disposal of hazardous waste		E3822 - Treatment and disposal of hazardous waste
Construction, extension, upgrade, operation and renewal of urban wastewater collection and treatment	E370 - Sewerage		E370 - Sewerage
Construction, extension, upgrade	E370 - Sewerage		E370 - Sewerage

Thailand Taxonomy activities	ISIC Code	ANDBI	TSIC
and operation of centralised wastewater collection and treatment			
Renewal of centralised wastewater collection and treatment	E370 - Sewerage		E370 - Sewerage
Phosphorus recovery from wastewater	E383 - Materials recovery, E370 - Sewerage		E383 - Materials recovery, E370 - Sewerage

Annex 2: Thailand Taxonomy and other taxonomies mapping

Table below provides a list of activities in the Taxonomy compared with activities from other benchmark taxonomies. (ASEAN, Singapore, and the European Union), as well as with the decarbonisation criteria of the Climate Bonds Initiative. The latter is used as a scientific benchmark for the Thailand Taxonomy Technical Screening Criteria (TSC) as Climate Bonds criteria are developed using the latest climate science, are regularly updated, and are not subject to distortions due to political or private sector influence. Please refer to the Climate Bonds Initiative's website[32] to learn more about how the criteria have been designed and developed.

Table 10 The correspondence of the Thailand Taxonomy activities to the activities in other national and international taxonomies

Thailand Taxonomy	EU Taxonomy[33]	Singapore Taxonomy[34]	ASEAN Taxonomy[35]	Climate Bonds Criteria[36]
Energy sector				
Solar energy generation	Electricity generation using concentrated solar power (CSP) technology and solar photovoltaic technology	Electricity generation using solar PV and CSP (including electricity, heat, cool)	Electricity generation using CSP technology and solar photovoltaic technology	Solar Energy[37]
Wind energy generation	Electricity generation from wind power	Electricity generation from wind power	Electricity generation from wind power	

[32] Climate Bonds Initiative, "Governance," July 31, 2018, https://www.climatebonds.net/standard/governance

[33] European Commission. "EU Taxonomy Navigator.", n.d., https://ec.europa.eu/sustainable-finance-taxonomy/home

[34] Monetary Authority of Singapore, "Singapore-Asia Taxonomy for Sustainable Finance," 2023, https://www.mas.gov.sg/-/media/mas-media-library/development/sustainable-finance/singaporeasia-taxonomy-updated.pdf

[35] ASEAN, "Asean Taxonomy Version 3," December, 2024, https://asean.org/wp-content/uploads/2024/03/ASEAN-Taxonomy-Version-3.pdf.

[36] Climate Bonds Initiative. "Climate Bonds Taxonomy," May 3, 2023, https://www.climatebonds.net/standard/taxonomy

[37] Climate Bonds Initiative. "Solar power". https://www.climatebonds.net/standard/solar

Thailand Taxonomy	EU Taxonomy[33]	Singapore Taxonomy[34]	ASEAN Taxonomy[35]	Climate Bonds Criteria[36]
Hydropower generation	Electricity generation from hydropower	Electricity generation from hydropower	Electricity generation from hydropower	Hydropower[38]
Geothermal power generation	Electricity generation from geothermal power	Electricity generation from geothermal energy	Electricity generation from geothermal energy	Geothermal Energy[39]
Bioenergy generation and production	Electricity generation from bioenergy	Electricity generation from bioenergy power	Electricity generation from bioenergy, including co-firing with fossil fuels	
Energy production from natural gas	Electricity generation from fossil gaseous fuels	Electricity generation from fossil gaseous fuels	Electricity generation from fossil gas	
Marine energy generation	Electricity generation from ocean energy technologies	Electricity generation from ocean energy	Electricity generation from ocean energy	Marine Renewable Energy[40]
Electricity generation from renewable non fossil gaseous and liquid fuels, including low carbon hydrogen	Electricity generation from renewable non-fossil gaseous and liquid fuels	Electricity generation from hydrogen or its derivatives (e.g. ammonia)	Electricity generation from renewable non-fossil gaseous and liquid fuels, including co-firing with fossil fuels	
Cogeneration of heating/cooling and power using renewable sources of energy	Cogeneration of heat/cool and power from renewable non-			

[38] Climate Bonds Initiative. "Hydropower". https://www.climatebonds.net/standard/hydropower

[39] Climate Bonds Initiative. "Geothermal Energy". https://www.climatebonds.net/standard/geothermal

[40] Climate Bonds Initiative. "Marine Renewable Energy". https://www.climatebonds.net/standard/marine

Thailand Taxonomy	EU Taxonomy[33]	Singapore Taxonomy[34]	ASEAN Taxonomy[35]	Climate Bonds Criteria[36]
	fossil gaseous and liquid fuels			
Production of heating and cooling using waste heat	Production of heating and cooling using waste heat	Production of heat or cool from waste heat	Production of heating/cooling using waste heat)	
Installation and operation of electric heat pumps	Installation and operation of electric heat pumps		Production of heating / cooling using electric heat pump	
Heating and cooling distribution	District heating/cooling distribution	District heating and cooling systems	District heating/cooling distribution	
Transmission and distribution networks for renewable and low-carbon hydrogen	Transmission and distribution networks for renewable and low-carbon gases	Transmission and distribution networks for renewable and low-carbon gases	- Transmission and distribution (incl. ICT and smart technology) - Gas distribution	
Storage of electricity, thermal energy and low-carbon hydrogen	Storage of electricity, thermal energy and hydrogen	Storage of electricity, hydrogen or its derivatives	- Storage of electricity, including pumped storage - Storage of renewable and low-carbon gases	Electrical Grids and Storage[41]
Transmission and distribution of electricity	Transmission and distribution of electricity	Transmission and distribution of electricity	Transmission and distribution (incl. ICT and smart technology)	
Transportation sector				

[41] Climate Bonds Initiative. https://www.climatebonds.net/standard/electrical-grids-and-storage

Thailand Taxonomy	EU Taxonomy[33]	Singapore Taxonomy[34]	ASEAN Taxonomy[35]	Climate Bonds Criteria[36]
Transport via railways	Freight rail transport	Transport via railways	- Passenger interurban rail transport - Freight rail transport	Low Carbon Transport[42]
Other passenger land transport	Freight transport services by road	Other passenger land transport	Transport by motorbikes, passenger cars and light commercial vehicles	
Urban and suburban passenger land transport	Urban and suburban transport, road passenger transport	Urban and suburban passenger land transport	Urban and suburban transport, road passenger transport	
Freight transport by road	Freight transport services by road	Freight transport by road	Freight transport services by road	
Sea and coastal water transport	- Sea and coastal freight water transport, vessels for port operations and auxiliary activities, - Sea and coastal passenger water transport	Sea and coastal water transport	- Sea and coastal freight water transport, vessels for port operations and auxiliary activities - Sea and coastal passenger water transport	
Inland water transport	Inland freight water transport, Inland passenger water transport	Inland water transport	Inland passenger water transport	
Retrofitting of sea and coastal freight	Retrofitting of sea and coastal freight		Retrofitting of sea and coastal freight	

[42] Climate Bonds Initiative. https://www.climatebonds.net/standard/transport

Thailand Taxonomy	EU Taxonomy[33]	Singapore Taxonomy[34]	ASEAN Taxonomy[35]	Climate Bonds Criteria[36]
and passenger water transport	and passenger water transpor		and passenger water transport	
Passenger and freight air transport	Passenger and freight air transport,	Air transport		
	Leasing of aircraft			
	Air transport ground handling operations			
	Airport infrastructure		Airport infrastructure, including low-carbon assets and facilities	
Enabling infrastructure for low-emission transport	Low carbon airport infrastructure	Low-carbon transport infrastructure	Infrastructure for road and public transportation, including infrastructure to enable low-carbon land transport	
	Infrastructure enabling low carbon water transport, road transport and public transport			
Agricultural sector				
Growing of perennial and non-perennial crops		Perennial and non-perennial crops		Climate Bonds Agricultural Criteria[43]
Sustainable sugarcane production				

[43] Climate Bonds Initiative, "Agriculture Criteria – Climate Bonds Standard & Certification Scheme," June, 2021, https://www.climatebonds.net/files/files/standards/agriculture/Agriculture%20Criteria%2020210622v3.pdf

Thailand Taxonomy	EU Taxonomy[33]	Singapore Taxonomy[34]	ASEAN Taxonomy[35]	Climate Bonds Criteria[36]
Sustainable rice production				
Sustainable rubber trees production				
Sustainable oil palm production				
Sustainable cassava production				
Livestock production		Animal production		
Sustainable aquaculture production				
Sustainable forest management	Forest management	Sustainable forest management		Climate Bonds Forestry Criteria[44]
Forestry plantation	Afforestation	Forestry plantation		
Conservation, restoration, and maintenance of natural forests	Rehabilitation and restoration of forests, including reforestation and natural forest regeneration after an extreme event Forest management Conservation forestry	Conservation, restoration, and maintenance of natural/pristine forests		
Construction and real estate sector				

[44] Climate Bonds Initiative, "Forestry Criteria – Climate Bonds Standard & Certification Scheme," November, 2018, https://www.climatebonds.net/files/files/standards/Forestry/Crit%20Forestry%20Criteria%20document_July%202020.pdf

Thailand Taxonomy	EU Taxonomy[33]	Singapore Taxonomy[34]	ASEAN Taxonomy[35]	Climate Bonds Criteria[36]
Construction of new buildings	Construction of new buildings	Construction of new buildings	Construction of new buildings	Climate Bonds Buildings Criteria[45]
Renovation of the existing buildings	Renovation of existing buildings	Renovation of existing buildings	Renovation of existing buildings	
Acquisition or ownership of buildings	Acquisition and ownership of buildings	Acquisition or ownership of buildings	Acquisition and ownership of buildings	
Installation, maintenance, and repair of special-purpose building equipment	- Installation, maintenance, and repair of energy efficiency equipment - Installation, maintenance, and repair of charging stations for electric vehicles in buildings (and parking spaces attached to buildings) - Installation, maintenance and repair of instruments and devices for measuring, regulating, and controlling energy performance of buildings	Installation, maintenance, and repair of equipment	- Energy efficient equipment; - Energy performance measurement, regulation, control; - Renewable Technologies; - Early Warning Systems	

[45] Climate Bonds Initiative, "Buildings Criteria – Climate Bonds Standard & Certification Scheme," December 2023, https://www.climatebonds.net/files/files/sector-criteria-buildings-criteria-v2-1-dec2023.pdf

Thailand Taxonomy	EU Taxonomy[33]	Singapore Taxonomy[34]	ASEAN Taxonomy[35]	Climate Bonds Criteria[36]
Demolition and site preparation	Demolition and wrecking of buildings and other structures		Demolition and site preparation	Asean Taxonomy[46]
Early Warning Systems			Early Warning Systems	
Manufacturing sector				
Manufacturing of cement	Manufacture of cement	Manufacture of cement		Climate Bonds Cement Criteria[47]
Manufacturing of aluminum	Manufacture of aluminum	Manufacture of aluminum		
Manufacturing of iron and steel	Manufacture of iron and steel	Manufacture of basic iron and steel		Climate Bonds Steel Criteria[48]
Manufacturing of hydrogen	Manufacture of hydrogen	Manufacture of hydrogen		Climate Bonds Hydrogen Criteria[49]
Manufacturing of basic chemicals		Manufacture of basic chemicals		Climate Bonds Basic Chemicals Criteria[50]
- Carbon black	Manufacture of carbon black			

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

[47] Climate Bonds Initiative, "Cement Criteria – Climate Bonds Standard & Certification Scheme," April 2023, https://www.climatebonds.net/files/files/standards/Cement/Sector%20Criteria%20-%20Cement%20Production%20v1_2%20%28April%202023%29%281%29.pdf.

[48] Climate Bonds Initiative, "Steel Criteria – Climate Bonds Standard & Certification Scheme," May 2023, https://www.climatebonds.net/files/files/Climate%20Bonds%20Steel%20Criteria.pdf

[49] Climate Bonds Initiative, "Hydrogen Criteria – Climate Bonds Standard & Certification Scheme," November 2023, https://www.climatebonds.net/files/files/criteria-document-hydrogen-production-and-delivery-criteria-final-for-publication.pdf

[50] Climate Bonds Initiative, "Basic Chemicals Criteria – Climate Bonds Standard & Certification Scheme," April 2023, https://www.climatebonds.net/files/files/standards/Chemicals%20-%20Basic/Sector%20Criteria%20-%20Basic%20Chemicals%20%28April%202023%29.pdf

Thailand Taxonomy	EU Taxonomy[33]	Singapore Taxonomy[34]	ASEAN Taxonomy[35]	Climate Bonds Criteria[36]
- Soda ash	Manufacture of soda ash			
- Chlorine	Manufacture of chlorine			
- Ethylene, propylene, butadiene	Manufacture of organic basic chemicals			
- Aromatics (acetylene, benzene, xylene, and toluene)				
- Anhydrous ammonia	Manufacture of anhydrous ammonia			
- Nitric acid	Manufacture of nitric acid			
- Ethanol				
Manufacturing of plastics in primary form	Manufacture of plastics in primary form	Manufacture of plastics in primary form		
Manufacturing of batteries	Manufacture of batteries	Manufacture of batteries		
Manufacturing of renewable energy technologies and products	Manufacture of renewable energy technologies	Manufacture of renewable energy technologies 4.9. Manufacture of equipment for the production of hydrogen through electrolysis		
Manufacture of low-carbon technologies for transport	Manufacture of low-carbon technologies for transport	Manufacture of low-carbon technologies for transport		

Thailand Taxonomy	EU Taxonomy[33]	Singapore Taxonomy[34]	ASEAN Taxonomy[35]	Climate Bonds Criteria[36]
Manufacturing of energy efficiency equipment for buildings	Manufacture of energy efficiency equipment for buildings	Manufacture of energy efficiency equipment for buildings		
Manufacturing of other low-carbon technologies	Manufacture of other low-carbon technologies	Manufacture of other low-carbon technologies for the household sector		
CCS/CCUS: Point-source capture of CO2		Point-source capture of CO2		
Transportation of captured CO2	Transport of CO2	Transportation of captured CO2	000[010] Transport of CO2	
Permanent sequestration of captured CO2	Underground permanent geological storage of CO2	Permanent sequestration of captured CO2	000[020] Underground permanent geological storage of CO2	
Utilisation of captured CO2				
Auxiliary transitional activity				
Waste management sector				
Anaerobic digestion of sewage sludge	Anaerobic digestion of sewage sludge	Biowaste treatment: anaerobic digestion		Climate Bonds Waste management[51]
Anaerobic digestion or composting of bio-waste	Anaerobic digestion or composting of bio-waste	Biowaste treatment: composting of biowaste		

[51] Climate Bonds Initiative, "Waste Management Criteria", August 2022, https://www.climatebonds.net/files/files/Waste%20Management%20Criteria_August2022.pdf

Thailand Taxonomy	EU Taxonomy[33]	Singapore Taxonomy[34]	ASEAN Taxonomy[35]	Climate Bonds Criteria[36]
Collection and transport of waste	Collection and transport of non-hazardous waste	Collection and transport of non-hazardous waste		
Depollution and dismantling of end-of-life products	Material recovery from non-hazardous waste	Material recovery facilities		
Waste to Energy	N/A	Waste to Energy (Incineration)		Climate Bonds Waste management[52]
Landfill gas capture and utilisation	Landfill gas capture and utilisation	Landfill gas capture and utilisation		
Remediation of contaminated sites and areas	Remediation of contaminated sites and areas	N/A		
Remediation of legally non-conforming landfills and abandoned or illegal waste dumps	Remediation of legally non-conforming landfills and abandoned or illegal waste dumps	N/A		
Sorting and material recovery from non-hazardous waste	Sorting and material recovery of non-hazardous waste	N/A		
Treatment of hazardous waste	E3822 - Treatment and disposal of hazardous waste	N/A		
Construction, extension,	Construction, extension and	N/A		

[52] Ibid.

Thailand Taxonomy	EU Taxonomy[33]	Singapore Taxonomy[34]	ASEAN Taxonomy[35]	Climate Bonds Criteria[36]
upgrade, operation and renewal of urban wastewater collection and treatment	operation of wastewater collection and treatment			
Construction, extension, upgrade and operation of centralised wastewater collection and treatment	Construction, extension and operation of wastewater collection and treatment	N/A		
Renewal of centralised wastewater collection and treatment	Renewal of wastewater collection and treatment	N/A		
Phosphorus recovery from wastewater	Phosphorus recovery from wastewater	N/A		

THAILAND TAXONOMY

Essential Criteria

Do No Significant Harm (DNSH) & Minimum Social Safeguards (MSS)

May 2025

THAILAND TAXONOMY BOARD

Table on Contents

Do No Significant Harm and Minimum Social Safeguards

The “Do No Significant Harm” (DNSH) and minimum social safeguards (MSS) principles are additional criteria that create necessary guardrails for taxonomies and help them to perform their functions. DNSH is applied to the taxonomies with multiple objectives in order to make sure that an activity substantially contributing to one objective does not cause damage to other objectives. MSS are included to make sure that the application of the Taxonomy is conducted in line with international treaties protecting social and labour rights and does not do damage to social peace and stability.

It is very 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.

Do No Significant Harm (DNSH)

1. DNSH application mechanism

To be compliant with the Taxonomy, an activity must fulfil the basic criteria specified in the activity cards as well as the DNSH rules. The DNSH requirements for each taxonomy objective are structured as follows:

- **General requirements**: These activities must be performed by all taxonomy users who claim to comply with DNSH rules. They usually consist of two parts: assessment of potential risks to the objective and requests to mitigate those risks to the extent possible.
- **Sector and subsector specific requirements**: these requirements need only be met if the activity falls within the specified sector or subsector.

However, many DNSH requirements require substantial preparation, information gathering, and, in some cases, the acquisition of licenses or certifications. Therefore, to ensure that DNSH requirements do not impede widespread use of the Taxonomy, a three-year grace period in DNSH application and "limited taxonomy compliance" status have been introduced. This is applied as follows:

- Activities that are compliant with substantial contribution criteria, DNSH and MSS requirements at the time the Taxonomy compliance status is determined (for example, if the manager (a person seeking Taxonomy compliance status for his or her activity) wants to issue a green bond or take a green loan) are granted taxonomy compliance status for the activity or project in question. In this case, it is recommended that Taxonomy external review 1is conducted only upon initial attainment of this status. In the case that the audit has found that the activities in question indeed meet the requirements, further audits (e.g. every few years in the case of a green loan or green bond) are left to the discretion of the organisation making the decision to grant the status.
- Activities that are compliant with the substantial contribution criteria, but do not meet the DNSH and/or MSS criteria, may still be assigned Taxonomy compliance status. In this case, the activity manager must publicly state which DNSH and/or MSS requirements is not compliant with and publish a plan to achieve DNSH and MSS compliance within a maximum of three years from the date of the assessment.
- It is important to note that compliance with or without remediation plan is not different when it comes to substantial contribution category. Activities compliant with the green category of the Taxonomy continue to be considered green even in the case of non-compliance with DNSH and/or MSS requirements (if the remediation plan is submitted and published). Amber activities do not become green if they are compliant with DNSH and MSS requirements.

2. DNSH requirements

In order to achieve full compliance with the Taxonomy, all activities must comply with DNSH criteria listed below, with the exception of activities in the Agriculture sector (for which separate DNSHs are provided within the sector itself). These criteria must be fulfilled at the level of the activity and not at the level of the enterprise (as it is required for MSS).

Thailand's taxonomy contains six environment-related objectives:

[1] The rules on how to conduct external review must be defined separately by the relevant Thailand authority

1. Climate change mitigation;
2. Climate change adaptation;
3. Sustainable use and protection of marine and water resources;
4. Protection and restoration of biodiversity and ecosystems;
5. Pollution prevention and control;
6. Promotion of resource resilience and transition to a circular economy.

The application of a taxonomy contributes to at least one taxonomy objective (it may contribute to multiple objectives). You can see which Taxonomy objective each activity contributes to in the "Objective" row of each activity card. If more than one Taxonomy objective is listed in this column, the Taxonomy user is free to decide which of the listed objectives he wants to contribute to by applying the Taxonomy. For the remaining taxonomy objectives (to which no contribution is made via the application of the Taxonomy), the Taxonomy user must fulfil the DNSH criteria.

For example, if the activity contributes to the objective of climate change adaptation, it must fulfill DNSH requirement only for climate change mitigation, sustainable use and protection of marine and water resources, protection and restoration of biodiversity and ecosystems, pollution prevention and control and promotion of resource resilience and transition to a circular economy.

It should be noted that in some cases not all DNSH requirements are applicable to a certain activity. A guidance on how to apply different sections are given **in Annex**.

3. DNSH compliance tables

Environmental objective: Climate change mitigation	
Generic DNSH requirements for all sectors	For an activity to demonstrate that it will do no significant harm with respect to factors related to climate change mitigation, the following must be implemented: ● The manager should calculate Scope 1 and Scope 2 emissions related to the activity as well as Scope 3

Environmental objective: Climate change mitigation	
	emissions if material to the sector in question[2]. Estimation of emissions referring to credible international or national proxies such as Intergovernmental Panel on Climate Change (IPCC) and Thailand Greenhouse Gas Management Organization (TGO) may be used.; ● The manager should identify potential risk to other people or assets to directly increase their GHG emissions as the result of the activity's implementation.; ● The manager should take actions to minimise GHG emissions associated with the implementation of the activity, including, but not limited to installation of monitoring and leak prevention measures (if applicable).
Specific requirements	
Construction and Real Estate sector	Adaptation measures applied should not lead to an increase in the consumption of fossil fuels by the construction to which they are applied or any other structures.
Waste Management sector	An assessment of the potential significant harm caused to the environment by an activity must be conducted if the Activity causes GHG emissions including methane which contribute to Climate Change. Where an Activity is applicable and deemed relevant based on the above assessment, the following actions should be in place, for which evidence is required as part of an assessment to determine if the Activity is causing significant harm to EO1:

[2] Materiality of Scope 3 emissions is defined with recommendations of GHG Protocol, Refer to https://ghgprotocol.org/sites/default/files/standards/ghg-protocol-revised.pdf

Environmental objective: Climate change mitigation	
	• Plans for the management and minimisation of Scope 1, Scope 2 emissions related to the Activity, as well as Scope 3 if relevant to the sector under assessment; • Evidence that the remediation plans have been implemented and are ongoing.

Environmental objective: Climate change adaptation	
Generic DNSH requirements for all sectors	• Any activity seeking to demonstrate its compliance with DNSH related to climate change adaptation must conduct a Climate Risk and Vulnerability Assessment (CRVA) in accordance with the guidance provided in Annex III: Climate Risk and Vulnerability Assessment (CRVA). • The manager of the activity should strive to minimise adaptation risks revealed throughout the CRVA. Adaptation solutions should support system adaptation that takes into consideration regional and national adaptation strategies and plans.

Environmental objective: Sustainable use and protection of marine and water resources	
Generic DNSH requirements for all sectors	• Risks associated with water consumption and water quality must be identified, assessed and mitigated to the biggest possible extent. Water risk analysis tools must be used for this purpose (e.g. risk assessments by national environmental

Environmental objective: Sustainable use and protection of marine and water resources	
	authorities, water footprint, WWF Water Risk Filter[3], WRI Aqueduct[4] or comparable). ● If assets or activities are located in water-stressed areas, may be affected by floods or water quality issues, ensure that water use and conservation management plans, developed in consultation with relevant stakeholders, have been implemented. ● Ensure that water use/conservation management plans (including monitoring, reporting and verification methodology), developed in consultation with relevant stakeholders, have been developed and implemented as per international standards and guidelines. (e.g., UNEP Framework for Freshwater Ecosystem Management; ISO 13.060: Water Quality or comparable).
Specific requirements	
Transportation sector	**Sea and coastal water transport**: Releases of ballast water containing non-indigenous species must be prevented in line with the International Convention for the Control and Management of Ships' Ballast Water and Sediments.
Construction and Real Estate sector	All relevant water appliances (shower solutions, mixer showers, shower outlets, taps, WC suites, WC bowls and flushing cisterns, urinal bowls and flushing cisterns, bathtubs) must be water efficient as per national or international water labelling systems (e.g., WELS, WaterSense, MWA Water Saving Label or comparable).

[3] World Wildlife Fund [WWF], "WWF Risk Filter Suite", 2023, https://waterriskfilter.org/

[4] World Resources Institute, "Aqueduct", 2024, https://www.wri.org/aqueduct

Environmental objective: Promotion of resource resilience and transition to a circular economy	
Generic DNSH requirements for all sectors	● In order to assess whether the activity in question is doing significant harm to this objective, a lifecycle assessment in line with ISO 14040 and ISO 14044 (or any comparable international methodology) should be conducted on the products, material, process, or other measurable activities. ● The activity manager should implement concrete demonstrable measures 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. ● New installations must be designed and manufactured for high durability, easy to dismantle, refurbishment and recycling to the extent possible. Potential of repair of facilities and equipment, and the accessibility and interchangeability of the activity's equipment components must be ensured. ● The activity shall apply relevant national regulations and international guidelines associated with retirement and dismantlement plans for plants and infrastructure related to the activity.
Specific requirements	
Energy Sector	● Ensure renewable energy installations and associated components have been designed and manufactured for high

Environmental objective: Promotion of resource resilience and transition to a circular economy	
	durability, easy dismantling, refurbishment, and recycling, aligned to international standards and guidelines (e.g., KAPSARC Guide to Circular Economy, French standard, XP X30-901, Circular economy—Circular economy project management system or comparable). ● Ensure reparability of renewable energy installations, accessibility and exchangeability of the components.
Transportation sector	Ensure proper waste management both at the use phase (maintenance) and the end-of-life for the rolling stock, e.g. reuse and recycle of parts like batteries, in compliance with international and national legislation on hazardous waste generation, management and treatment, e.g., KAPSARC Guide to circular economy, French standard, XP X30-901, Circular economy – Circular economy project management system or comparable. Measures must be in place to manage waste in accordance with the waste hierarchy, in particular during maintenance.
Manufacturing sector	The activity manager must strive to minimise and manage waste and material use, especially hazardous manufacturing waste as per international standards and guidelines (e.g., KAPSARC Guide to circular economy, French standard, XP X30-901, Circular economy – Circular economy project management system; ISO/TC 323 (In development Scenario 2); ISO/AWI 59014: Secondary materials — Principles, sustainability and traceability requirements; Global Recycled Standard (GRS); Strategic Approach to International Chemicals Management (SAICM); ISO 11014:2009 (en) Safety data sheet for chemical products or comparable).

Environmental objective: Promotion of resource resilience and transition to a circular economy	
Construction and Real Estate sector	● At least 80% (by weight) of the non-hazardous construction, renovation and demolition waste (excluding naturally occurring material) generated on the construction site must be prepared for re-use, recycling and other material recovery, including backfilling operations using waste to substitute other materials. ● Activities must be aligned with international standards with international standards on sustainable management in this sphere, e.g., ISO 20887:2020 – Sustainability in buildings and civil engineering works or comparable ● For new construction (buildings or portions of buildings), a cradle-to-grave life-cycle assessment of the projects structure and enclosure should be conducted.
Waste Management sector	Avoid mixing segregated waste fractions in waste storage or transfer facilities.

Environmental objective: Pollution prevention and control	
Generic DNSH requirements for all sectors	● A recognised environmental management system (ISO 14001, EMAS, or comparable) should be adopted for the enterprise where the activity takes place. ● Ensure the activity undergoes screening to assess whether it leads to the manufacture, placing on the market, or use of dangerous substances (as defined by relevant Thailand laws and regulations), whether on their own, in mixtures, or in articles, and causes significant harm to the environment.

Environmental objective: Pollution prevention and control	
	• Integrated Environmental Assessment in line with the UN Environment Programme's Guidelines for Conducting Integrated Environmental Assessments[5] must be conducted for the activity to specifically identify and manage environmental detrimental risks related to the emission of pollutants, heat, light or noise to the environment. • It must be demonstrated that neither the construction nor operation of the activity is emitting dangerous substances, noise, light or heat in excess of those allowed by relevant national or international regulations. Furthermore, the achievement of applicable air, water and soil quality targets should not be hampered due to the activity. • In the case that the construction and/or operation of the activity is known to cause significant harm to the environment, the activity must identify risk-based measures to prevent the pollution, and safely remediate any contamination caused by the activity. • Based on the EIA, ensure that management plans are developed for every pollutant causing significant harm. Management plans are to be drafted in consultation with relevant stakeholders. Furthermore, Monitoring, Reporting and Verification strategies are to be implemented to monitor the compliance and effectiveness of the mitigation measures.

[5] UN Environment program, "Guidelines for Conducting Integrated Environmental Assessments", April, 2019, https://wedocs.unep.org/bitstream/handle/20.500.11822/16775/IEA_Guidelines_Living_Document_v2.pdf?sequence=1&isAllowed=y

Environmental objective: Pollution prevention and control	
Specific requirements	
Energy sector	**Wind Energy**: Ensure any required mitigation measures for avoiding underwater noise created by the installation of offshore wind turbines
Transportation sector	**All road vehicles**: vehicles must comply with regulations on the sound level of motor vehicles and of replacement silencing systems, e.g. IFC EHS Guidelines: Air emissions and ambient air quality; ISO 13.040.50: Transport Exhaust emissions; ISO 362 Measurement of noise emitted by accelerating road vehicles; ISO 28580:2018 - Passenger car, truck and bus tyre rolling resistance measurement method — Single point test and correlation of measurement results or comparable.
Manufacturing sector	● A recognised environmental management system (ISO 14001, EMAS, or comparable) must be adopted for the enterprise where the activity takes place. ● **Production of steel**: ensure emissions to air, water and soil are prevented / minimised as per international standards and guidelines (e.g. for pH, total suspended solids (TSS), chemical oxygen demand (COD), chromium (total) and heavy metals, for sulphur dioxide – SO2, nitrogen oxide – NOx, particulate matter, polychlorinated dibenzo-dioxins/furans, mercury (Hg), hydrogen chloride (HCL) and hydrogen fluoride (HF). These guidelines may include IFC EHS Guidelines: Air emissions and ambient air quality; ISO 14001:2015 Environmental management systems — Requirements with guidance for use; Strategic Approach to International Chemicals Management (SAICM); ISO 11014:2009(en) Safety

Environmental objective: Pollution prevention and control	
	data sheet for chemical products or any other comparable and applicable guidelines. ● **Production of cement**: a waste management plan must be implemented to minimise and manage waste and material use as per international standards and guidelines (e.g., KAPSARC Guide to circular economy, French standard, XP X30-901, Circular economy – Circular economy project management system; ISO/TC 323 (In development Scenario 2); ISO/AWI 59014: Secondary materials — Principles, sustainability and traceability requirements; Global Recycled Standard (GRS); ETP Clean Energy Technology Guide). ● **Production of chemicals, hydrogen and plastics in primary form:** ensure emissions to air, water and soil are prevented/minimised as per international and national standards, e.g. IFC EHS Guidelines: Air emissions and ambient air quality; ISO 14001:2015 Environmental management systems — Requirements with guidance for use; Strategic Approach to International Chemicals Management (SAICM); ISO 11014:2009(en) Safety data sheet for chemical products. ● **Production of aluminium:** ensure emissions to air (e.g. sulphur dioxide - SO2, nitrogen oxide - NOx, particulate matter, Total Organic Carbon (TOC), dioxins, mercury (Hg), hydrogen chloride (HCL), hydrogen fluoride (HF), Total Fluoride, and (PFCs) polyfluorinated hydrocarbons (PFCs) are prevented/minimised as per international standards and guidelines (e.g., IFC EHS Guidelines: Air emissions and ambient air quality; ISO 14001:2015 Environmental management systems — Requirements with guidance for use; Strategic Approach to International Chemicals

Environmental objective: Pollution prevention and control	
	Management (SAICM); ISO 11014:2009(en) Safety data sheet for chemical products). ● **Manufacture of plastics in primary form**: Plastic producers should implement and maintain a certified Extended Producer Responsibility (EPR) scheme. Upon the enactment of relevant legislation, producers are required to comply with all applicable regulatory provisions. This scheme must ensure that producers bear financial and/or operational responsibility for the collection, sorting, treatment, and recycling of plastic products and packaging at the post-consumer stage of their lifecycle. ● **CCS-related activities**: fans, compressors, pumps and other equipment, must comply, where relevant, with the top class requirements of the energy label, and represent the best available technology. Release of CO2 during operation must be prevented by implementing permanent leakage detection systems.
Construction and Real Estate sector	● Ensure that building components and materials do not contain asbestos nor substances of very high concern as per national and international standards. ● If the new construction is located on a potentially contaminated site (brownfield site), the site must be subject to an investigation for potential contaminants.
Waste Management sector	Ensure emissions to air, water and soil are prevented/minimised as per international and national standards and guidelines (e.g. IFC EHS Guidelines: Air emissions and ambient air quality; ISO 14001:2015 Environmental Management systems – Requirements with guidance for use; Strategic Approach to International

Environmental objective: Pollution prevention and control	
	Chemicals Management (SAICM); ISO 11014:2019(en) Safety data sheet for chemical products). ● **For activities that produce leachate such as compost of bio-waste and hazardous waste treatment:** the site must have a system in place that monitors leachate quality and minimizes leachate reaching groundwater ● **For activities that combust biogas or such as Landfill Gas Capture and Anaerobic Digestion:** emissions to air (e.g. Sox, NOx) after combustion must be controlled, abated (when needed) and within the limits set by national legislation. ● **For wastewater related activities:** identify and manage risks related to water quality and/or water consumption at the appropriate level, in accordance to national standards.

Environmental objective: Protection and restoration of biodiversity and ecosystems	
Generic DNSH requirements for all sectors	● The determination of whether a biodiversity related environmental impact assessment (EIA) is required for a particular activity or not is made through a case-by-case examination of the activity[6]. If applicable, an Integrated Environmental Assessment (EIA) in line with the UN Environment Programme's Guidelines for Conducting

[6] As determined by Notification of MoNRE on the projects that require EIA. Refer to https://law.onep.go.th/wp-content/uploads/2021/07/law51.4.pdf

Environmental objective: Protection and restoration of biodiversity and ecosystems	
	Integrated Environmental Assessments[7] must be conducted for the activity. ● The activity manager must mitigate all potential risks for biodiversity and ecosystems associated with activity implementation that were identified throughout the EIA. ● Ensure the Biodiversity and Ecosystem Management Plans are developed in consultation with relevant stakeholders. Furthermore, ensure that the Monitoring, Reporting and Verification strategies are implemented to monitor the compliance and effectiveness of the mitigation measures. ● 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 Thailand lists of nationally protected areas or on the IUCN Red List[8]. Museums or technical facilities (specifically electronic communications network equipment and facilities used to originate, process, transfer, transmit or receive electronic communications calls and information signals) necessary for their functioning are exempt from this requirement. ● For sites and operations located in or near biodiversity sensitive areas (defined as areas included into, UNESCO World Heritage sites and Key Biodiversity Areas, as well as other protected areas), an appropriate assessment must be

[7] UN Environment program, "Guidelines for Conducting Integrated Environmental Assessments", April, 2019, https://wedocs.unep.org/bitstream/handle/20.500.11822/16775/IEA_Guidelines_Living_Document_v2.pdf?sequence=1&isAllowed=y

[8] International Union for Conservation of Nature's Red List [IUCN], "IUCN Red List of Threatened Species", 2024, https://www.iucnredlist.org/

Environmental objective: Protection and restoration of biodiversity and ecosystems	
	carried out in line with the criteria set by IFC Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources[9]. For these sites, a long-term biodiversity monitoring and assessment programme must be adopted.
Specific requirements	
Forestry subsector	● Measures must be taken to ensure sustained or improved long term conservation status at the landscape level. ● In designated conservation areas, actions should be demonstrated to be in line with the conservation objectives for those areas. ● A forest management plan (or equivalent) that includes provisions for maintaining biodiversity must be developed. ● The ecosystem service provision with the aim to not decrease the amount and quality of ecosystem services provided must be evaluated.
Transportation sector	● **Sea and coastal water transport**: the measures must be in place to prevent the introduction of non-indigenous species by biofouling the hull and niche areas of ships, taking into account the IMO Biofouling Guidelines. Noise and vibrations are limited by using noise-reducing propellers, hull design, or onboard machinery in line with the guidance given in the IMO Guidelines for the Reduction of Underwater Noise.

[9] International Finance Corporation [IFC], "Performance Standard 6: : Biodiversity Conservation and Sustainable Management of Living Natural Resources", January 1, 2012, https://www.ifc.org/en/insights-reports/2012/ifc-performance-standard-6

Environmental objective: Protection and restoration of biodiversity and ecosystems	
	● **Sea and coastal water transport**: the measures to minimise toxicity of anti-fouling paint and biocides must be introduced.
Construction and Real Estate sector	● At least 80% of all timber products used in the new construction for structures, cladding and finishes must have been either recycled/reused or sourced from sustainably managed forests as defined by the Forestry criteria of the Thailand Taxonomy.

Minimum Social Safeguards (MSS)

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 Thai regulatory framework and policies, relevant internationally recognized principles and conventions, and have a social management system in place. MSS must be adhered to at the enterprise level (not a single activity) at the time an activity is assigned taxonomy compliant status and throughout the lifetime of the activity in that status. There is no remediation period for MSS; a manager must fulfil all MSS conditions to obtain taxonomy compliant status.

MSS must be applied to all workers, including informal workers, regardless of their employment status or contractual agreements. In activities involving informal workers, particularly within hazardous sectors like electronic waste dismantling in Thailand, a thorough due diligence process is crucial to understand the social welfare of these workers. This assessment should go beyond simply acknowledging their presence and delve into the specific risks they face. For example, in e-waste dismantling, this includes evaluating exposure to toxic substances, the use of appropriate personal protective equipment (PPE), working conditions (including ventilation and workspace safety), access to healthcare (including occupational health services), and fair compensation. Based on the identified risks, robust mitigation measures must be implemented. These measures might include providing appropriate PPE

and training on its use, establishing safe handling and disposal procedures for e-waste, ensuring access to regular health check-ups and treatment for occupational illnesses, promoting fair wages and working hours, and facilitating access to social security schemes where possible, even for informal workers. Furthermore, these safeguards should be regularly monitored and adapted to ensure their effectiveness and responsiveness to the evolving needs of informal workers in the e-waste sector.

The minimum number of laws, standards and regulations that should be observed by the manager includes (including, but not limited to):

- United Nations Guiding Principles on Business and Human Rights (2011)

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:

- Universal Declaration of Human Rights (1948)
- International Covenant on Civil and Political Rights (1966)
- International Covenant on Economic, Social and Cultural Rights (1966)

The practices of activity that manager must not contradict the following IFC Performance Standards[10], 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 manager of the activity in question considers some of the standards inapplicable, he or she should justify it and attach this justification to the relevant set of documents.

[10] IFC, “IFC's Performance Standards on Environmental and Social Sustainability” , January 1, 2012, https://www.ifc.org/en/insights-reports/2012/ifc-performance-standards

Annex: Application of DNSH criteria to Thailand taxonomy activities

No.	Sector	Activity	Climate change mitigation	Climate change adaptation	Sustainable use and protection of marine and water resources	Promotion of resource resilience and transition to a circular economy	Pollution prevention and control	Protection and restoration of biodiversity and ecosystems
1	Energy	Solar energy generation	Generic criteria	Generic criteria	Generic criteria	Generic criteria + Specific criteria for energy sector	Generic criteria	Generic criteria
2	Energy	Wind energy generation	Generic criteria	Generic criteria	Generic criteria	Generic criteria + Specific criteria for energy sector	Generic criteria + Specific criteria for energy sector	Generic criteria
3	Energy	Hydropower generation	Generic criteria	Generic criteria	Generic criteria	Generic criteria + Specific criteria for energy sector	Generic criteria	Generic criteria
4	Energy	Geothermal power generation	Generic criteria	Generic criteria	Generic criteria	Generic criteria + Specific criteria for energy sector	Generic criteria	Generic criteria
5	Energy	Bioenergy generation and production	Generic criteria	Generic criteria	Generic criteria	Generic criteria + Specific criteria for energy sector	Generic criteria	Generic criteria

No.	Sector	Activity	Climate change mitigation	Climate change adaptation	Sustainable use and protection of marine and water resources	Promotion of resource resilience and transition to a circular economy	Pollution prevention and control	Protection and restoration of biodiversity and ecosystems
6	Energy	Energy production from natural gas	Generic criteria	Generic criteria	Generic criteria	Generic criteria + Specific criteria for energy sector	Generic criteria	Generic criteria
7	Energy	Marine energy generation	Generic criteria	Generic criteria	Generic criteria	Generic criteria + Specific criteria for energy sector	Generic criteria	Generic criteria
8	Energy	Electricity generation from renewable non-fossil gaseous and liquid fuels, including green hydrogen	Generic criteria	Generic criteria	Generic criteria	Generic criteria + Specific criteria for energy sector	Generic criteria	Generic criteria
9	Energy	Cogeneration of heating/cooling and power using renewable sources of energy	Generic criteria	Generic criteria	Generic criteria	Generic criteria + Specific criteria for energy sector	Generic criteria	Generic criteria

No.	Sector	Activity	Climate change mitigation	Climate change adaptation	Sustainable use and protection of marine and water resources	Promotion of resource resilience and transition to a circular economy	Pollution prevention and control	Protection and restoration of biodiversity and ecosystems
10	Energy	Production of heating and cooling using waste heat	Generic criteria	Generic criteria	Generic criteria	Generic criteria + Specific criteria for energy sector	Generic criteria + Specific criteria for energy sector	Generic criteria
11	Energy	Installation and operation of electric heat pumps	Generic criteria	Generic criteria	Generic criteria	Generic criteria + Specific criteria for energy sector	Generic criteria	Generic criteria
12	Energy	Heating and cooling distribution	Generic criteria	Generic criteria	Generic criteria	Generic criteria + Specific criteria for energy sector	Generic criteria + Specific criteria for energy sector	Generic criteria
13	Energy	Transmission and distribution networks for renewable and low-carbon gases, including green hydrogen	Generic criteria	Generic criteria	Generic criteria	Generic criteria + Specific criteria for energy sector	Generic criteria + Specific criteria for energy sector	Generic criteria
14	Energy	Storage of electricity, thermal energy and green hydrogen	Generic criteria	Generic criteria	Generic criteria	Generic criteria + Specific criteria for energy sector	Generic criteria	Generic criteria

No.	Sector	Activity	Climate change mitigation	Climate change adaptation	Sustainable use and protection of marine and water resources	Promotion of resource resilience and transition to a circular economy	Pollution prevention and control	Protection and restoration of biodiversity and ecosystems
15	Energy	Transmission and distribution of electricity	Generic criteria	Generic criteria	N/A	Generic criteria + Specific criteria for energy sector	Generic criteria	Generic criteria
16	Transportation	Transport via railways	Generic criteria	Generic criteria	Generic criteria	Generic criteria + Specific criteria for transportation sector	Generic criteria + Specific criteria for transportation sector	Generic criteria
17	Transportation	Other passenger land transport	Generic criteria	Generic criteria	Generic criteria	Generic criteria + Specific criteria for transportation sector	Generic criteria + Specific criteria for transportation sector	Generic criteria
18	Transportation	Urban and suburban passenger land transport	Generic criteria	Generic criteria	Generic criteria	Generic criteria + Specific criteria for transportation sector	Generic criteria + Specific criteria for transportation sector	Generic criteria
19	Transportation	Freight transport by road	Generic criteria	Generic criteria	Generic criteria	Generic criteria + Specific criteria	Generic criteria + Specific criteria	Generic criteria

No.	Sector	Activity	Climate change mitigation	Climate change adaptation	Sustainable use and protection of marine and water resources	Promotion of resource resilience and transition to a circular economy	Pollution prevention and control	Protection and restoration of biodiversity and ecosystems
						for transportation sector	for transportation sector	
20	Transportation	Enabling infrastructure for low-emission transport	Generic criteria	Generic criteria	Generic criteria	Generic criteria + Specific criteria for transportation sector	Generic criteria	Generic criteria
21	Transportation	Sea and coastal water transport	Generic criteria	Generic criteria	Generic criteria + Specific criteria for transportation sector	Generic criteria + Specific criteria for transportation sector	Generic criteria	Generic criteria + Specific criteria for transportation sector
22	Transportation	Inland water transport	Generic criteria	Generic criteria	Generic criteria	Generic criteria + Specific criteria for transportation sector	Generic criteria	Generic criteria
23	Transportation	Retrofitting of sea and coastal freight and	Generic criteria	Generic criteria	Generic criteria	Generic criteria + Specific criteria	Generic criteria	Generic criteria

No.	Sector	Activity	Climate change mitigation	Climate change adaptation	Sustainable use and protection of marine and water resources	Promotion of resource resilience and transition to a circular economy	Pollution prevention and control	Protection and restoration of biodiversity and ecosystems
		passenger water transport				for transportation sector		
24	Transportation	Passenger and freight transport by air	Generic criteria	Generic criteria	Generic criteria	Generic criteria + Specific criteria for transportation sector	Generic criteria + Specific criteria for transportation sector	Generic criteria
25	Construction and Real Estate	Construction of new buildings	Generic criteria + Specific criteria for Construction and real estate sector	Generic criteria	Generic criteria + Specific criteria for Construction and real estate sector	Generic criteria + Specific criteria for Construction and real estate sector	Generic criteria + Specific criteria for Construction and real estate sector	Generic criteria + Specific criteria for Construction and real estate sector
26	Construction and Real Estate	Renovation of the existing residential or commercial buildings	Generic criteria + Specific criteria for Construction and real estate sector	Generic criteria	Generic criteria + Specific criteria for Construction and real estate sector	Generic criteria + Specific criteria for Construction and real estate sector	Generic criteria + Specific criteria for Construction and real estate sector	Generic criteria + Specific criteria for Construction and real estate sector

No.	Sector	Activity	Climate change mitigation	Climate change adaptation	Sustainable use and protection of marine and water resources	Promotion of resource resilience and transition to a circular economy	Pollution prevention and control	Protection and restoration of biodiversity and ecosystems
27	Construction and Real Estate	Acquisition or ownership of buildings	Generic criteria + Specific criteria for Construction and real estate sector	Generic criteria	Generic criteria + Specific criteria for Construction and real estate sector	Generic criteria + Specific criteria for Construction and real estate sector	Generic criteria + Specific criteria for Construction and real estate sector	Generic criteria + Specific criteria for Construction and real estate sector
28	Construction and Real Estate	Installation, maintenance, and repair of special-purpose building equipment	Generic criteria + Specific criteria for Construction and real estate sector	Generic criteria	Generic criteria + Specific criteria for Construction and real estate sector	Generic criteria + Specific criteria for Construction and real estate sector	Generic criteria + Specific criteria for Construction and real estate sector	N/A
29	Construction and Real Estate	Demolition and site preparation	Generic criteria + Specific criteria for Construction and real estate sector	Generic criteria	Generic criteria + Specific criteria for Construction and real estate sector	Generic criteria + Specific criteria for Construction and real estate sector	Generic criteria + Specific criteria for Construction and real estate sector	Generic criteria + Specific criteria for Construction and real estate sector

No.	Sector	Activity	Climate change mitigation	Climate change adaptation	Sustainable use and protection of marine and water resources	Promotion of resource resilience and transition to a circular economy	Pollution prevention and control	Protection and restoration of biodiversity and ecosystems
30	Construction and Real Estate	All activities contributing solely to adaptation objective	Generic criteria + Specific criteria for Construction and real estate sector	Generic criteria	Generic criteria	Generic criteria	Generic criteria	Generic criteria
31	Manufacturing	Manufacture of basic chemicals	Generic criteria	Generic criteria	Generic criteria	Generic criteria + Specific criteria for Manufacturing sector	Generic criteria + Specific criteria for production of chemicals, hydrogen and plastics in primary form	Generic criteria
32	Manufacturing	Manufacture of cement	Generic criteria	Generic criteria	Generic criteria	Generic criteria + Specific criteria for Manufacturing sector	Generic criteria + Specific criteria for production of cement	Generic criteria

No.	Sector	Activity	Climate change mitigation	Climate change adaptation	Sustainable use and protection of marine and water resources	Promotion of resource resilience and transition to a circular economy	Pollution prevention and control	Protection and restoration of biodiversity and ecosystems
33	Manufacturing	Manufacture of basic iron and steel	Generic criteria	Generic criteria	Generic criteria	Generic criteria + Specific criteria for Manufacturing sector	Generic criteria + Specific criteria for production of steel	Generic criteria
34	Manufacturing	Manufacture of aluminium	Generic criteria	Generic criteria	Generic criteria	Generic criteria + Specific criteria for Manufacturing sector	Generic criteria + Specific criteria for production of aluminium	Generic criteria
35	Manufacturing	Manufacture of hydrogen	Generic criteria	Generic criteria	Generic criteria	Generic criteria + Specific criteria for Manufacturing sector	Generic criteria + Specific criteria for production of chemicals, hydrogen and plastics in primary form	Generic criteria
36	Manufacturing	Manufacture of plastics in primary form	Generic criteria	Generic criteria	Generic criteria	Generic criteria + Specific criteria	Generic criteria + Specific criteria	Generic criteria

No.	Sector	Activity	Climate change mitigation	Climate change adaptation	Sustainable use and protection of marine and water resources	Promotion of resource resilience and transition to a circular economy	Pollution prevention and control	Protection and restoration of biodiversity and ecosystems
						for Manufacturing sector	for production of chemicals, hydrogen and plastics in primary form	
37	Manufacturing	Manufacture of batteries	Generic criteria	Generic criteria	Generic criteria	Generic criteria + Specific criteria for Manufacturing sector	Generic criteria + Specific criteria for Manufacturing sector	Generic criteria
38	Manufacturing	Manufacture of renewable energy technologies	Generic criteria	Generic criteria	Generic criteria	Generic criteria + Specific criteria for Manufacturing sector	Generic criteria + Specific criteria for Manufacturing sector	Generic criteria
39	Manufacturing	Manufacture of low-carbon technologies for transport	Generic criteria	Generic criteria	Generic criteria	Generic criteria + Specific criteria for Manufacturing sector	Generic criteria + Specific criteria for Manufacturing sector	Generic criteria

No.	Sector	Activity	Climate change mitigation	Climate change adaptation	Sustainable use and protection of marine and water resources	Promotion of resource resilience and transition to a circular economy	Pollution prevention and control	Protection and restoration of biodiversity and ecosystems
40	Manufacturing	Manufacture of energy efficiency equipment for buildings	Generic criteria	Generic criteria	Generic criteria	Generic criteria + Specific criteria for Manufacturing sector	Generic criteria + Specific criteria for Manufacturing sector	Generic criteria
41	Manufacturing	Manufacture of other low-carbon technologies	Generic criteria	Generic criteria	Generic criteria	Generic criteria + Specific criteria for Manufacturing sector	Generic criteria + Specific criteria for Manufacturing sector	Generic criteria
42	Manufacturing	CCS: Point-source capture of CO2	Generic criteria	Generic criteria	Generic criteria	Generic criteria + Specific criteria for Manufacturing sector	Generic criteria + Specific criteria for CCS related activities	Generic criteria
43	Manufacturing	Transportation of captured CO2	Generic criteria	Generic criteria	Generic criteria	Generic criteria + Specific criteria for Manufacturing sector	Generic criteria + Specific criteria for CCS related activities	Generic criteria

No.	Sector	Activity	Climate change mitigation	Climate change adaptation	Sustainable use and protection of marine and water resources	Promotion of resource resilience and transition to a circular economy	Pollution prevention and control	Protection and restoration of biodiversity and ecosystems
43	Manufacturing	Permanent sequestration of captured CO2	Generic criteria	Generic criteria	Generic criteria	Generic criteria + Specific criteria for Manufacturing sector	Generic criteria + Specific criteria for CCS related activities	Generic criteria
44	Manufacturing	Utilisation of captured CO2	Generic criteria	Generic criteria	Generic criteria	Generic criteria + Specific criteria for Manufacturing sector	Generic criteria + Specific criteria for CCS related activities	Generic criteria
45	Manufacturing	Introduction of energy efficiency and decarbonisation measures in manufacturing activities not specified in the Thailand Taxonomy	Generic criteria	Generic criteria	Generic criteria	Generic criteria + Specific criteria for Manufacturing sector	Generic criteria + Specific criteria for Manufacturing sector	Generic criteria

No.	Sector	Activity	Climate change mitigation	Climate change adaptation	Sustainable use and protection of marine and water resources	Promotion of resource resilience and transition to a circular economy	Pollution prevention and control	Protection and restoration of biodiversity and ecosystems
46	Waste	Anaerobic digestion of bio-waste or wastewater	Generic criteria + Specific criteria for Waste sector	Generic criteria	Generic criteria	Generic criteria + Specific criteria for Waste sector	Generic criteria + Specific criteria for Waste sector	Generic criteria
47	Waste	Composting of bio-waste	Generic criteria + Specific criteria for Waste sector	Generic criteria	Generic Criteria	Generic criteria + Specific criteria for Waste sector	Generic criteria + Specific criteria for Waste sector	Generic criteria
48	Waste	Collection and transport of waste	Generic criteria	Generic criteria	Generic criteria	Generic criteria + Specific criteria for Waste sector	Generic criteria + Specific criteria for Waste sector	Generic criteria
49	Waste	Depollution and dismantling of end-of-life products	Generic criteria	Generic criteria	Generic criteria	N/A	Generic criteria + Specific criteria for Waste sector	Generic criteria
50	Waste	Waste to Energy	Generic criteria	Generic criteria	Generic criteria	N/A	Generic criteria + Specific criteria for Waste sector	Generic criteria

No.	Sector	Activity	Climate change mitigation	Climate change adaptation	Sustainable use and protection of marine and water resources	Promotion of resource resilience and transition to a circular economy	Pollution prevention and control	Protection and restoration of biodiversity and ecosystems
51	Waste	Landfill gas capture and utilisation	N/A	Generic criteria	Generic criteria	Generic criteria	Generic criteria + Specific criteria for Waste sector	Generic criteria
52	Waste	Remediation of contaminated sites and areas	Generic criteria	Generic criteria	Generic criteria	Generic criteria + Specific criteria for waste sector	N/A	Generic criteria
53	Waste	Remediation of legally non-conforming landfills and abandoned or illegal waste dumps	Generic criteria + Specific criteria for waste sector	Generic criteria	Generic criteria	Generic criteria + Specific criteria for waste sector	N/A	Generic criteria
54	Waste	Sorting and material recovery from non-hazardous waste	Generic criteria	Generic criteria	Generic criteria	N/A	Generic criteria + Specific criteria for Waste sector	Generic criteria
55	Waste	Treatment of hazardous waste	Generic criteria	Generic criteria	Generic criteria	Generic criteria	Generic criteria + Specific criteria for Waste sector	Generic criteria

No.	Sector	Activity	Climate change mitigation	Climate change adaptation	Sustainable use and protection of marine and water resources	Promotion of resource resilience and transition to a circular economy	Pollution prevention and control	Protection and restoration of biodiversity and ecosystems
56	Waste	Construction, extension, upgrade, operation and renewal of decentralized wastewater collection and treatment	Generic criteria + Specific criteria for waste sector	Generic criteria	Generic criteria	Generic criteria	Generic criteria + Specific criteria for Waste sector	Generic criteria
57	Waste	Construction, extension, upgrade, and operation of centralised wastewater collection and treatment	Generic criteria + Specific criteria for waste sector	Generic criteria	Generic criteria	Generic criteria	Generic criteria + Specific criteria for Waste sector	Generic criteria
58	Waste	Renewal of centralised wastewater collection and treatment	Generic criteria + Specific criteria for waste sector	Generic criteria	Generic criteria	Generic criteria	Generic criteria + Specific criteria for Waste sector	Generic criteria

THAILAND TAXONOMY

Agiculture Sector

May 2025

THAILAND TAXONOMY BOARD

Table of Contents

List of Tables

List of Figures

Thailand Taxonomy Board Phase 2

Agriculture sector

1. Department of Climate Change and Environment, Ministry of Natural Resources and Environment
2. Bank of Thailand
3. Securities and Exchange Commission
4. Stock Exchange of Thailand
5. Department of Alternative Energy Development and Efficiency, Ministry of Energy
6. Thailand Greenhouse Gas Management Organization
7. Office of Natural Resources and Environmental Policy and Planning, Ministry of Natural Resources and Environment
8. Department of Agriculture, Ministry of Agriculture and Cooperatives
9. Office of Agricultural Economics, Ministry of Agriculture and Cooperatives
10. Rice Department, Ministry of Agriculture and Cooperatives
11. Department of Livestock Development, Ministry of Agriculture and Cooperatives
12. Royal Forest Department, Ministry of Natural Resources and Environment
13. Department of National Parks, Wildlife and Plant Conservation, Ministry of Natural Resources and Environment
14. Department of Fisheries, Ministry of Agriculture and Cooperatives
15. Department of Marine and Coastal Resources, , Ministry of Natural Resources and Environment
16. Board of Trade of Thailand
17. Federation of Thai Industries
18. Renewable Energy Industry Club, Federation of Thai Industries
19. Thai Bankers' Association
20. Association of International Bank
21. Government Financial Institutions Association

Sponsored by

GB-TAP Green Bond Technical Assistance Program
IFC International Finance Corporation
IN PARTNERSHIP WITH
Kingdom of the Netherlands
Australian Aid

Developed by

Climate Bonds Initiative

In cooperation with

CREAGY

Local Consultant

TDRI Thailand Development Research Institute

1. Introduction

As a country most directly impacted by climate change[1], Thailand needs to accelerate investment in both climate change mitigation and adaptation. The agriculture and forestry sectors are highly vulnerable to the impacts of climate change and a wide range of other environmental challenges exacerbated by climate change, such as biodiversity loss. Most of the crops grown in Thailand are dependent on the climatic situation[2], and its change can affect the sector in a very negative way. The same is true for the livestock and forestry sectors.

Agriculture (subdivided into plant cultivation, livestock production and aquaculture production) and forestry are combined within the ISIC classification into a single category, but in this taxonomy, the methodological approach to creating criteria for them differs significantly. Therefore, an overview will be given for both agriculture and forestry together, but methodologically, they will be considered in separate sections.

Agriculture

2. Agriculture background

Agricultural activities, including crop production, livestock production, and aquaculture production, play a pivotal role in Thailand's economy, food security, and rural livelihoods. Forestry is also an important economic sector for Thailand, with key exports including sawn wood, paper and paperboard, fibreboard, particleboard, wooden furniture, and furniture parts (mostly made from rubberwood)[3]. Together, the agriculture, forestry, and fishing sectors contributed 8.8% added value to Thailand's GDP in 2022, coming down from 36.4% in 1960.[4]

---

[1] ReliefWeb, "Global Climate Risk Index," 2021, https://reliefweb.int/report/world/global-climate-risk-index-2021?gad_source=1&gclid=CjwKCAjwtqmwBhBVEiwAL-WAYZQyOQsMhUgutJQL5kjszGNOULPSLejOzOMRRQp1vc7b-1B_g7qI4RoCaooQAvD_BwE

[2] UNFCCC, "Thailand's Fourth National Communication under the United Nations Framework Convention on Climate Change," December 22, 2022, https://unfccc.int/sites/default/files/resource/Thailand%20NC4_22122022.pdf

[3] Only a very small volume of unprocessed logs (mostly plantation-grown teak) is exported each year by the Forest Industry Organization, which is the only legally authorised entity for exporting unprocessed logs (See Timber Trade Portal, "Overview of Timber Sector of Thailand," n.d., https://www.timbertradeportal.com/en/thailand/142/timber-sector.).

[4] World Bank Open Data. "World Bank Open Data," n.d. https://data.worldbank.org/country/thailand.

While the sector has seen a decline in contribution to the GDP, it remains a major source of employment for some 12.7 million workers, approximately 30% of Thailand's total labour force.[5] Labour shortage, lack of production planning and management, inequality of access to water resources, and climate change are among the key challenges facing the Thai agricultural sector.[6] There are about 7.4 million agricultural households in Thailand.[7] Land ownership situations in the Thai agricultural sector vary. Around 40% of farmers either own a small amount of land or no land.[8] However, Thai farmers who own land have an average of 3.2 ha of land, which is higher than in other countries of Asia.

2.1 Crop production

As of 2021, 46% of Thailand's land area is agricultural land.[9] In 2021, total agricultural production increased by 1.4%, recovering from a decline of 3.5% in 2020. Thailand has experienced substantial progress in increasing the value of productivity per labour unit and the gross income of small-scale agricultural producers. In 2019, the gross agricultural product was valued at USD 21.68 billion, compared to USD 17.25 billion in 2016. Thailand has increased the amount of sustainable agricultural land in the past four years, with increased government investment in the sector.[10] Thailand is a top-ten global producer of agricultural products, including rice, cassava, sugarcane, palm oil, coconut, pineapple, and natural rubber.[11] The country has become the world's 13th largest exporter of agricultural products after a more

[5] International Labour Organization, "Working and employment conditions in the agriculture sector in Thailand," 2021, https://www.ilo.org/sites/default/files/wcmsp5/groups/public/@asia/@ro-bangkok/documents/publication/wcms_844317.pdf.

[6] International Labour Organization, "Working and employment conditions in the agriculture sector in Thailand," 2021, https://www.ilo.org/sites/default/files/wcmsp5/groups/public/@asia/@ro-bangkok/documents/publication/wcms_844317.pdf.

[7] Thailand Development Research Institute, "Thai Agriculture Needs a Shake-Up," November 2022, https://tdri.or.th/en/2022/11/thai-agriculture-needs-a-shake-up/.

[8] Digital Economy Promotion Agency (DEPA), "Agriculture Landscape In Thailand," 2020, https://www.depa.or.th/storage/app/media/file/investment-bulletin.pdf.

[9] World Bank, "Agricultural Land (% of Land Area) - Thailand," n.d., https://data.worldbank.org/indicator/AG.LND.AGRI.ZS?end=2021&locations=TH&start=1990&view=chart.

[10] UNFCCC, "Thailand's Fourth Biennial Update Report under the United Nations Framework Convention on Climate Change," November 29, 2022, https://unfccc.int/documents/624750.

[11] Thailand Board of Investment, "Food Industry,"n.d., https://www.boi.go.th/upload/content/Food%20industry_5aa7b40bd758b.pdf.

than 20% surge in agricultural trade in the first 11 months of 2022; the top three top agricultural products by revenue were fruits (164.79 billion baht), meat and fish (97.14 billion baht), and rubber (83.91 billion baht).[12] The following table shows the production statistics of major Thai agricultural crops.

Table 1 Production of major crops in Thailand (2022)

Crops	Yield (kg/Rai)	Production (ton)	Area harvested (Rai)	% of Area harvested
Rice	18,675	34,317,028	71,776,456	51%
Natural rubber	8,600	4,825,907	21,928,413	16%
Cassava	134,138	34,068,005	9,921,056	7%
Sugar cane	377,425	92,095,784	9,531,688	7%
Maise (corn)	28,563	4,895,904	6,695,188	5%
Oil palm fruit	121,063	19,061,392	6,150,375	4%

Source: The Food and Agriculture Organization.[13]

2.2 Livestock production

Livestock production in Thailand is on the rise.[14] Poultry, particularly broilers, make up the majority of the livestock population in the country. In 2022, the number of poultry was 1,460,708,000 animals, followed by the number of pigs at 11,827,495 animals and cattle at 1,185,348 animals.[15] The three product segments with the highest export growth are frozen meat (356,748 tonnes worth 48.07 billion baht, up 11.5% year on year); animal products, such as milk, eggs and canned food (98,066 tonnes worth 8.79 billion baht, up 5.4% year on year); and animal feed (105,461 tonnes worth 4.46 billion baht, up 11.7% year on year).[16] Thailand-based Charoen Pokphand Foods (CPF) group is the world's largest producer of feed and shrimp

[12] The Nation Thailand, "Thailand is now the world's 13th largest exporter of agricultural products: minister," January 20, 2023, https://www.nationthailand.com/thailand/economy/40024187.

[13] FAO, "FAOSTAT", https://www.fao.org/faostat/en/#data.

[14] The Livestock Production Index includes meat and milk from all sources, dairy products such as cheese, and eggs, honey, raw silk, wool, and hides and skins

[15] FAO, "FAOSTAT" – Crops and Livestock Products, https://www.fao.org/faostat/en/#data/QCL.

[16] The Nation Thailand, "Exports of livestock products are rising, with frozen meat leading the way," June 18, 2023, https://www.nationthailand.com/thailand/economy/40028622.

and is a global top-three producer of poultry and pork.[17] By value, Thailand is the world's biggest exporter of processed chicken and its 6th biggest exporter of frozen chicken.[18]

Table 2 The number of livestock and poultry farmers by region, 2023

Region	Farmer (person)	Livestock (animal)							
		Beef	Cow	Buffalo	Pig	Chicken	Duck	Goat	Sheep
Total	**3,551,607**	**9,655,380**	**774,461**	**1,784,160**	**11,172,465**	**519,520,597**	**31,928,467**	**1,568,059**	**136,539**
Northern	714,050	1,484,190	78,382	359,335	2,123,579	70,017,748	4,709,988	221,520	25,262
Northeast	1,916,654	5,405,876	242,569	1,283,137	2,378,066	107,835,466	7,693,411	338,779	12,314
Central	397,300	1,624,420	446,599	114,248	5,211,854	299,869,346	16,056,765	565,293	67,992
Southern	523,603	1,140,894	6,911	27,440	1,458,966	41,798,037	3,468,303	442,467	30,971

Source: Information on the number of livestock in Thailand 2023, Department of Livestock Development

Beef produced in Thailand has been produced exclusively for domestic consumption. Beef cattle are mainly in the northeast (55.99%), with 16.82% in The Central Region 15.37% in the Northern area and 11.82% in the Southern area (2023). The greatest proportionate increase has occurred in the Southern and Northern regions, where cattle numbers have increased by 12.8% and 9.5% per year (2013-2023), respectively.

2.3 Aquaculture

The aquaculture and fisheries sector in Thailand has long been a crucial component of the country's economy, providing significant contributions through the supply of aquatic products for both domestic consumption and export. The sector has gained increasing importance due to changing societal values, growing domestic demand for aquatic resources, and the decline in natural fishery production. As natural aquatic resources face degradation, aquaculture has emerged as a critical means to supplement and sustain the supply of aquatic products, vital for both food security and economic stability. Factors such as climate change, the loss of natural habitats, and rising demand for seafood have driven this shift, prompting the Fisheries

[17] Logistics Magazine, "CPF: The World's Largest Producer of Feed and Shrimp," September 2021, https://logisticsmag.net/%E0%B8%94%E0%B8%B9%E0%B8%9A%E0%B8%97%E0%B8%84%E0%B8%A7%E0%B8%B2%E0%B8%A1-103089-cpf-the-worlds-largest-producer-of-feed-and-shrimp.html#:~=CPF%20is%20the%20world's%20largest,brand%20in%20many%20international%20markets

[18] Suppakorn Kornboontritos, "Industry Outlook 2023-2025: Chilled, Frozen and Processed Chicken Industry", February 15, 2023 https://www.krungsri.com/en/research/industry/industry-outlook/food-beverage/frozen-processed-chicken/io/io-chilled-frozen-processed-chicken

Department of Thailand to align its strategies with national policies and long-term development goals.

1. Freshwater aquaculture

Freshwater aquaculture in Thailand includes a variety of farming methods, such as monoculture (single-species farming), polyculture (multi-species farming), and integrated farming, where fish farming is combined with other agricultural activities like livestock rearing, crop cultivation, or rice farming. Predominantly, herbivorous fish species are farmed, followed by carnivorous species.

Over the past decade (2013-2023), freshwater aquaculture has seen a steady increase in production and economic value, driven by several factors. The average annual number of freshwater aquaculture farms was 521,847, covering 818,962 rai, with an average production of 429,292 tons per year, valued at 25,526 million baht. This represents 45.17% of total aquaculture production and 27.51% of its economic value. Production and value have been increasing at annual rates of 0.42% and 1.52%, respectively.

The growth in freshwater aquaculture can be attributed to the increase in registered farmers, partly due to government assistance during natural disasters such as floods and unfavourable weather conditions. Additionally, rising market prices for aquatic products have encouraged farmers to expand their operations. The relatively low investment and short production cycles associated with freshwater aquaculture make it an attractive option for both household consumption and commercial sales. Furthermore, government policies and measures, such as promoting the use of technology to reduce production costs and expanding market channels, have supported continuous production and provided farmers with more opportunities to sell their products.

2. Coastal Aquaculture

Coastal aquaculture in Thailand primarily involves the farming of marine shrimp, brackish water fish, marine fish, various shellfish species (such as oysters, cockles, and mussels), and sea crabs. Among these, marine shrimp farming is the most prominent, accounting for approximately 60% of the total coastal aquaculture production. However, the sector has faced challenges, particularly due to the outbreak of Early Mortality Syndrome (EMS) in shrimp, which has significantly impacted overall coastal aquaculture production.

From 2013 to 2023, the number of coastal aquaculture farms averaged 40,816 annually, covering 439,984 rai. The average production from these farms was 521,003 tons per year, with an economic value of 67,266 million baht. Despite being a smaller portion of the overall number of farms (7.25%), coastal aquaculture contributed 54.83% of total aquaculture production and 72.49% of its economic value. The EMS outbreak has led to a downward trend in coastal aquaculture production, beginning in 2013, highlighting the vulnerability of this sector to disease outbreaks and other environmental challenges.

Moving forward, the sector's ability to adapt to changing conditions, improve disease management, and leverage new technologies will be critical to sustaining its growth and ensuring its contribution to Thailand's economy and food security.

This Taxonomy will focus on the scope of aquaculture practices. The seawater or freshwater fishery is not included in the scope of this Taxonomy due to its complexity and lack of science-based criteria. Gratitude is extended to the Department of Fisheries, Ministry of Agriculture and Cooperatives for initiating and developing aquaculture practices in Thailand Taxonomy, which have been fundamental to the advancement of this field.

3. Major climate and environment-related issues

Climate change affects the Thai agricultural sectors through key changes in parameters such as temperature and precipitation.[19] For example, some regions of Thailand are already experiencing average growing season maximum temperatures above 34C°, which is a temperature threshold above which rice yields can be negatively affected unless adaptation actions are taken. Changing precipitation patterns negatively affect rice farming, which is the backbone of the country's agriculture[20].

According to the studies, by 2050, changes in average temperatures and an increase in extreme events will result in losses to Thailand's agricultural sector, ranging from USD 17.83 billion to

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

[20] Arunrat, Noppol, Nathsuda Pumijumnong, Sukanya Sereenonchai, Uthai Chareonwong, and Can Wang, "Assessment of Climate Change Impact on Rice Yield and Water Footprint of Large-scale and Individual Farming in Thailand,"2020, Science of the Total Environment 726 (July): 137864. https://doi.org/10.1016/j.scitotenv.2020.137864.

USD 83.83 billion, affecting all provinces of the country[21]. These negative impacts on agriculture are projected to have regional variation; the western, north-central and north-western regions are likely to suffer less negative impacts compared to the eastern, south-central, and north-eastern regions of the country[22]. To adapt to the impacts of climate change, research has shown that climate–smart varieties of rice, together with adjusted management practices, has led to significant increases in yield and sustenance of production in climate change stress-affected areas, including those inhabited by the most impoverished farming communities.[23]

The use of traditional agricultural practices involving biomass burning is one of the most serious problems in Thailand's forestry and agriculture sectors from an environmental perspective. Rice, sugarcane and maise are among the key crops involved in the field burning of agricultural residues, which is both a major source of agricultural CO_2 emissions and a serious air pollution (PM2.5) problem in Thailand. According to a report by the Thailand Environment Institute (TEI), it is estimated that burning is involved in 57% of harvested areas for off-season rice, 47% for sugar cane, 35% for maise and 29% for in-season rice, respectively.

Table 3 Calculation of burning areas and PM2.5 emissions of cash crops, 2021

Crops	Harvest area (1000 km^2)	Burning (%) / Area (1000 km^2)	Dry biomass (kg/ 1600 m^2)	PM2.5 (kg/ 1600 m^2)	Calculation	
					Dry biomass (million tons/year)	PM2.5 (ten thousand tons/year)
Sugarcane	11.46	47% / 5.39	4,272	17.60	23.03	9.49
Rice (in-season)	54.39	29% / 15.77	329	4.18	5.19	6.59
Rice (off-season)	6.33	57% / 3.61	329	4.18	1.19	1.51
Maise	5.85	35% / 2.05	330	3.09	0.68	0.63

Source: Thailand Environment Institute Foundation, 2021[24]

[21] Attavanich, Witsanu. “Effect of climate change on Thailand’s agriculture: New results,” MPRA Paper No. 118290, 2017, https://mpra.ub.uni-muenchen.de/118290/1/Attavanich%20%282017%29.pdf

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

[23] CGIAR, "Climate-Smart Rice," Innovation Explorer, https://www.cgiar.org/innovations/climate-smart-rice/

[24] Thailand Environment Institute Foundation, "Management and Reduction of Burning Practice in Agricultural Areas and Policy Recommendations to Tackle PM25 in Thailand," 2022, https://www.tei.or.th/file/library/2022-ABM-ENG_76.pdf.

Another major problem affecting the sector is the excessive use of pesticides and herbicides by farmers, which has a negative impact on the health of the country's population[25]. Farmers themselves and their family members who work with them in the field are particularly at risk, which, given the proportion of people employed in agriculture, endangers more than a third of the country's population. Despite Thai governmental legislation to control pesticide use, many farmers continue to use banned pesticides, apply higher concentrations than recommended, and do not use adequate personal protective equipment[26].

Key sectoral climate policies

Thailand's Climate Change Master Plan (CCMP) (2015-2050) aims for Thailand to be resilient to the impacts of climate change and to achieve low carbon growth through sustainable development. The CCMP Strategy 2, "Mitigation and low carbon development" for agriculture, comprises actions and measures focusing on low-emission agricultural practices with environmental and financial co-benefits; it also increases the capacity of farmers to accommodate GHG reduction technologies and management systems.

Climate change mitigation actions for agriculture are further elaborated in Thailand's 2nd updated NDC[27] framework, which is similar to that of LT-LEDS. The LT-LEDS elaborates that mitigation actions in the agricultural sector will likely focus on those with multiple benefits, such as increasing climate resilience, resource efficiency, and productivity. These include better manure management, improved agriculture waste management, improved rice cultivation and practices, increased efficiency in water resource management, smart farming, high-efficiency plant cultivation and livestock, promotion of organic fertilisers, increased renewable energy uses (solar, biofuels and electrification), and energy efficiency in water pumping, threshing, and tilling. Two measures from the agricultural sector (*fixed dome digester*

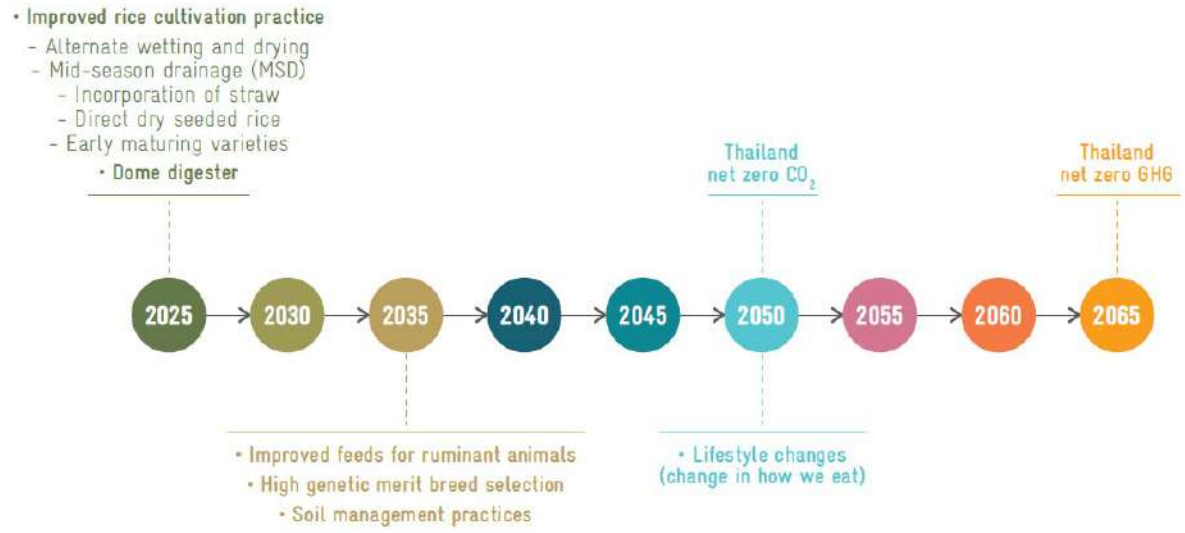
[25] Laohaudomchok, W.et al. (2021), "Pesticide use in Thailand: Current situation, health risks, and gaps in research and policy. Human and ecological risk assessment," HERA, 27(5), 1147–1169, 2021, https://doi.org/10.1080/10807039.2020.1808777

[26] Edward P. Rivera and other writers, "Health Risk Related To Pesticide Exposure in the Agriculture System in Thailand: a Systematic Review," Journal of Health Research 30 (2016): S71, https://doi.nrct.go.th//ListDoi/listDetail?Resolve_DOI=10.14456/jhr.2016.69

[27] The 2nd updated NDC is conducted with reference to the planned implementation goals of each relevant Ministry in the energy, industrial Processes and Product Use (IPPU), Agriculture, LULUCF, and waste management sectors.

biogas production measures and *improvements in rice farming to reduce methane emissions*) were also incorporated into the 2nd updated NDC goal and guidelines to reduce GHG emissions. All such measures have already been included in the list of eligible practices under the Thailand Taxonomy.

Figure 1 Net zero GHG emission timeline for the agriculture sector



Source: Office of Natural Resources and Environmental Policy and Planning (2022)[28]

In October 2023, the Ministry of Agriculture and Cooperatives launched the Climate Change Action Plan for Thai Agriculture (2023 – 2027)[29]**.** The plan incorporates a GHG reduction target of 1 million tons and includes the following measures:

- encouraging farmers to alternate between wet and dry rice farming;
- using waste from pig manure from the livestock sector to produce biogas to produce electricity;
- reducing the use of chemical fertilisers with the application of the Thai Soil Fertility Management;
- aggregating large plots to mix fertilisers for own use.

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

[29] Office of Agricultural Economics, *Climate Change Action Plan for Thai Agriculture (2023 – 2027)*, Bangkok: Office of Agricultural Economics, February 15, 2023, https://www.oae.go.th/assets/portals/1/files/jounal/2567/Artwork-ENG-04102567.pdf

It is expected that continued adoption of the above measures will reduce GHG emissions from the agricultural sector by up to 2.74 million CO2eq tons by 2030.[30]

Agricultural industry players also established industry-level climate action targets. For example, in February 2022, the Thai Livestock and Aquatic Consortium implemented a project on the Thai Livestock Technical Consortium for Climate Neutrality, which focuses on the reduction of GHG emissions in the Thai livestock industry chain and sets a target to achieve climate neutrality by 2040. Under the project, a joint working group of 2 parties are established and divided into four groups of selected products: maise, fishmeal, meat cattle and milk cow.[31]

4. Agricultural sub-activities climate materiality assessment

The table below contains information on the emission of activities within the agricultural sector based on data from the Thailand GHG Inventory. Inventory data is extrapolated to ISIC codes used in the Taxonomy. The cut-off line for the materiality of emissions for sectoral analysis is 1% of gross sectoral emission. Therefore, activities that contribute less than 1% to gross emissions are not included in the table.

Table 4 Agricultural sector emission profile

Subsector	IPCC 2006 Code	Agricultural sector GHG Emissions, total in GgCO2eq (share of total sectoral emission, %)	Corresponding proposed activities under the Thailand Taxonomy
Rice Cultivation	3I	33,631.60 (50.57%)	Cultivation of rice
Enteric Fermentation	3A	15,364.76 (23.10%)	Livestock production
Direct N2O Emissions from Managed Soils	3F	7,669.56 (11.53%)	Growing of perennial and non-perennial crops, incl. corn, mango, pineapples, banana etc. Growing of sugarcane Cultivation of rice

[30] OAE (2023): The agricultural sector sets a goal to reduce greenhouse gas emissions by 1 million tons and is preparing to announce the 5-year Agricultural Climate Change Action Plan by the end of this year (News No. 122/2566, dated 9 November 2023).

[31] UN Global Compact, "Thai Feed Mill Association – ComSummary of Thai Feed Mill Association's Policy and Action on the Environmental Sustainability Communication on Engagement | UN Global Compact," n.d., https://unglobalcompact.org/participation/report/cop/detail/479837.

Subsector	IPCC 2006 Code	Agricultural sector GHG Emissions, total in GgCO2eq (share of total sectoral emission, %)	Corresponding proposed activities under the Thailand Taxonomy
			Cultivation of rubber trees Cultivation of cassava Cultivation of palm oil trees
Manure Management	3B	3,472.08, (5.22 %)	Livestock Production
Indirect N2O Emissions from Managed Soils	3G	2,833.66 (4.26%)	Growing of perennial and non-perennial crops, incl. corn, mango, pineapples, banana etc. Growing of sugarcane Cultivation of rice Cultivation of rubber trees Cultivation of palm oil trees Cultivation of cassava
Field Burning of Agricultural Residues	3C	1,617.03 (2.43%)	Growing of perennial and non-perennial crops, incl. corn, mango, pineapples, banana etc. Growing of sugarcane Cultivation of rice Cultivation of rubber trees Cultivation of palm oil trees Cultivation of cassava
Urea Fertilisation	3E	1,294.18 (1.95%)	Growing of perennial and non-perennial crops, incl. corn, mango, pineapples, banana etc. Growing of sugarcane Cultivation of rice Cultivation of rubber trees Cultivation of palm oil trees Cultivation of cassava

Source: Thailand's First Biennial Transparency report[32]

[32] UNFCCC, "Thailand's First Biennial Transparency Report under the United Nations Framework Convention on Climate Change," December 26, 2024, https://unfccc.int/documents/645098

Rice cultivation, which accounts for the highest greenhouse gas emissions, is also included as a sub-activity in this Taxonomy. Furthermore, enteric fermentation and manure management are both covered under the **livestock production** activity in this Taxonomy. The remaining climate-material activities are related to emissions associated with soil tillage and fertiliser application. These two categories are relevant for all proposed plant-growing activities included in this Taxonomy, and relevant mitigation practices will be proposed for all types of agricultural activities. Fertiliser production itself is not covered by the Taxonomy, but the production of major chemical components of fertilisers (ammonia, nitric acid, and others) is covered by the basic chemicals' subsector of Manufacturing criteria.

It is also proposed that sugarcane, cassava, rubber tree cultivation and oil palm cultivation be identified as separate activities because of the special circumstances that set them apart from other crops. The unsustainable cultivation of these crops has become a particularly serious problem in Southeast Asia because, in past years, it has often resulted in the destruction of natural forests, damage to ecosystems, and destruction of biodiversity[33].

Furthermore, both the incineration of sugarcane waste and "slash and burn" practices significantly contribute to air pollution with higher PM 2.5 particle concentrations and negatively impact the overall environmental situation in Thailand[34]. Emissions associated with this practice also contribute to the category "Field Burning of Agricultural Residues" in **Table 3**.

Moreover, oil palm and rubber tree cultivation are also associated with deforestation[35] and the burning of agricultural residues is causing substantial environmental damage. Concurrently, local sustainability-minded industrial associations like Thailand Sustainable Palm Oil Alliance[36] are actively looking for ways to reduce potential negative impacts, while external actors like the European Union are introducing stringent regulations that could potentially limit the

[33] Kanokwan Saswattecha et al., "Assessing the Environmental Impact of Palm Oil Produced in Thailand," Journal of Cleaner Production 100 (August 1, 2015): 150–69, https://doi.org/10.1016/j.jclepro.2015.03.037.

[34] The Nation, "Crop Burning Shortening Average Life Expectancy," The Nation Thailand, September 15, 2023, https://www.nationthailand.com/thailand/general/40031056.

[35] Aruna Chandrasekhar, "Rubber Drives 'At Least Twice' as Much Deforestation as Previously Thought," Carbon Brief, November 1, 2023, https://www.carbonbrief.org/rubber-drives-at-least-twice-as-much-deforestation-as-previously-thought/.

[36] Fauzi Nash, "RSPO Launches the Thailand Sustainable Palm Oil Alliance With Five Partner Organisations," Press release, Roundtable on Sustainable Palm Oil (RSPO), November 29, 2022, https://rspo.org/press-release-rspo-launches-the-thailand-sustainable-palm-oil-alliance-with-five-partner-organisations/.

export potential of Thai rubber and palm oil if not dealt with properly. As a consequence, tailored practice lists for oil palm and rubber production will be separately developed for the Taxonomy to provide a set of tailored criteria that can address the sustainability challenges associated with the two crops.

Apart from the crops mentioned above, all other types of agricultural crops may be grouped under one generic activity in Taxonomy, i.e. "Sustainable perennial or non-perennial crops, incl. corn, mango, pineapples, banana, etc." because of the similarity of farming practices and sustainability challenges associated with them. This generic activity encompasses growing fruits and vegetables, coconuts, and all other crop types that do not fall into other crop-specific activity categories.

4.1 Agricultural criteria scope

The boundary of the eligible crop, livestock production, and aquaculture systems within Thailand Taxonomy is “farmgate to farmgate,” meaning that they cover everything that happens within the farm. These boundaries can include non-contiguous lands and production systems. The farm is treated as the **production unit** and thus includes areas such as any forest holdings linked to the agricultural production system by ownership or ecosystem function. Non-contiguous production activities are eligible if they are related to farm production prior to the sale of the product (such as storage, manure management, or composting) and managed by the production unit. These criteria are neutral regarding the future use of crops and livestock once they have left the agricultural production unit (except for the provision of traceability systems).

Users are expected to clearly define the land boundaries of the production unit. Normally, this will be the farm holding, including riparian buffer zones, conservation set-asides, grassland, or forest areas. For clarification, conservation and set aside areas may be considered as part of the agriculture production unit if they constitute part of the land property of the farm production unit owned or leased by the same unit as the production property and are not used as offsets for other GHG emissions sources.

In particular, the proposed criteria cover:

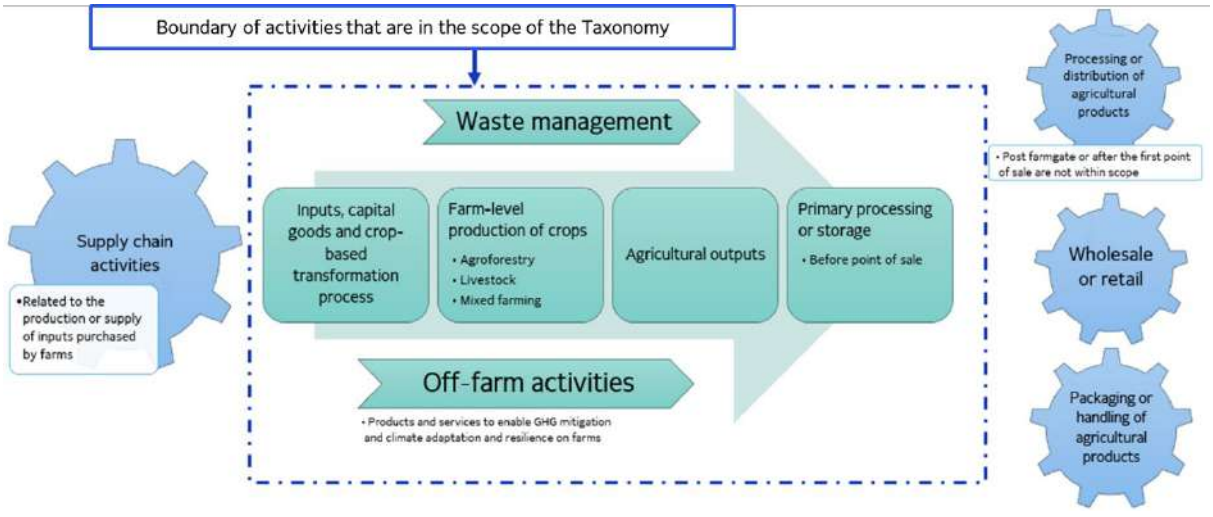
- farm-level production of crops (including agroforestry) and livestock, including mixed farming;
- activities off-farm that provide products or services to enable GHG mitigation and climate adaptation and resilience on farms;
- inputs, capital goods, crop-based transformation processes;
- agricultural outputs;
- waste management;
- primary processing or storage before the point of sale.

The proposed criteria do not cover:

- the production or supply of inputs purchased by farms;
- the processing or distribution of agricultural products post the farmgate or after the first point of sale;
- packaging or handling of agricultural products that left the farm (on-farm basic packaging and storage are included);
- wholesale or retail.

The scope defined above for agriculture sector criteria in Thailand's taxonomy is illustrated in Figure below.

Figure 2 Agricultural activities within the scope of Agricultural criteria



From the point of view of types of produce, agricultural criteria cover all crops, plants, livestock and aquaculture products of industrial importance to Thailand. The practices lists are added to Annex I include separate lists for rice, sugarcane, oil palm, rubber trees, cassava and all one general list of practices for other plants that are industrially planted in Thailand. Livestock criteria cover all major agricultural animals used in Thailand, including cattle, poultry, and other types of livestock. Meanwhile, aquaculture encompasses various aquatic species such as fish, shrimp, shellfish, and squid.

Eligible activities and associated assets and projects include those integral to the whole production unit (such as land purchase costs for an entire farm) or only a part of the production unit (such as equipment or infrastructure for particular aspects of production or the purchase of additional land for expansion of the farm). The criteria vary according to whether the use of proceeds covers the whole production system or a component of it.

4.2 Agricultural criteria methodological approach

The approach suggested for the agricultural sector in Thailand is different in mechanics from the traffic lights system used for other sectors of the taxonomy. This approach aligns with agricultural sector methodologies in other taxonomies and incorporates additional content to enhance the utility and applicability of the eligibility criteria within the country's context. The suggested approach is the culmination of extensive, multi-year research conducted by Climate Bonds. It has been developed on the basis of Climate Bonds Agricultural Criteria[37] and specifically tailored by the local consultants' team to ensure that it meets the unique needs and challenges of the agricultural sector in Thailand.

This approach is based on the understanding that, at present, collecting, analysing and evaluating accurate data on the impact of different practices on key agricultural climate indicators is extremely challenging, not only for individual farmers but also for government agencies. The lack of reliable, comparable data makes defining precise science-based boundaries for the green, amber and red categories virtually impossible without years of country-specific research. Against this background, the Climate Bonds Initiative has developed

[37] Climate Bonds Initiative. Climate Bonds Standard: Agriculture Criteria., https://www.climatebonds.net/files/files/standards/agriculture/Agriculture%20Criteria%2020210622v3.pdf.

a practice-based approach that enables farmers to make a significant contribution to agricultural sustainability without the need for overly complex and costly measurements.

Definition of Agricultural practice.

An agricultural practice refers to the methods and techniques used in farming to cultivate crops and rear animals. Practices can be sustainable or unsustainable, meaning that they can either contribute to taxonomy objectives (like the application of nature-based solutions[38]) or be harmful to them (like slash-and-burn practices). The taxonomy incentivises the application of sustainable practices given in Annex and disincentivises from applying unsustainable practices (addressed through **Table 6**).

The agricultural sector is also more heterogeneous in terms of its impact on the ecosystem and climate than other sectors, and therefore, sustainable practices proposed under a practice-based approach can contribute not only to the objective of climate change mitigation but also to the objectives of climate change adaptation, sustainable use and protection of marine and water resources, pollution prevention and control, protection and restoration of biodiversity and ecosystems and to circular economy promotion. In most cases, each recommended practice contributes to several objectives at once.

A practice-based model is constructed as a three-tiered system of basic, intermediate and advanced practices where practices grow in complexity and sophistication from one level to another. It is recommended that practices from the next tier should be implemented after all practices from the previous tier are adopted. In addition, the complementary adoptions section includes measures that can benefit any farm at any stage of development. Tiers differ in the following ways:

- **Basic practices**: measures that are relatively low-cost and not very complex. They generate benefits by enabling more efficient use of resources and environmental preservation with respect to the traditional extensive model.
- **Intermediate practices**: measures and technologies of greater complexity than the basic ones, incorporating greater technical knowledge and investment.

[38] Nature-based solutions are actions to protect, conserve, restore, and sustainably use and manage ecosystems in a way that addresses social, economic and environmental challenges while simultaneously benefiting human well-being and biodiversity. https://www.wri.org/insights/what-exactly-are-nature-based-solutions

- **Advanced practices**: changes that fundamentally modify the production model, integrating techniques, knowledge and inputs that allow for the highest productive and environmental yields.
- **Complementary adoptions**: these are specific technologies that are beneficial to any farm at any stage of its development. The manager of the farm may choose one of the complementary adoptions as one of the practices to implement under the transformation project.

The Taxonomy includes (under Annex) 8 lists of sustainable practices recommended for rice, sugarcane, oil palm, rubber tree, cassava, the remaining plants, livestock and aquaculture. It is important to note that rice, sugarcane, oil palm, rubber tree and cassava producers can also use the practices listed in the Annex (Sustainable perennial or non-perennial crops, incl. corn, mango, pineapples, banana etc.). The use of general practices for these crops will also be considered consistent with the Taxonomy, although they might be not so effective for a certain crop as specific practices from Tables in Annex.

The Taxonomy also allows to certify finished products that meet the requirements of Thai, regional and international organic, sustainable, and climate-focused agricultural certification labels (**Table 5**), which will ultimately facilitate the adoption of the Taxonomy by domestic users.

Taxonomy compliance also involves ensuring that the ecosystem of the production unit is not harmed, and a farm manager contributes to at least one of the objectives of the taxonomy. To meet these two conditions, **Table 6 and 7** were designed. **Table 6** is a Do-No-Significant-Harm section that is designed to ensure that at the time of the start of the transformational project and during it, a farm manager does not apply and does not plan to apply any practices that harm climate, environment, biosphere, or taxonomy objectives.

Table 7 is aimed at ensuring that the implementation of practices from Annex contributes to the achievement of at least one taxonomy objective by contributing to the achievement of a certain desired result described in the “Description of contribution” column of the table. As part of the preparation of an Integrated Farm Management Plan (IFMP), the farm manager must indicate to what result, indicated in this table, the application of practices from Annex, selected by the farm manager for the transformational project, leads. For further information on IFMP, please see section Integrated Farm Management Plan.

This structure aims to enhance the compatibility Thailand Taxonomy with other national taxonomies. The best practice approach on which the criteria are based is aligned with existing taxonomies in Rwanda, Colombia, Mexico, and Panama as well as (to a certain extent) Singapore. This facilitates data integration and comparison.

5. Taxonomy application scheme

The main application of the taxonomy in practice in the agricultural sector is its application to the **transformational project.** Such a project implies the transition of the farm from its current state to a more climatically and environmentally sustainable state through the application of sustainable practices, making a significant contribution to the objectives of the taxonomy and preventing harm to the ecosystem and biodiversity of the production unit.

There are two basic options under which the manager of the farm can align a transformational project with the Taxonomy:

Option 1: Through the preparation of the IFMP

Step 1. Provide a statement of the farm's compliance with the Thai national laws and regulations relevant to the farm.

Even though all activities across all sectors need to comply with national laws and regulations, the idea of this requirement in agriculture is to provide further guidance to financial sector users to check compliance against specific norms (e.g., the farm is not located in a forest or a protected area) before evaluating if it is sustainable.

The relevance of different laws and regulations is defined by the manager of the farm and assessed by the person or agency checking the validity of the alignment.

Step 2. Define the activity to be assessed.

A transformation project can be carried out for the following activities that are included under the Agricultural section of the Taxonomy: *(See the Tables in Annex)*

- Growing of perennial or non-perennial crops, incl. corn, mango, pineapples, banana etc.
- Growing of rice
- Growing of sugarcane

- Growing of oil palm
- Growing of rubber tree
- Growing of cassava
- Livestock production
- Aquaculture production

Crop-specific tables include practices that provide the best results for the specific crops, but **table 9** with general practices for perennial and non-perennial crops, incl. corn, mango, pineapples, banana etc. *(See the Tables in Annex)* can be utilised for these crops as well.

Step 3. Select at least two practices from Annex tables

For a transformation project to be aligned with the taxonomy, **at least two sustainable agricultural practices from the ones listed in the Annex tables including at least one non-basic (intermediate or advanced) practice needs to be selected for implementation** throughout it. Complementary adoptions are not considered practices and can not be counted towards compliance with this requirement (they are minor technological interventions that are not sufficient to qualitatively improve the situation on the farm, but can be useful as a supplement).

Each practice consists of three elements:

- **Title**. This title must be indicated in the IFMP.
- **Description**. The description includes all actions that must be implemented to consider the practice fully implemented.
- **Eligible inputs**. The procurement of these inputs is aligned with the taxonomy, meaning that they may be financed through green or sustainable debt or programmes tied to taxonomy-aligned agriculture. At present, only these inputs can be financed to implement a certain practice.

Step 4. Prepare and adopt an IFMP

An IFMP is a document that confirms that the farm manager:

- Has chosen at least two practices and is intended to implement them in a proper manner in order to achieve some results relevant to the objectives of the Taxonomy;

- has not now and will not, by implementing the transformation project, cause significant damage to the ecosystem of the production unit, climate, and the environment as a whole;
- will make a significant contribution to one or more of the objectives of the taxonomy as part of the transformation project.

An IFMP has no established structure (the structure might be defined either by the farm manager or by the institution verifying the compliance with the Taxonomy), but as a minimum, it includes the following sections:

- Objective of the transitional project;
- Current situation on the farm;
- The nature of transition;
- Expected results of the project;
- Environmental damage prevention measures taken by the farm manager;
- Taxonomy objectives and contribution actions will be taken by the farm manager throughout the project.

A detailed description of the IFMP content can be found in Section IFMP**.**

Option 2: Getting a credible international or national certification

Alternatively, the manager of the farm may choose to substitute the preparation of the IFMP with a credible international or national certification scheme from one of the recognised certification providers. These international certifications include sufficiently stringent requirements comparable in stringency to those required of the farm manager under Option 1. If the production of the farm or the farm itself is certified under one of these, the farm manager does not need to provide an IFMP but still needs to implement at least two practice from Annex tables. Here is the list of available certification schemes:

Table 5 List of eligible certification schemes

Certification scheme	Associated crops
Cocoa Certification — Conservation Alliance [39]	Cocoa
Certification Scheme for Organic Agriculture (Thailand)[40]	General perennial and non-perennial crops, incl. corn, mango, pineapples, banana etc.
Thai Agricultural Standard Organic Agriculture: The production, Processing, Labelling and Marketing Of Organically Produce And Products (TAS 9000-2021) [41]	General perennial and non-perennial crops, incl. corn, mango, pineapples, banana etc.
UTZ Certified and Rainforest Alliance[42]	General perennial and non-perennial crops, incl. corn, mango, pineapples, banana etc.
International Sustainability and Carbon Certification[43]	General perennial and non-perennial crops, incl. corn, mango, pineapples, banana etc.
Thai Quality Good Agricultural Practice (Q GAP)[44]	General perennial and non-perennial crops, incl. corn, mango, pineapples, banana etc.
Singapore Good Agricultural Practice (SG GAP) Certification[45]	General perennial and non-perennial crops, incl. corn, mango, pineapples, banana etc.
Global GAP [46]	General perennial and non-perennial crops, incl. corn, mango, pineapples, banana etc.;

[39] Conservation Alliance, "COCOA CERTIFICATION,", n.d., https://conservealliance.org/cocoa-certification/.

[40] Organic Agriculture Certification Thailand, "ACT Organic- Services,", n.d., https://www.actorganic-cert.or.th/

[41] National Bureau of Agricultural Commodity and Food Standards Ministry of Agriculture and Cooperatives, "Organic Agriculture: The Production, Processing, Labelling and Marketing of Organic Produce and Products", February 21, 2022, https://acfs-backend.acfs.go.th/storage/ProductStandards/Files/20240529155100_828699.pdf

[42] Rainforest Alliance, "UTZ Certification (Now Part of the Rainforest Alliance) | Rainforest Alliance," November 21, 2022, https://www.rainforest-alliance.org/utz/.

[43] ISCC, "ISCC System – Solutions for Sustainable and Deforestation Free Supply Chains," n.d., https://www.iscc-system.org/.

[44] National Bureau of Agricultural Commodity and Food Standards, "Thai Agricultural Standard Tas 9001-2013: Good Agricultural Practices for Food Crop," report, *National Bureau of Agricultural Commodity and Food Standards*, 2013, https://www.acfs.go.th/standard/download/eng/GAP_Food_Crop.pdf.

[45] Singapore Government Singapore Food Agency, "SFA | Singapore Good Agricultural Practice (SG GAP)," n.d., https://www.sfa.gov.sg/food-farming/quality-assurance-schemes/singapore-good-agriculture-practice-(sg-gap).

[46] "Global G.A.P- Global smart farm assurance solutions," GlobalG.A.P, n.d., https://www.globalgap.org

Certification scheme	Associated crops
	Livestock production; Aquaculture production.
Farm Sustainability Assessment (FSA)[47]	General perennial and non-perennial crops, incl. corn, mango, pineapples, banana etc.;
Singapore Clean and Green Certification [48]	General perennial and non-perennial crops, incl. corn, mango, pineapples, banana etc.
IFOAM Standard [49]	General perennial and non-perennial crops, incl. corn, mango, pineapples, banana etc.; Aquaculture production.
Organic label of the National Bureau of Agricultural Commodity and Food Standards[50]	General perennial and non-perennial crops, incl. corn, mango, pineapples, banana etc.
Proterra Foundation [51]	General perennial and non-perennial crops, incl. corn, mango, pineapples, banana etc.
RSB Standard [52]	General perennial and non-perennial crops, incl. corn, mango, pineapples, banana etc.
Climate Bonds Protected Agriculture and Water Infrastructure Criteria[53]	General perennial and non-perennial crops, incl. corn, mango, pineapples, banana etc.
USDA Organic Label[54]	General perennial and non-perennial crops, incl. corn, mango, pineapples, banana etc.

[47] SAI Platform: Farm Sustainability Assessment, https://saiplatform.org/fsa/

[48] Singapore Government Singapore Food Agency, "SFA | Singapore Clean and Green Urban Farms (SG C&G)," n.d., https://www.sfa.gov.sg/food-farming/quality-assurance-schemes/singapore-clean-and-green-urban-farms-(sg-c-g).

[49] "IFOAM - Organics International | Home," IFOAM, n.d., https://www.ifoam.bio/.

[50] "Labeling Organic Products | Agricultural Marketing Service," n.d., https://www.acfs.go.th/standard/list

[51] ProTerra Foundation, "The ProTerra Network | ProTerra Foundation," ProTerra Foundation, April 9, 2024, https://www.proterrafoundation.org/the-proterra-standard/.

[52] "Framework – RSB," n.d., https://rsb.org/framework/.

[53] "Protected Agriculture in Mexico," Climate Bonds Initiative, April 11, 2023, https://www.climatebonds.net/standard/protected-agriculture.

[54] "Labeling Organic Products | Agricultural Marketing Service," n.d., https://www.ams.usda.gov/rules-regulations/organic/labeling.

Certification scheme	Associated crops
Naturland Standards[55]	General perennial and non-perennial crops, incl. corn, mango, pineapples, banana etc.
EU Organic Regulations[56]	General perennial and non-perennial crops, incl. corn, mango, pineapples, banana etc.
Roundtable of Sustainable Palm Oil [57]	Palm oil
Indonesian Sustainable Palm Oil[58]	Palm oil
Malaysia Sustainable Palm Oil[59]	Palm oil
Palm Oil Innovation Group[60]	Palm oil
Forest Sustainability Council (FSC)	Rubber trees
Programme for the Endorsement of Forest Certification (PEFC)	Rubber trees
Sustainable Rice Platform[61]	Rice
T-VER-P-METH-13-08[62]	Rice
Climate-Friendly Rice Certification (AgriCapture)[63]	Rice
Thai Agricultural Standard for Sustainable Rice (TAS 4408-2022)[64]	Rice

[55] Minou Yussefi-Menzler, "Naturland Standards," Naturland, n.d., https://www.naturland.de/en/naturland/what-we-stand-for/quality/naturland-standards.html.

[56] "Organic Production and Products," Agriculture and Rural Development, March 4, 2024, https://agriculture.ec.europa.eu/farming/organic-farming/organic-production-and-products_en.

[57] Roundtable on Sustainable Palm Oil (RSPO), "A Global Partnership to Make Palm Oil Sustainable - Roundtable on Sustainable Palm Oil (RSPO)," May 17, 2024, https://rspo.org/.

[58] ISPO, "Indonesia Sustainable Palm Oil", n.d., https://www.indonesiapalmoilfacts.com/ispo/

[59] "About MSPO — MSPO," MSPO, n.d., https://mspo.org.my/about-mspo.

[60] "Palm Oil Innovation Group | a Journey Towards Responsible Palm Oil," n.d., https://poig.org/.

[61] "Sustainable Rice Platform", n.d., https://sustainablerice.org/

[62] "T-VER Enhanced Good Practices in Paddy Rice Field" https://ghgreduction.tgo.or.th/en/premium-t-ver-methodology/methodology/reduction-absorption-and-removal-of-greenhouse-gases-from-the-forestry-and-agriculture-sectors/item/5094-enhanced-good-practices-in-paddy-rice-field.html

[63] AgriCapture, "Climate Friendly RIce Certification", n.d., https://agricapture.com/certification/

[64] National Bureau of Agricultural Commodity and Food Standards et al., "THAI AGRICULTURAL STANDARD TAS 4408-2022 SUSTAINABLE RICE," *National Bureau of Agricultural Commodity and Food Standards*, May 17, 2022, https://www.acfs.go.th/files/files/commodity-standard/20221011102422_823691.pdf.

Certification scheme	Associated crops
Roundtable on Responsible Soy [65]	Soy
Bonsucro [66]	Sugarcane
Smartcane BMP [67]	Sugarcane
Aquaculture Stewardship Council[68]	Aquaculture production
Best Aquaculture Practices[69]	Aquaculture production
Premium T-VER[70]	
Agricultural Product Standards: Good Agricultural Practices[71]	Livestock production
Thai Agricultural Standard Organic Livestock[72]	Livestock production
Better Cotton Initiative (BCI)[73]	Cotton
Soy Sustainability Assurance Protocol (SSAP)[74]	Soy

If this option of chosen, steps 1, 2 and 3 are the same as in the Option 1, but the step 4 is replaced by obtaining one of the certificates mentioned above.

[65] "Roundtable on Responsible Soy", n.d., https://responsiblesoy.org/?lang=en

[66] "Bonsucro", n.d., https://bonsucro.com/

[67] "Smartcane BMP", n.d., https://smartcane.com.au/

[68] Aquaculture Stewardship Council." https://asc-aqua.org/

[69] Best Aquaculture Practices." https://www.bapcertification.org/

[70] Thailand Greenhouse Gas Management Organization, "Premium T-VER" https://ghgreduction.tgo.or.th/en/premium-t-ver.html.

[71] Agricultural Product Standards: Good Agricultural Practices, https://certify.dld.go.th/certify/index.php/th/2016-05-01-14-47-42/2016-05-03-02-04-15/1067-2019-09-02-03-31-36

[72] Thai Agricultural Standard TAS 9000-2005 https://www.acfs.go.th/standard/download/eng/Organic_Agriculture2.pdf

[73] Better Cotton Initiative, https://bettercotton.org/

[74] Soy Sustainability Assurance Protocol, https://ussec.org/resources/u-s-soy-sustainability-assurance-protocol-ssap-2022/

5.1 Eligible expenditures and produces

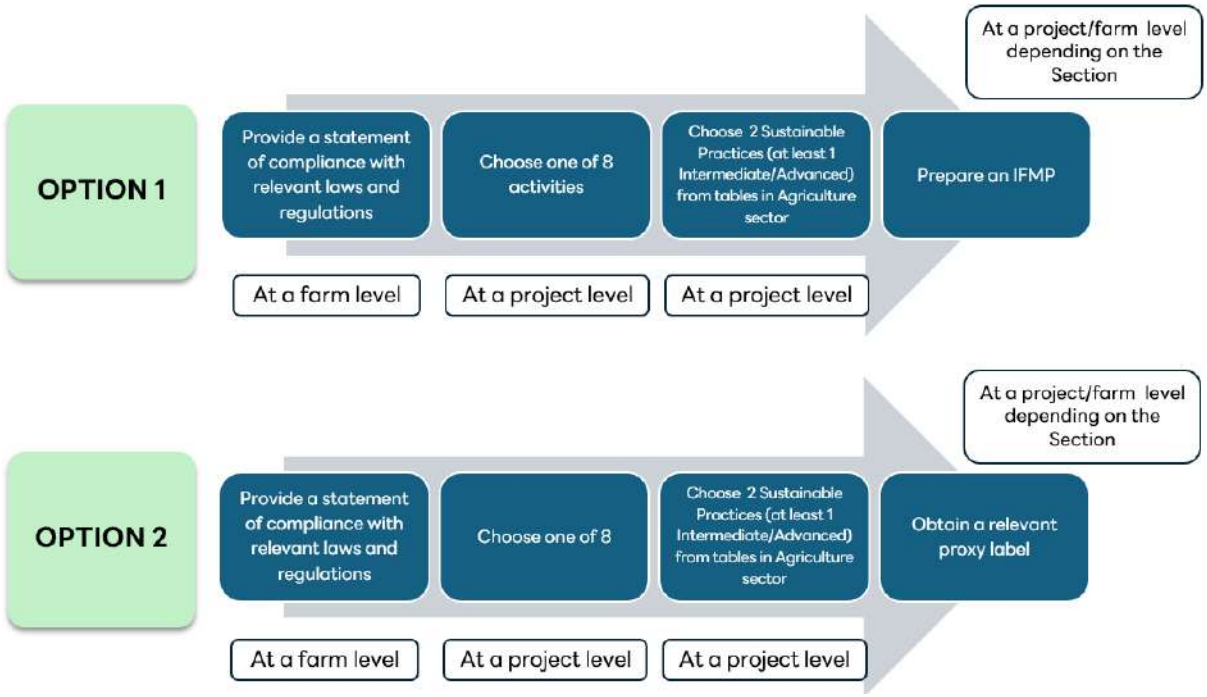
Regardless of the chosen option, alignment with the taxonomy allows to mark as taxonomy-aligned the following items and revenue streams:

- Expenditures required to implement the transformation project, including items and services from the "eligible inputs" column of each tables of Annex;
- Expenditures required to make substantial contribution to measures;
- Revenues coming from selling farm production **after** the transformation project was completed. Please note that only revenues from farm products that were transformed throughout the transformation project are considered taxonomy aligned. For example, if the farm grows corn and soy together and the manager carries out a transformation project aimed at increasing biofertiliser input for soy (or obtained Roundtable on Responsible Soy certification), only soy and revenues associated with selling soy are considered taxonomy aligned. This product taxonomy alignment lasts two years[75], counting from the date when the transformation project was fully implemented.

Do-No-Significant-Harm section measures from Table 6 must be implemented before the start of the transformation project and be continued throughout the project implementation process. Financial inputs required to provide them thus cannot be aligned with the Taxonomy.

[75]The two-year limitation is intended to incentivize farmers to adopt more sustainable practices. After this two-year period, farms can either repeat the same practices or implement at least two other practices to maintain their green revenue status.

Figure 3 Agricultural Criteria Application Scheme



5.2 Integrated Farm Management Plan

There is no standard template for the Farm Management Plan, and different formats[76] can be adopted depending on the institution requesting it (for example, a government agency that supports farmers whose projects and farm practices align with the Taxonomy). Regardless of what template is used, IFMP should include the following information:

- **Objectives of the transformational project**: a general description of what changes are planned to be achieved on the farm by implementing the practices from Annex of the tables and fulfilling the requirements of **Table 6 and 7**; what is the expected result of the project.

[76] For example, one can look at the IFMP templates from
South Africa: South Africa Environmental Management Plan, "Environmental Management Plan", n.d. https://view.officeapps.live.com/op/view.aspx?src=https%3A%2F%2Fsiza.co.za%2Fwp-content%2Fuploads%2F2023-Draft_Environmental-Management-Plan.docx&wdOrigin=BROWSELINK
New Zealand: New Zealand Farm Environment Plan templates, "Farm Environment Plan Templates," FAR Research, n.d., https://www.far.org.nz/resources/farm-environment-plan-templates.or
Australia: Australia Department of Agriculture, Generic Environmental Management Plan, n.d., https://agriculture.vic.gov.au/__data/assets/pdf_file/0004/925150/Broiler_Generic-Environmental-Management-Plan.pdf.

- **Current situation on the farm**: In this section, the farmer should describe his or her farm. The description of the farm should include a geophysical map of the area accompanied by supportive maps or GPS coordinates. It should also include information on the natural environment surrounding the farm, such as the presence of high-carbon or high-biodiversity ecosystems nearby. Additionally, it should include details about the production model yields. This part may also answer the following questions:
  - **Natural resources stocktake**. What natural resources (soil quality, vegetation, water sources, etc.) are available on the farm and in the surrounding area?
  - **Information about the fertilisers and pesticides the farm manager uses**. What kind of fertilisers are used, how and why? What amount of fertiliser per square metre is needed for your farm based on soil, climatic conditions, and crop type?
  - **Climate-relevant data**. Are any data on climate vulnerability or greenhouse gas emissions associated with your farm available?
  - **Existing practices**. Are there any conservation practices that have already been integrated into the production system?
- **The nature of transformation**: in this section, the farmer should indicate what changes will be implemented throughout the project based on the adoption of the selected practice(s), what agricultural inputs the selected practice(s) will require, and what the expected environmental impacts will be for the farm and its surrounding environment; what the expected changes in the farming system will be as a result of the adoption of the selected practices (i.e. lower fertiliser use, increase agricultural output, crop diversification, increased biodiversity, enhanced energy efficiency etc).
- **Environmental harm prevention**: this section should confirm that the transformational project will not result in any of the adverse effects reflected in **Table 6** or any other adverse effects that may be materially detrimental to the objectives of the Taxonomy.
- **Objectives contribution**: in this section, the farmer should describe how selected practices contribute to one of the objectives of the taxonomy described (in relation to the agricultural sector) in **Table 7**. Given that more than one practice can be chosen and many practices may contribute to more than one objective of the Taxonomy, the

specific wording of the contribution is always left to the farmer's discretion. The statement should, however, clearly reflect the relevance of the transformational project to the overall objectives of the Taxonomy. **Table 7** gives shortened examples how this contribution can be expressed for different objectives.

5.3 Do No Significant Harm Measures of Agriculture Sector

Table 6 Do No Significant Harm Measures: DNSH

Environmental objectives	Do-No-Significant-Harm Measures
Climate Change Mitigation	● The project should not lead to conversion of high carbon stock lands[77]. ● Any slash-and-burn practices or burning of agricultural residues must be avoided at any stage. ● Avoid overtelling, overgrazing and excessive application of fertilisers. ● Avoid unnecessary waste of food, maximise animal diet efficiency from the points of view of nutritional value and GHG emission reduction potential
Climate Change Adaptation	● Clear boundaries and critical interdependencies between the agricultural production unit and the ecosystem within which it operates must be identified. ● An assessment has been undertaken to identify the key physical climate hazards to which the production unit will be exposed and vulnerable over its operating life. ● The measures that have been or will be taken to address those risks mitigate them to a level so that the production unit is able to manage changing climatic conditions over its operational life.

[77] Definition of high carbon stock land: https://highcarbonstock.org/what-is-the-high-carbon-stock-approach/#:~:text=The%20'High%20Carbon%20Stock'%20in,carbon%20dioxide%20from%20the%20atmosphere. Can be proven by submission of maps (see Global Forest Watch maps), georeferenced photographs or satellite imagery of land use change and burning, for example. Forest inventory surveys or other formal government data can also be used.

Environmental objectives	Do-No-Significant-Harm Measures
	● <u>**Aquaculture only**</u>: Avoid using species that are intolerant and/or vulnerable to temperature fluctuations, salinity changes, and other climate-related stressors to reduce vulnerability to climate change impacts.
Sustainable use and protection of marine and water resources	● Protect riparian corridors, wetlands, and other water bodies. ● Control pollution of watercourses and avoid the discharge of sediments into water bodies, nutrients, and agrochemicals. ● Regulate the volume of water abstracted and returned to natural sources, improving the efficiency of use per unit of production. ● Maintaining appropriate stocking densities to reduce the pressure on local water resources and minimize the accumulation of waste and uneaten feed, which can lead to eutrophication.
Pollution prevention and control	● Prevent physical degradation, e.g., erosion and soil compaction. ● Prevent chemical degradation, e.g. salinisation, acidification, alkalinisation and pollution. ● Avoid biological degradation, e.g. loss of organic matter, imbalance of biological activity and mineralisation processes. ● Avoid uncontrolled discharge of wastewater into natural water bodies, uncontrolled and excessive release of nutrients, chemicals, and organic matter.
Protection and restoration of biodiversity and ecosystems	● Avoid habitat destruction: burning, felling or fragmentation of natural vegetation. ● Protect areas of natural forest. Set aside at least 40% of the forest for regeneration or conservation.

Environmental objectives	Do-No-Significant-Harm Measures
	• Avoid the introduction of non-native species. Native species are allowed. Naturalised species with proven benefits in restoration programmes are allowed. • Control the use of agrochemicals (fertilisers and pesticides) because, in excess, they cause the decline of populations of beneficial organisms in terrestrial and aquatic ecosystems.
Livestock-related DNSH (applicable to livestock only)	Provide reasonable level of animal welfare, avoid cruel and inhumane practices. Provide the animal with Five Freedoms.[78]
Aquaculture-related DNSH (applicable to aquaculture only)	Ensure minimal use of antibiotics in line with the latest FAO guidelines[79], SeaBOS[80] or scientific publications[81].

[78] National Archives, "The Five Freedoms," The UK Government Web Archive, https://webarchive.nationalarchives.gov.uk/ukgwa/20121010012427, http://www.fawc.org.uk/freedoms.htm

[79] Hernández Serrano, Pilar. *Responsible Use of Antibiotics in Aquaculture*. FAO Fisheries Technical Paper No. 469. Rome: Food and Agriculture Organization of the United Nations, 2005. https://openknowledge.fao.org/server/api/core/bitstreams/bf43d03e-11bf-47d1-83c2-fd02cc94baa4/content.

[80] SeaBOS Task Force III. *Antibiotics Stewardship Roadmap*. Stockholm: Stockholm Resilience Centre, October 2021. https://seabos.org/wp-content/uploads/2021/10/Antibiotics-Roadmap.pdf.

[81] P. Smith, *7 - Antibiotics in aquaculture: reducing their use and maintaining their efficacy*, Editor(s): Brian Austin, In Woodhead Publishing Series in Food Science, Technology and Nutrition, Infectious Disease in Aquaculture, Woodhead Publishing, 2012, Pages 161-189, ISBN 9780857090164, https://doi.org/10.1533/9780857095732.2.161.

Table 7 Examples of sustainable contribution to the objectives of Thailand Taxonomy

Environmental objective	Description of contribution	Examples of contribution
Climate change mitigation	Implemented measures lead to the reduction of GHG emission or prevent loss of carbon stocks	● Selected measures help to reduce methane emissions in treatment plants and water-intensive crops (e.g. rice, coffee). ● Selected measures help to increase the use of higher carbon fixing plant species, protect the forests, coastal and marine habitats (blue carbon). They involve introduction of agroforestry systems, reduction of methane emissions in agricultural waste management or reduce emissions from biomass burning. ● Selected measures help to increase and sequester carbon above and below ground, e.g. through good tillage practices and cover with improved pastures and woody species in livestock systems. They also decrease NO2 emissions in fertilised soils. ● Selected measures help to restore degraded areas that once were high-carbon stocks.
Climate change adaptation	Implemented measure improve production unit's resilience to the effects of climate change at the same time not harming the climate resilience of the ecosystems within which it is carried out.	● Selected measures help to improve the resilience of ecosystems to climate variability and enhance their climate regulating services (e.g. by protecting mangroves, forests, and wetlands). ● Selected measures help to reduce pressure on the biological balance and its climate resilience. Climate-tolerant agricultural varieties, breeds and forest species will be used.

Environmental objective	Description of contribution	Examples of contribution
Sustainable use and protection of marine and water resources;	Implemented measures protect water sources, optimise utilisation of water and prevent its contamination	● Selected measures help to increase the stabilisation of aquifer recharge areas. They help to reduce the sedimentation potential of reservoirs that allow water regulation. ● Selected measures help to adjust water planning criteria according to the assessment of climate scenarios and their adaptation to applicable climate adaptation plans. ● Selected measures help to protect and optimise water supply for other uses, such as protecting ecological minimum flows (for freshwater and coastal ecosystem functions), especially in periods of water scarcity. ● Selected measures help to manage runoff in times of excessive precipitation.
Protection and restoration of biodiversity and ecosystems;	Implemented measures help to protect or restore biodiversity and stability of the ecosystem where the production unit is situated	● Selected measures help to encourage the use of native species or species compatible with the original habitat. ● Selected measures help to combat pre-existing invasive species without deteriorating the biological balance. ● Selected measures help to increase species diversity and abundance, seeking to connect non-degraded fragments and recover already attenuated areas under a biological corridor and buffer zone approach. Involve planting and maintenance of vegetation:

Environmental objective	Description of contribution	Examples of contribution
		trees, shrubs, mangroves, and other natural ecosystems.
Pollution prevention and control;	Implemented measures prevent air, soil or ecosystem pollution	● Selected measures help to adequately collect, recycle, clean and dispose containers of pesticides and chemicals. ● Selected measures help to develop a contaminated water treatment system to treat waste and nutrients. ● Selected measures help to reduce or stop the burning of crops such as the management and processing of agricultural residues
Promotion of resource resilience and transition to a circular economy.	Implemented measures contribute to keeping agricultural biomass, waste and residues from agricultural activities as reusable resources	● Selected measures help to produce fertiliser and biogas from manure and other organic waste. ● Selected measures help to increase organic matter content in the soil by incorporating residues from crop production.

Forestry

6. Forestry background

As of 2021, the forest area in Thailand was estimated at 102,212,434 rai or 31.59% of the country's total area.[82] The majority of Thailand's forest land is characterised as naturally regenerating forests, followed by plantation forests.[83] Thailand's forest areas are categorized into three main types: conservation forests, national reserved forests, and mangrove forests.[84] Conservation forests account for approximately 64% of the total forest area in Thailand, national reserved forests make up about 34%, and mangrove forests constitute the remaining 2%.[85]

Some key underlying factors contributing to the loss of forest areas in Thailand are population growth, high economic value of timber, insecure land ownership and land rights, etc. At the sub-national level, 36 provinces out of 77 have less than 20% of total area under forest cover, 23 provinces have forest cover of 20-40%, 7 have 40-60%, and seven provinces have over 60% of forest cover. These latter seven provinces are Chiangmai, Nan, Phrae, Lampang, Mae Hong Son, Tak and Kanchanaburi, which are all located in the North and the West of the country.[86]

---

[82] Forest Land Management Office, "Project to prepare the foundation of the forest in 2022," Ministry of Natural Resources and Environment (Royal Forest Department, n.d.), https://www.forest.go.th/land/wp-content/uploads/sites/29/2023/01/Forest-Area-2565-Full_compressed.pdf.

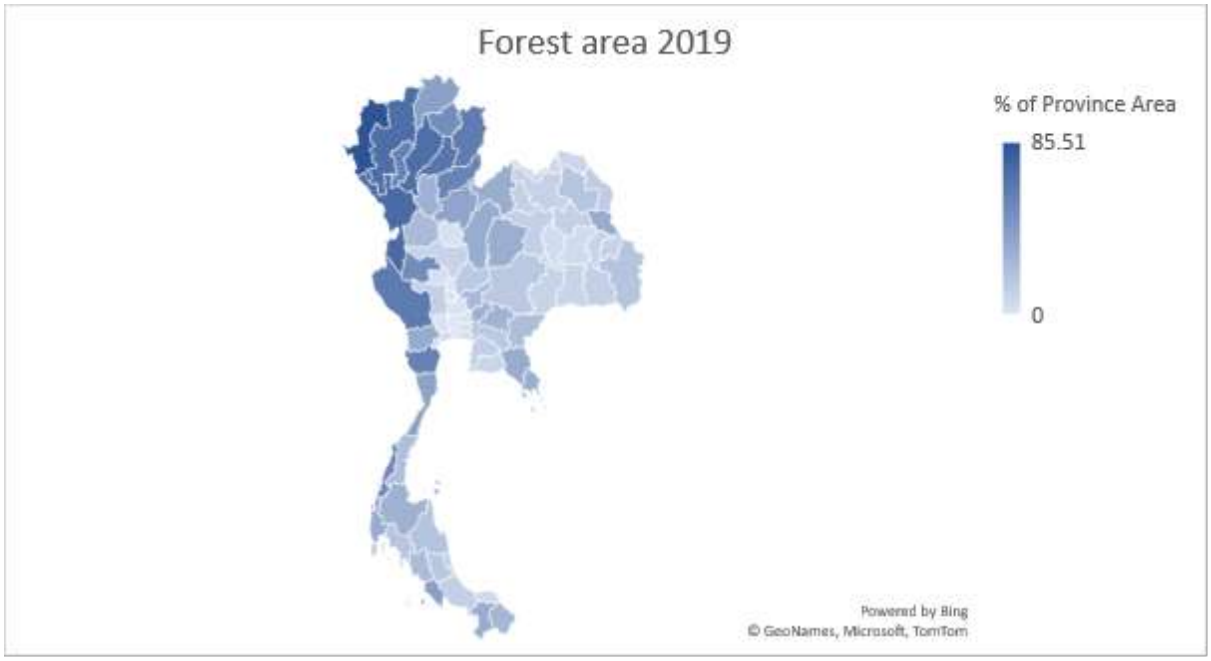
[83] FAO, " Global Forest Resources Assessment-Thailand," 2020, https://openknowledge.fao.org/server/api/core/bitstreams/8b3aa28e-5086-4548-b71a-fef4bc64d8c6/content

[84] Conservation Forests are managed by the Department of National Parks Wildlife and Conservation (DNP) and consist of National Parks, Wildlife Sanctuaries and other conserved forest classifications which historically were not subjected to active forest management practices; Forests outside conservation forests are managed by the Royal Forest Department (RFD) and consist of forest lands that have historically been subjected to active forest management activities, excluding mangrove forests, which are managed by the Department of Marine and Coastal Resources (DMCR).

[85]UNFCCC, "Thailand Forest Reference Emission Level (FREL) and Forest Reference Level (FRL) Report," 2020, https://redd.unfccc.int/media/thailand_frel_frl_report.pdf

[86] Ibid.

Figure 4 Thailand's Forest Area (% of Province Area), 2019



Source: Royal Forest Department

7. Major climate and environment-related issues

Deforestation is a key problem in the forestry sector and indirectly affects agricultural productivity. According to the Global Forest Watch, between 2001 and 2022, Thailand lost 15.06 rai (2.41 Mha) of tree cover, equivalent to a 12% decrease in tree cover or and 1.43 Gt of CO_2e emissions[87]. Since 1960s, total area of the country covered by forests decreased[88] from 53% to 36%. Historical deforestation has also exposed Thailand's soils to erosion and degradation and ultimately impacted negatively on biodiversity.[89]

Key sectoral climate policies

As for the forestry sector**,** the CCMP Strategy 2 focuses on creating carbon sinks via forest conservation, restoration, reforestation, and afforestation. The Strategy states that measures that affect communities in forested areas should be evaluated on the merits of their

[87] Vizzuality, "Thailand Deforestation Rates & Statistics | GFW," n.d., https://www.globalforestwatch.org/dashboards/country/THA/?location=WyJjb3VudHJ5IiwiVEhBIl0%3D.

[88] "Thailand | Forest Carbon Partnership," n.d., https://www.forestcarbonpartnership.org/country/thailand.

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

environmental and social impact via public hearings. Although the NDC target in 2030 excludes the LULUCF sector as part of its implementation, forest protection and conservation actions have been implemented continuously in Thailand.[90] The following actions were summarised in the LT-LEDS[91]:

- The National Forest Policy was adopted to ensure sustainable management of forests. To safeguard forests and enhance carbon sink, a target to increase green area cover to 55% (282,216 km2) of the total land area in 2037 has been adopted by the government, comprising 35% natural forest, 15% economic forest, and 5% urban and suburban green areas. Thailand aims to increase its green areas by 9% and plans to plant more trees in natural forests, economic forests, and urban areas.
- The involvement of local communities and private sectors is highlighted as a key strategy to protect Thai forests and enhance natural carbon sink. The Community Forest Act B.E. 2562 was adopted to empower local communities living in approximately 14,000 community forest areas to work with the government to manage and utilise natural resources in a sustainable way.
- To promote private sector participation in forest plantation, a voluntary carbon market for this sector known as Thailand Voluntary Emission Reduction Program for forestry and green space has been developed.

8. Forestry activities climate materiality assessment

Forestry and its associated activities are critical to the country's climate policy. Forests, peatlands, and wetlands store or absorb significant amounts of GHGs, which stabilise the ecosystem and provide climate regulation services. The proposed activities under this Taxonomy are related to the conservation of forests and associated ecosystems, which have the ultimate goal of maximising their ability to act as carbon sinks. These activities contribute not only to the main objective of climate change mitigation but also to the objective of protection and restoration of biodiversity and ecosystems.

[90] UNFCCC, “Thailand 2nd Updated NDC | UNFCCC,” n.d., https://unfccc.int/documents/620602.

[91] United Nations Framework Convention on Climate Change, "Thailand Long-Term Low Greenhouse Gas Emission Development Strategy (Revised Version)," November, 2022, https://unfccc.int/sites/default/files/resource/Thailand%20LT-LEDS%20%28Revised%20Version%29_08Nov2022.pdf

It is important to note that, according to the ISIC classification system, forestry is part of agriculture (and it will be treated as such in the Taxonomy), but in the IPCC 2006 classification system, forestry is part of the broader category that is called Land Use, Land-Use Change and Forestry (LULUCF). The table below shows the emissions of the most climate-material components of the LULUCF sector. The emissions of some activities in the LULUCF sector may be mitigated through practices currently included in the agriculture criteria of this Taxonomy.

Table 8 Land Use, Land-Use Change and Forestry sector emission profile

Subsector	IPCC 2006 Code	LULUCF sector GHG Emission and Sinks, total in GgCO2eq[92]	Corresponding proposed activities under the Thailand Taxonomy
Forest Land Remaining Forest Land	4A	-29,328.06	Sustainable forest management Forestry plantation Conservation, restoration, and maintenance of natural forests
Cropland Remaining Cropland	4B	-91,486.96	Sustainable perennial or non-perennial crops, incl. corn, mango, pineapples, banana etc. Growing of sugarcane Cultivation of rice Cultivation of rubber trees Cultivation of palm oil trees Cultivation of cassava
Land Converted to Cropland	4C	12,489.37	Sustainable forest management Sustainable perennial or non-perennial crops, incl. corn, mango, pineapples, banana etc. Growing of sugarcane Cultivation of rice Cultivation of rubber trees Cultivation of palm oil trees Cultivation of cassava

Source: Thailand's First Biennial Transparency Report[93]

[92] Negative value means the activity works as a sink for GHG emissions. The share of emission for each activity can't be given due to combination of positive and negative numbers

[93] UNFCCC, "Thailand's First Biennial Transparency Report under the United Nations Framework Convention on Climate Change," December 26, 2024, https://unfccc.int/sites/default/files/resource/THAILAND%E2%80%99S%20BTR1.pdf

The main objective of the Taxonomy in the forestry sector is to promote sustainable forest management practices, including forestry plantations, conservation, restoration, and maintenance of the existing forests, and to encourage certification schemes such as the Forest Stewardship Council[94] (FSC), the Program for the Endorsement of Forest Certification[95] (PEFC) or Premium T-VER[96]. Such certification schemes also prioritise aspects of biodiversity and highlight the imperative of supporting, conserving, and increasing biological diversity in forest ecosystems. The activities there are grouped as follows:

- **Sustainable forest management.** Forest management is the process of controlling the use or exploitation of forested land, including the extraction of timber and other forestry products. Sustainable forest management means the stewardship and use of forests and forest lands in such a way and at a rate that maintains their biodiversity, productivity, regeneration capacity, vitality and potential to fulfil, now and in the future, relevant ecological, economic and social, functions, at local, national, and global levels, and that does not cause damage to other ecosystems;
- **Forestry plantation**. A tree plantation, plantation forest, timber plantation or tree farm is a forest planted for high-volume production of wood, usually by planting one type of tree as a monoculture forest. Managed forests comprise trees that are planted (as opposed to naturally regenerated) which are of the same age and generally of the same species and are intended to maximise the production of timber and wood fibre;
- **Conservation, restoration, and maintenance.** Actions are needed to return existing natural forests to a healthy state and maintain them in this state. These include controlling invasive species, maintaining tree diversity, returning forest composition and structure to a more natural state, and pruning or removing underbrush that competes with trees.

As for the cropland-related sources of emission in **Table 4**, the activities that are proposed for addressing them in the taxonomy are covered by the agricultural section above, as well

[94] FSC, “Home | Forest Stewardship Council,” February 16, 2024, https://fsc.org/en.

[95] “PEFC - Programme for the Endorsement of Forest Certification,” n.d., https://www.pefc.org/.

[96] Thailand Greenhouse Gas Management Organization, "Premium T-VER," https://ghgreduction.tgo.or.th/en/premium-t-ver.html

as the “Sustainable Forest Management” activity and associated labelling schemes that will cover such emissions.

8.1 Forestry criteria scope

The Taxonomy has the following scope of objects and activities related to forestry[97]:

- **Natural or pristine forests -** natural forests are forest areas with many of the principal characteristics and key elements of a native ecosystem, such as complexity, structure, and biological diversity, including soil characteristics, flora, and fauna, in which all or almost all the trees are native species, not classified as plantations.
- **Plantation forestry** – planted forest that is intensively managed.
- **Sustainable forest management** – commercial management of natural forests in a sustainable manner for the production of timber.
- **Forest conservation** – non-commercial forestry activities designed to maintain the existing forest habitat in both area and quality. Activities will range from minimal interventions to active management and could include protection from deforestation risk, voluntary and mandatory set aside and active conservation efforts.
- **Forest restoration and rehabilitation** – non-commercial forestry activities designed to increase the area or improve the quality of existing forest habitat or to establish new forest stands. Activities will range from minimal interventions to active restoration including facilitating regeneration and restoration via natural or artificial means.

8.2 Forestry criteria methodological approach

Within the forestry sector, all activities were grouped into three large clusters, organised on the basis of their objectives, operations and application outcomes. The three groups of activities cover a wide range of practices within the forestry sector[98]:

- **Sustainable forest management.** Forest management is the process of controlling the use or exploitation of forested land, including extraction of timber and other forestry products. Sustainable forest management means the stewardship and use of

[97] Definition of forest can be found here: FAO, “SECOND EXPERT MEETING ON HARMONIZING FOREST-RELATED DEFINITIONS FOR USE BY VARIOUS STAKEHOLDERS,” n.d., https://www.fao.org/4/Y4171E/Y4171E10.htm.

[98] Monetary Authority of Singapore, “Singapore-Asia Taxonomy for Sustainable Finance,”2023, . https://www.mas.gov.sg/-/media/mas-media-library/development/sustainable-finance/singaporeasia-taxonomy-updated.pdf

forests and forest lands in such a way, and at a rate, that maintain their biodiversity, productivity, regeneration capacity, vitality and their potential to fulfil, now and in the future, relevant ecological, economic and social functions, at local, national, and global levels, and that does not cause damage to other ecosystems.

- **Forestry plantation**. A tree plantation, plantation forest, timber plantation or tree farm is a forest planted for high volume production of wood, usually by planting one type of tree as a monoculture forest. The type of managed forest in which the trees are planted (as opposed to naturally regenerated), of the same age and generally of the same species, and are intended to maximise the production of timber and wood fibre;
- **Conservation, restoration, and maintenance.** Actions needed to return existing natural forests to a healthy state and maintain them in this state. These include controlling invasive species, maintaining tree diversity, returning forest composition and structure to a more natural state, and pruning or removing underbrush that competes with trees.

The criteria have been designed to be applicable to granular green activities as well as to the wider level. For example, some of the criteria are suitable for green use of proceeds instruments, such as green bonds, where a bond is raised for a specific project or asset (e.g. nurseries), while others (e.g. the proxy certification standards) are applicable at the forestry project level and could be used as part of corporate disclosure to classify green revenues.

Compliance with the green threshold may be achieved by obtaining a recognised sustainable forest management certification label. This label is intended to confirm that the activities of the site operator will not lead to deforestation and that forest resources are used to the fullest extent and in the minimum amount necessary without disturbing the structure of the forest biosphere.

Eligible labels are as follows:

- **Thai Forest Certification Council (TFCC).** TFCC is a national Thai label for sustainable forestry aimed at promoting sustainable practices and combating climate change by preserving forests. Products bearing TFCC labels support the conservation of Thailand's diverse ecosystems and safeguard habitats crucial for biodiversity;
- **Forest Stewardship Council (FSC).** The FSC label promotes sustainable forestry practices ensuring that forests are managed appropriately. This allows the production

of timber, non-timber products and ecosystem services to maintain the forest's **biodiversity, productivity, and ecological processes**. Beyond environmental and ecosystem benefits, FSC-certified forest management also offers social advantages, providing long-term benefits to both local communities and society at large. It creates a significant incentive for local people to sustain forest resources (as referenced in the FSC Principles and Criteria for Forest Stewardship (FSC-STD-01-001 V5-3 EN)) FSC-certified forests prioritise the protection of endangered species and habitats, contributing to the overall health of ecosystems. Sustainable forestry practices endorsed by FSC labels reduce deforestation rates, helping to maintain the integrity of global carbon sinks;

- **Programme for the Endorsement of Forest Certification (PEFC)**. PEFC certification provides a mechanism to promote the sustainable management of forests and ensures that forest-based products reaching the marketplace have been sourced from sustainably managed forests.
- **Premium T-VER.** Premium T-VERs (Thailand Voluntary Emission Reductions) is a national labelling system for projects that reduce or remove greenhouse gas emissions. In the agriculture and forestry sectors these projects focus on sustainable land management, reforestation, afforestation, and improved agricultural practices that capture carbon or prevent emissions. Premium T-VERs undergo rigorous verification to ensure their environmental integrity and additionality, meaning they provide genuine emission reductions beyond business-as-usual activities.

If the certification is obtained, inputs indicated in green and amber categories are considered aligned with the Taxonomy.

Amber activities of the forestry sector of the Taxonomy are either not defined there is no need for them as there are no hard-to-abate activities that require gradual transition or for forestry plantations include certain activities that must be phased out by the Thailand Taxonomy sunset date (2040). These activities involve the use of chemical fertilisers, which is suboptimal compared to the use of organic or bio-fertilisers but may be an option if the latter are of limited availability.

Red activities are defined as either activities that directly threaten endangered or rare species, involve illegal harvesting, trigger deforestation, or are associated with the use of prohibited chemicals.

9. Forestry subsector criteria and thresholds

1. Sustainable forest management

Sector	Forestry
Activity	Sustainable forest management
ISIC Code	0200
	Management of planted and natural forests that ensures that forests supply goods and services to meet both present-day and future needs and contribute to sustainable development.
Objective	Climate change mitigation; Protection and restoration of biodiversity and ecosystems
Green	In order to be aligned with the green category of the Taxonomy, the forest manager must first obtain a valid certification (e.g., TFCC, FSC, PEFC, Premium T-VER) for an area where the management activity is taking place. If certification is obtained, the following activities or inputs are aligned with the Taxonomy as green[99]: ● Conservation, restoration, and maintenance of forest areas; ● Expenditures required to obtain the relevant certification; ● Creation and maintenance of nurseries[100] where seeds and seedlings are sourced from sustainably managed areas[101]; ● Adoption and maintenance of monitoring technology that enables the tracking of the forest extracts and their conservation status;

[99] At least one input should be selected for the alignment with the taxonomy

[100] Nurseries are defined any facility designated to produce tree seedlings grown under favourable conditions until they are ready for planting

[101] FAO, "Sustainable Forest Management," Food and Agriculture Organization of the United Nations, n.d., https://www.fao.org/sustainable-forests-management/en/.

	• Equipment and costs incurred by forest management activities – pre and post extraction, including primary processing that is either powered by renewable energy or appear amongst the most energy efficient in the country – as certified by local energy efficiency standards. • The use of diverse native plants that are suitable for the area to promote biodiversity. Community rights must be respected when implementing any of those practices[102].
Amber	N/A
Red	Exploitation of timber and non-timber products from any species would lead to or further its threatened conservation status is harmful to the objectives of climate change mitigation and protection and restoration of biodiversity and ecosystems.
Criteria reference	Climate Bonds Forestry criteria; Singapore Asia Taxonomy Criteria

2. Forestry plantation

Sector	Forestry
Activity	Forestry plantation
ISIC Code	0200
Description	Plantation of forests and associated activities
Objective	Climate change mitigation; Protection and restoration of biodiversity and ecosystems

[102] In line with the Regulation of the Community Forest Policy Committee on Governance, Maintenance, Utilization of Timber, and Utilization of Community Forest Areas B.E. 2566 (2023); The Regulation of the Community Forest Policy Committee on the Utilization of Products and Services from Community Forests B.E. 2566 (2023) and Community Forestry Act B.E. 2562 (2019).

Green	In order to be aligned with the green category of the Taxonomy, the forest manager must first obtain a valid certification (TFCC, FSC, PEFC or Premium T-VER) for an area where the forestry plantation activity is taking place[103]. If certification is obtained, the following activities or inputs are aligned with the Taxonomy as green[104]: ● Expenditures required to obtain the relevant certification; ● Use of organic and bio fertilisers; ● Use of physical and biocontrol of pathogens, pests, and weeds; ● Conservation, restoration, and maintenance; ● Creation and maintenance of nurseries[105] where seeds and seedlings are sourced in sustainably managed areas[106]; ● Adoption and maintenance of monitoring technology that enables the tracking of the forest extracts. ● Equipment and costs incurred by the above-mentioned activities (equipment must be powered by renewable energy or appear amongst the most energy efficient in the country – as certified by local energy efficiency standards); ● The use of nature-based solutions / integrated landscape management ● The use of diverse native plants that are suitable for the area to promote biodiversity

[103] Database for checking the suitable areas for planting forest in Thailand by The Royal Forest Department: https://site-matching.forest.go.th/

[104] At least one input should be selected for the alignment with the taxonomy

[105] Nurseries are defined any facility designated to produce tree seedlings grown under favourable conditions until they are ready for planting

[106] FAO, "Sustainable Forest Management," Food and Agriculture Organization of the United Nations, n.d., https://www.fao.org/sustainable-forests-management/en/.

	Community rights must be respected when implementing any of those practices[107].
Amber	In order to be aligned with the amber category of the Taxonomy, the forest manager must first obtain a valid certification (TFCC, FSC, PEFC or Premium T-VER) for an area where the management activity is taking place. The following activities or inputs are aligned with the Taxonomy as amber: ● Nutrient management plan[108] based solely on chemical fertilisers (available only until 2040) and all associated inputs; ● The phytosanitary management plan is based solely on chemicals (available only until 2040) and all associated inputs.
Red	● Use of chemicals listed in the Stockholm Convention 1a or 1b in the WHO classification of pesticides by hazard or not in compliance with the Rotterdam Convention is harmful to the objectives of climate change mitigation and protection and restoration of biodiversity and ecosystems; ● Operations on land that has been converted from high carbon stock (HCS55) after Jan 1, 2010 is harmful to the objective of climate change mitigation.
Criteria reference	Climate Bonds Forestry criteria; Singapore Asia Taxonomy Criteria

[107] In line with the Regulation of the Community Forest Policy Committee on Governance, Maintenance, Utilization of Timber, and Utilization of Community Forest Areas B.E. 2566 (2023); The Regulation of the Community Forest Policy Committee on the Utilization of Products and Services from Community Forests B.E. 2566 (2023) and Community Forestry Act B.E. 2562 (2019).

[108] A Nutrient Management Plan identifies actions and priorities that optimise the amounts, timing, and forms of nutrients used for optimal plant yield and minimises the potential for environmental impact: Government of Newfoundland and Labrador, "Nutrient Management Planning - Fisheries, Forestry and Agriculture," Fisheries, Forestry and Agriculture, August 10, 2021, https://www.gov.nl.ca/ffa/faa/agrifoods/land/soils/fertility/.

3. Conservation, restoration, and maintenance of natural forests

Sector	Forestry
Activity	Conservation, restoration, and maintenance of natural forests
ISIC Code	0200
Description	Actions needed to protect and assure that environmental services are provided by natural or pristine forests
Objective	Climate change mitigation; Protection and restoration of biodiversity and ecosystems
Green	In order to be aligned with the green category of the Taxonomy, the forest manager must first obtain a valid certification (TFCC, FSC, PEFC or Premium T-VER) for an area where the management activity is taking place. If certification is obtained, the following activities or inputs are aligned with the Taxonomy as green[109]: ● Expenditures required to obtain the relevant certification; ● Land acquisition with the purpose of conservation, restoration, and maintenance of natural forests; ● Any activities associated with the implementation of the Community Forests Act[110]; ● Any activity aimed at the restoration, protection, or proliferation of mangroves; ● Use of organic and biofertilisers for the purpose of restoration or replanting of natural forests; ● Use of physical and biocontrol of pathogens, pests, and weeds for the purpose of restoration or replanting of natural forests;

[109] At least one input should be selected for the alignment with the taxonomy

[110] Food and Agriculture Organization, "Land and Agricultural Reform Act B.E. 2518 (1975)," https://faolex.fao.org/docs/pdf/tha195322.pdf.

	• Nurseries[111] where seeds and seedlings are sourced in sustainably managed areas[112]; • Adoption and maintenance of monitoring technology that enables the tracking of natural forest extracts and their conservation status; • Equipment and costs incurred by the above-mentioned activities (equipment must be powered by renewable energy or appear amongst the most energy efficient in the country – as certified by local energy efficiency standards); • The use of nature-based solutions / integrated landscape management • The use of diverse native plants that are suitable for the area to promote biodiversity Community rights must be respected when implementing any of those practices[113].
Amber	N/A
Red	N/A
Criteria reference	Climate Bonds Forestry criteria; Singapore Asia Taxonomy Criteria

[111] Nurseries are defined as any facility designated to produce tree seedlings grown under favourable conditions until they are ready for planting.

[112] Food and Agriculture Organization, "Land and Agricultural Reform Act B.E. 2518 (1975)," https://faolex.fao.org/docs/pdf/tha195322.pdf.

[113] In line with the Regulation of the Community Forest Policy Committee on Governance, Maintenance, Utilization of Timber, and Utilization of Community Forest Areas B.E. 2566 (2023); The Regulation of the Community Forest Policy Committee on the Utilization of Products and Services from Community Forests B.E. 2566 (2023) and Community Forestry Act B.E. 2562 (2019).

Annex: Eligible agricultural practices

1. Sustainable perennial or non-perennial crops

Table 9 Eligible practices for Sustainable perennial or non-perennial crops, including corn, mango, pineapples, banana etc.

Title	Description	Eligible Inputs
Basic Practices		
Soil conservation	Carry out minimum soil preparation or tillage with permanent soil cover and use of green manures. On sloping soils, planting on contour lines through terracing, deep-rooting mulching, or other methods. Maintain soil biomass cover on at least 80% of the farm and prepare plots or soil according to soil conservation principles by reducing erosion or preventing soil degradation, preserving nutrient levels and soil properties. The goal is to maintain long-term soil fertility through practices such as cover cropping, crop rotation, contour planting, avoiding burning, and minimizing chemical use. Employ practices related to soil quality improvement and/or soil pH management, if applicable.	▪ Seeds, fertilisers, and light equipment for soil protection works ▪ Cover crops (seeds and seeding inputs) ▪ Living mulch ▪ Soil pH management ▪ The use of terracing techniques, either through rapid (radical) transformation or gradual (progressive) implementation, helps prevent soil erosion and enhances land use efficiency to boost productivity.
Irrigation management	Employ efficient irrigation methods such as drip or micro-sprinkler irrigation to deliver water directly to the root zone of perennial plants, minimizing water wastage and reducing the risk of foliar diseases. Schedule irrigation based on crop water requirements, soil moisture	Any inputs associated with implementing this practice.

Title	Description	Eligible Inputs
	levels, and weather conditions to optimise water use efficiency and prevent waterlogging or drought stress.	
Water management	Improve crop water productivity by comparing documented water yields per rai by crop type. OR Introduce water use efficiency in water systems in agricultural areas, irrigation (surface water and groundwater), and storage. Prevent water pollution with organic or chemical residues. Avoid excessive crop waterlogging with better drainage.	▪ Technologies for improvement of irrigation, storage, drainage systems, water remediation and treatment systems. ▪ Establishment of individual/community-based pumping system associated to small scale irrigation system solar energy powered with water saving technology like drip irrigation. ▪ Installation of efficient water management systems (rainwater harvesting systems, water rationing, reclaimed water and water recycling) ▪ Applying techniques of radical or progressive terraces against erosion and improving the efficient use of land for increased productivity
Fertiliser management	Nutrient management (including N-P-K) is carried out efficiently according to the needs of each crop (fertiliser type, quantity, method, and timing) and in line with soil quality. Organic or bio-fertilisers, or soil amendments, may be used, with an appropriate balance between chemical and organic fertilisers. Practical considerations are also taken into account (sources, available nutrients, and related transportation). The goal is to use organic fertilisers in	▪ Fertilisers in measured doses; ▪ Fertigation (a technique that allows the simultaneous application of water and fertilisers through the irrigation system), ▪ Fertiliser application equipment and materials that allow timely and efficient dosage (hardware and software). ▪ Soil fertility assessment such as Soil testing kits (LDD TEST KITS), laboratory analysis services, precision fertiliser application equipment, and training

Title	Description	Eligible Inputs
	combination with chemical fertilisers, while still considering crop yield.	programs on soil analysis and interpretation.
Pest and disease control	Apply Integrated Pest Management[114] (IPM) for pest and weed control. It is a selection of various pest control methods that are used together correctly at the right time, appropriate to the situation and area conditions. Employ IPM techniques, from planting to harvest, including disease- and pest-resistant crop varieties, planting at appropriate densities, releasing natural enemies, using traps, applying biological control agents, and using chemical pesticides correctly. This approach reduces incidence of insect pest, soil-borne and foliar diseases, and judicious use of pesticides to manage pests while minimizing environmental impact and reducing risk to people. Use bio-inputs, bio-pesticides, bio-fertilisers, and conservation biocontrol for organic production. In order to avoid biodiversity loss, the minimum number of chemical pesticides (if required) shall be used. Utilize automated laser weeding machines to reduce the use of chemical herbicides.	▪ Inputs for biological and physical pest and disease control, e.g., repellent plant seeds, traps, or nets; laser-based weed eliminators and blacklight traps; ▪ Disease-resistant plant varieties and seedlings
Management and processing of agricultural residues	▪ Avoid open field burning of agricultural biomass or residues after harvest during every	▪ Equipment for removal and collection of agricultural residues (e.g. straw balers, combined harvesters) and

[114] European Commission, "Integrated Pest Management (IPM)," EU - Food Safety, n.d., https://food.ec.europa.eu/plants/pesticides/sustainable-use-pesticides/integrated-pest-management-ipm_en

Title	Description	Eligible Inputs
	production cycle (in particular for rice, sugar cane and maise). Open field causes air pollution, fine particulate matter, greenhouse gas emissions, and destroys organic matter and nutrients in the soil. ▪ Incorporation into the soil if residues are allowed to degrade aerobically (min 30 days before flooding), removal, transport, storage, and processing of residues. Potential use of residues for composting and fertiliser production, mushroom production (rice straw), bioenergy and biogas production, animal feed, paper and pulp production.[115] ▪ Additionally, straw and stubble can be fermented using microorganisms to decompose the rice straw or processed into products like pelletized biomass[116], biochar, or charcoal.	transport, processing (increasing density) of residues, equipment for paper and pulp production from rice straw. ▪ The use of animal (cattle) feed needs to be assessed for potential life cycle CH4 emissions.
Compliance with agricultural standards	Implement actions required to obtain sustainable agriculture certification from Table: List of eligible certification schemes. (**Table 5**)	Inputs required to transform the farm in line with the requirements for the said certifications
Crop rotation (in transient or short-cycle crops)	Crop rotation is essential to prevent the buildup of pests and diseases in the soil. Rotating crops helps break	Seeds, seedlings, equipment, and labour to enable crop rotation.

[115] IRRI, "Rice Straw Management," International Rice Research Institute, May 31, 2019, https://www.irri.org/rice-straw-management.

[116] Technology Catalog Contributing to Production Potential and Sustainability in the Asia-Monsoon Region https://www.jircas.go.jp/sites/default/files/TechCatalog_v3.0_en.pdf

Title	Description	Eligible Inputs
	pest cycles, improves soil structure, and balances nutrient availability. In short-cycle crops, rotations are carried out according to a periodic programme depending on the region. Establish associated crops (including nitrogen fixation crops) for moisture management, fertility, and biological activity. Rotation with green manure to improve productivity can also be carried out.	
Intermediate Practices		
Utilize Agrimap for zoning agricultural land based on various factors such as soil type, crop suitability, and climate conditions	Agrimap is a tool that helps in dividing agricultural land into different zones based on specific criteria such as soil properties, topography, water availability, and historical yield data. This zoning allows for tailored management practices in each zone, optimizing input use and improving overall farm productivity. By understanding the unique characteristics of each zone, farmers can apply precise amounts of fertilisers, water, and other inputs, reducing waste and environmental impact.	Access to Agrimap software, training on using Agrimap, soil and climate data collection tools, GPS equipment for accurate mapping, and data analysis services.
Land levelling	Land levelling is a technology used to level fields by removing soil from high points of the field and depositing it in low points of the field. It improves crop establishment and enables crops to mature uniformly.	Electric, hybrid or biofuel-based equipment and machinery for laser land levelling (scraper and laser guidance system), LLL services

Title	Description	Eligible Inputs
	It reduces greenhouse gas emissions by saving energy, reducing cultivation time, and improving input-use efficiency. In a level field, water is distributed evenly, thus reducing the amount of time and volume of water needed for irrigation. Fertiliser use is more efficient as nutrient runoff from high points to low points in the field is less. Prior to using alternate wetting and drying, LLL avoids too much drying of high points in the field, resulting in a yield penalty during the AWD process.[117]	
Water harvest technologies (NBS)	Harvesting activities of rainwater to keep it for agriculture and livestock while fighting erosion. Improve solar energy use in irrigation to fight the effect of drought.	Knowledge, skills and equipment
Composting, organic and bio-fertilisers	▪ Utilise compost and organic fertilisers derived from plant residues, animal manure, or other organic sources. It enhances soil fertility and reduces dependence on chemical fertilisers. ▪ Utilise bio-fertilisers. This approach improves soil structure and microbial activity over time. ▪ If the use of inorganic fertilisers is unavoidable, it is crucial to apply them in prescribed doses, at the appropriate time, and precisely	▪ Equipment for soil improvement with organic and bio-fertilisers. ▪ Compost production equipment

[117] International Rice Research Institute, "Laser land leveling", n.d., https://ghgmitigation.irri.org/mitigation-technologies/laser-land-leveling

Title	Description	Eligible Inputs
	where the plants need them, to avoid excessive environmental contamination.	
Integrated weed management	Employ mulching, manual weeding, and integrated weed management techniques to control weed growth without relying solely on herbicides, which can have adverse effects on soil health and beneficial organisms. Weed control also help to reduce number of host plants for pests and plant diseases, or the accumulation of pests in the field.	Any inputs associated with implementing this practice.
Laser-based weed eliminators	Use of autonomous laser-based weed eliminators to cut the use of herbicides	Any inputs or technical assistance required to implement the practice
Implement precision agriculture technologies and practices	Precision agriculture involves using technology to monitor and manage field variability in crops. Techniques such as GPS-guided equipment, drones, sensors, and data analytics are used to optimize field-level management regarding crop farming. This approach enhances efficiency, productivity, and sustainability by ensuring that crops receive the precise number of inputs they need, such as water, fertilisers, and pesticides.	GPS and GNSS systems for field mapping and equipment guidance; auto-steering systems for tractors and harvesters; Variable Rate Technology (VRT) for site-specific application of seeds, fertilisers, and pesticides; remote sensing tools such as drones, satellites, and multispectral cameras for crop health monitoring and field analysis; yield monitoring systems installed on combines to generate yield maps during harvest; soil sensors and probes for real-time soil moisture and nutrient monitoring, precision sprayers with electronically controlled valves for targeted chemical application; smart irrigation systems including drip and automated sprinklers for optimized water management; data collection and analytics platforms (farm management

Title	Description	Eligible Inputs
		software) for decision support; artificial intelligence and machine learning tools for robotic operations and data-driven recommendations. Training for farmers on precision agriculture technologies.
Waste management and treatment of water contaminated with organic wastes	Appropriate collection, recycling, cleaning, and disposal of containers of pesticides and chemicals. Use post-harvest residues in the plantation. Develop a contaminated water treatment system to treat waste and nutrients.	Equipment, tools, inputs, and labour.
Traceability and certification	Traceability is a mechanism to ensure transparency in monitoring the environmental, economic, health and social consequences of agricultural production. It also allows exporters to quickly identify and withdraw any product with sanitary or phytosanitary problems or non-compliance with protocols. Certification of products can further enhance their safety, value and marketing potential.	Certification costs, technical assistance, monitoring systems, and internet connection costs
Advanced Practices		
Biodigesters	Implement biodigesters for compost and methane (biogas) production. The production of fertiliser and biogas from animal manure and other organic waste involves supporting collection areas for those in need of large biogas digesters. This can be achieved by gathering manure from multiple farmers and small-scale farms.	Equipment, supplies, and labour, *fixed dome digester,* including construction, improvement, and machinery for efficient wastewater treatment, such as sludge dewatering machines

Title	Description	Eligible Inputs
Improvement of genetic material in seeds and reproductive material. Biotechnology in agricultural production chains	Use improved seeds[118] and newly developed germplasm to increase yields and resilience to climate variability (these already exist for rice, maize, beans, and cassava). Use biotechnology for the production of agricultural inputs derived from residual crop biomass (e.g. biofertilisers and bio fungicides), as well as for the development of extracts and oils with pharmaceutical, food, cosmetic, industrial, etc. applications.	Inputs of these materials and technical assistance, including disease-resistant plant varieties.
Introduction of polycultures or intercropping of permanent crops	Introducing polycultures or crops associated with compatible species (preferably native timber, banana, or fruit trees) protects the soil, increases carbon and nitrogen fixation, diversifies production, and increases resilience to climate variability.	Seeds, seedlings, material for nursery development, and other inputs (equipment and labour).
Shift from transient crops or pasture to agroforestry systems (e.g. fruit or forestry) and agroforestry systems (NBS)	Shift land use towards systems with higher carbon sequestration (such as agroforestry systems), with better soil protection and congruence with its vocation.	Seeds, seedlings, material, including for nursery development, and other inputs (equipment and labour).
Payment for Environmental Services (PES)	Payment for Environmental Services (PES) is an advanced practice that involves compensating landowners or resource managers for maintaining or enhancing ecosystem services, such as water purification, carbon sequestration, or biodiversity	Technical assistance, costs of certification, costs of MRV

[118] Including new breeding technologies (GMO and others)

Title	Description	Eligible Inputs
	conservation. This mechanism creates financial incentives for environmental stewardship, aligning economic interests with conservation goals and promoting sustainable land management. PES helps ensure the long-term viability of natural ecosystems by embedding ecosystem service values into market structures	
Complementary adoptions		
Parametric Insurance for mitigating climate risks	Parametric insurance or insurance based on climatic indexes are contracts that stipulate compensation based on the occurrence of specified climatic events (severe cyclones, heatwaves, floods, landslides, mudslides among others).	Insurance based on climatic indexes – for e.g., estimated rainfall and temperature based on satellite imagery.
Capacity building on sustainable agriculture models	Strengthen training and capacity building of farmers on the nexus between the agriculture sector and climate change, financial literacy, and sustainable agriculture models that build adaptive capacity to climate impacts.	Reinforcement of capacity building programmes on sustainable agriculture models; promotion of technological development agreements with the private sector and human capital formation; training on green business.
Nature-based water management (NBS)	Nature-based[119] water management for water resources management involve the planned use of ecosystem services to improve water quantity and quality and increase resilience to climate change.	▪ The activity is identified as a flood risk reduction or a drought risk reduction measure either in a water use and protection management plan at the river basin scale. ▪ The activity identifies and address the risks of environmental degradation

[119] World Bank Group, "What You Need to Know About Nature-Based Solutions to Climate Change," World Bank, May 17, 2022, https://www.worldbank.org/en/news/feature/2022/05/19/what-you-need-to-know-about-nature-based-solutions-to-climate-change

Title	Description	Eligible Inputs
	Including measures to help prevent and protect against floods or droughts or phytoremediation.	related to the preservation of water quality and the prevention of water stress and deterioration of the status of affected water bodies to achieve good water status and ecological potential. ▪ The activity includes nature restoration or conservation actions that demonstrate specific ecosystem co-benefits, which contribute to achieving good water status. Local stakeholders are involved from the outset in the planning and design phase. The activity is based on the principles outlined by the IUCN Global Standard for nature-based solutions. Note 1: the activity takes into account National Biodiversity Strategies and Action Plans for the setting of nature conservation and restoration targets and for the description of the measures to achieve these targets. Note 2: A monitoring programme is in place to evaluate the effectiveness of a nature-based solution scheme in improving the status of the affected water body, achieving the conservation and restoration targets and in adapting to changing climate conditions.
Energy saving and clean energy	▪ Improve energy efficiency and use renewable sources, such as biogas and solar energy. ▪ Ensure adequate maintenance of equipment and improve energy efficiency. Replace traditional hydrocarbons-fuelled agricultural	Installation of renewable energy systems. Equipment maintenance services to improve efficiency. Procurement of electric, hybrid or biofuel-based agricultural machinery.

Title	Description	Eligible Inputs
	machinery with biogas-fuelled or electricity-fuelled	

2. Sustainable rice production

Table 10 Eligible practices for sustainable rice production

Title	Description	Eligible inputs
	Basic Practices	
Alternative wetting and drying	AWD entails periodic draining of the field to a certain threshold, usually 15 cm below the soil surface, and re-flooding. A perforated tube placed in the soil enables the farmer to monitor the water level below the soil surface to determine when to irrigate. The AWD technology has also been proven to effectively mitigate greenhouse gas emissions, specifically methane, from rice production by 30-70% without causing a yield reduction. During the dry phases, the methane-producing bacteria are inhibited, thus setting a condition to reduce GHG emission[120].	Equipment, Inputs, Labour, Monitoring equipment or services for water levels, installation of improved water management systems and tools, efficient irrigation systems
Soil conservation	Reduce machinery passes and apply minimum tillage to the soil. Tillage with adequate moisture and equipment. Manage cultivated areas according to the land conditions. For flat areas, ensure that paddy fields are levelled evenly. In gently sloping areas, plough along contour lines to prevent soil erosion, and plough when the soil has the right level of moisture. Practices like leaving rice stubble after harvest can also be implemented.	Seeds, fertilisers, and light equipment for soil work.
Water resources management	- Effective and efficient use of water and irrigation in rice reduces wastage. - Rainwater harvesting.	Membranes will cover the canal, flow meters, irrigation

[120] IRRI, "Alternate Wetting and Drying," IRRI- GHG Mitigation in Rice, n.d., https://ghgmitigation.irri.org/mitigation-technologies/alternate-wetting-and-drying; Technology Catalog Contributing to Production Potential and Sustainability in the Asia-Monsoon Region https://www.jircas.go.jp/sites/default/files/TechCatalog_v3.0_en.pdf

Title	Description	Eligible inputs
	- Alternate Wetting and Drying (AWD)[121] irrigation	systemisation, control, and water quality equipment. Storage tanks and ponds.
Pest and disease control	▪ Plants live fences with native species as biological barriers. Integrated pest and disease management. ▪ Biological control.	Plant material, seeds, native seedlings. Materials required in biological control.
Prolonged midseason drainage	Mid-season drainage involves the removal of surface flood water from the rice crop for about seven days towards the end of tillering. Mid-season drainage reduces methane emissions of paddy fields, with reductions ranging from 7 to 95%	Drainage infrastructure, canals and associated tools
Crop diversification and rotation	▪ Rotation crops to be planted before or after rice (including e.g. mung beans, corn, potato, and others) ▪ Switch to perennial crops, e.g. in line with Thailand's 3R policy	▪ Inputs for rotation crops or inter cropping including seeds, labour, harvesting and other services covering the full crop cycle ▪ Inputs for switch to perennial crops to follow self sufficient economy philosophy, covering seedlings, labour, establishment costs, etc covering full crop cycle.
Intermediate Practices		
Rice variety diversification (drought- and heat-tolerant strains and short-duration varieties)	Diversification of sow-certified rice seed varieties including new authorized RD varieties with increased resilience towards climate impacts, shorter growing duration or higher yield	Certified and high-quality seeds and related inputs

[121] IRRI, "Alternate Wetting and Drying," IRRI- GHG Mitigation in Rice, n.d., https://ghgmitigation.irri.org/mitigation-technologies/alternate-wetting-and-drying

Title	Description	Eligible inputs
Laser land levelling	Laser land levelling (LLL) is a laser-guided technology used to level fields by removing soil from high points of the field and depositing it in low points of the field. It improves crop establishment and enables crops to mature uniformly. It reduces greenhouse gas emissions by saving energy, reducing cultivation time, and improving input-use efficiency. In a level field, water is distributed evenly, thus reducing the amount of time and volume of water needed for irrigation. Fertiliser use is more efficient as nutrient runoff from high points to low points in the field is less. Prior to using alternate wetting and drying, LLL avoids too much drying of high points in the field, resulting in a yield penalty during the AWD process[122].	Electric, hybrid or biofuel-based equipment and machinery for laser land levelling (scraper and laser guidance system), LLL services
Dry Direct-Seeded Rice (DSR)	In this technology, rice is directly seeded in the main plot with 2- or 4-wheel tractor/power tiller-drawn seed drills. DSR can be readily adopted by small farmers as well as large farmers, provided that the required machinery is locally available. The technology has a lower water requirement for crop establishment as puddling is not required in this method. The soil in DSR remains aerobic most of the time during the season, which reduces methane emissions as well as increases resilience to drought and high yields.	Electric, hybrid or biofuel-based machinery, equipment, and services required to implement the practice as well as knowledge and skills.

[122] International Rice Research Institute, "Laser land levelling", n.d., https://ghgmitigation.irri.org/mitigation-technologies/laser-land-leveling

Title	Description	Eligible inputs
Composting, organic and bio-fertilisers	▪ Utilise compost and organic fertilisers derived from plant residues, animal manure, or other organic sources. It enhances soil fertility and reduces dependence on chemical fertilisers. ▪ Utilise bio-fertilisers. This approach improves soil structure and microbial activity over time. If non-organic fertilisers are unavoidable, keep in mind that they should be applied in measured doses when and where the crop requires them, avoiding excessive contamination of the environment.	Equipment for soil improvement with organic and bio-fertiliser. Equipment for composting.
Machinery and accessories providing alternatives to burning waste	Adopt machines and methods of processing residues that allow to completely eliminate burning of agricultural residues.	Tools, labour, and electric, hybrid or biofuel-based machinery/accessories provide alternatives to burning waste, such as electric, hybrid or biofuel-based mechanised harvesters.
Advanced Practices		
Biodigesters	Implement biodigesters for compost and methane (biogas) production. The production of fertiliser and biogas from animal manure and other organic waste involves supporting collection areas for those in need of large biogas digesters. This can be achieved by gathering manure from multiple farmers and small-scale farms.	Equipment, supplies, and labour, *fixed dome digester,* including construction, improvement, and machinery for efficient wastewater treatment, such as sludge dewatering machines
Straw and stubble management (SSM)	▪ Straw and stubble collection and removal for valorization purposes ▪ Incorporating straw and stubble into the soil while allowing sufficient time for aerobic decomposition	▪ Harvesting and baling services for straw collection including equipment cost, labour, transport and storage ▪ Costs for incorporation services and equipment

Title	Description	Eligible inputs
	▪ Decomposition in the field using effective microorganisms (EM) for compost and methane (biogas) production ▪ For removal options, selling the straw and stubble to buyers or own use, including e.g. the following ▪ Composting of straw ▪ Mushroom production from straw ▪ Industrial uses of straw (e.g. pulping or conversion into biofuels) and biomass-to-energy uses	▪ Costs for effective microorganisms (EM) inputs and related costs for application services, labour for decomposition of straw and stubble in-field ▪ Inputs for compost production from rice straw including equipment, services, labour, manure for mixing, biodigesters ▪ Inputs for value added products, such as biomass, packaging, and mushroom production and processing from rice straw, e.g. sheds and equipment pieces, labour, substrate and fungal strains and other inputs
Drones for agricultural use	Employ unmanned aerial vehicle used in agriculture operations, mostly in yield optimization and in monitoring crop growth and crop production. Agricultural drones provide information on crop growth stages, crop health, and soil variations.	Drones, auxiliary equipment, training
Precision agriculture equipment	Precision agriculture is a farming management strategy based on observing, measuring and responding to temporal and spatial variability to improve agricultural production sustainability. It is used in both crop and livestock production. Precision agriculture often employs technologies to automate agricultural operations, improving their diagnosis, decision-making or performing. The goal of precision agriculture research is to	Any precision agriculture equipment contributing to the objectives of the Taxonomy. (Please refer to **Table 9** under Precision Agriculture Practices.)

Title	Description	Eligible inputs
	define a decision support system for whole farm management with the goal of optimizing returns on inputs while preserving resources.	
Agro-met advisory services	▪ Targeted advisory service and data in connection with farm and weather advisory ▪ GIS or drone-based analysis and monitoring for agricultural recommendations	▪ Farm planning with Agro-met information and smart farm management systems, smart sensors ▪ Data services and subscription fees for climate-smart agricultural advisory services
Agrosilvopastoral systems (NBS)	Implement integrated farming systems that combine tree crops, annual crops, and livestock production on the same area of land. These systems aim to maximise the productivity and sustainability of land use by harnessing complementary interactions between different components.	Seeds, seedlings, fertilisers, animals, and other supplies.

Complementary Adoptions	
▪ **Rice harvesters** ▪ **Infrastructure and equipment to produce bio-inputs in general.** ▪ **Establishment of forest plantations (NBS)** ▪ **Maintenance of forest plantations (NBS)**	▪ Efficient engines ▪ Efficient pumping systems ▪ Modernisation of the cooling systems ▪ Energy saving and clean technology

3. Sustainable sugarcane production

Table 11 Eligible practices for sustainable sugarcane production

Title	Description	Eligible inputs
	Basic Practices	
Conservation tillage	Practice minimum tillage or no-till farming to improve soil structure, reduce erosion, and enhance organic matter content. Covering cropping during fallow periods helps protect the soil and improve its fertility. Minimising soil disturbance through techniques like no-till or reduced tillage helps to retain soil moisture, prevent erosion, and maintain soil structure, leading to improved soil health and reduced carbon emissions.	Seedlings, seeds, fertilisers, light equipment for soil work, planting materials such as stem cuttings
Pest and disease control	▪ Plants live fences with native species as biological barriers. ▪ Integrated pest and disease management. ▪ Biological control.	▪ Plant material, seeds, native seedlings. ▪ Materials required in biological control. ▪ Insect pest control
Water resources management	Enhance water use efficiency in sugarcane production management by comparing the effectiveness of water use per unit area. Introduce water use efficiency in irrigation. Prevent water contamination with organic or chemical residues. Avoid excessive crop waterlogging with better drainage. Manage wastewater using natural based solution like constructed wetland.	▪ Systemisation of irrigation, control, and water quality equipment. ▪ Storage tanks and ponds. ▪ Efficient water control systems tailored to the available water supply, including quality water management equipment. ▪ Natural water sources (canals, natural ponds) and constructed water sources (reservoirs, shallow wells, boreholes).

Title	Description	Eligible inputs
Crop rotation	Crop rotation is essential to prevent the buildup of pests and diseases in the soil. Rotating crops helps break pest cycles, improves soil structure, and balances nutrient availability. Implement rotations according to a periodic program based on the region; then, establish associated crops for moisture management, fertility, and biological activity.	Seeds, seedlings, equipment, and labour for crop rotation.
Intermediate Practices		
Land levelling	Land leveling is a process used in agriculture to create a uniformly flat or gently sloping surface. This technique involves reshaping the natural contours of the land to eliminate variations in elevation, thereby ensuring that the surface is even and suitable for specific purposes. The levelled ground makes it easier to use electric, hybrid or biofuel-based agricultural machinery for harvesting sugarcane.	Any input associated with the implementation of the practice.
Composting, organic and bio-fertilisers	▪ Utilise compost and organic fertilisers derived from plant residues, animal manure, or other organic sources. It enhances soil fertility and reduces dependence on chemical fertilisers. ▪ Utilise bio-fertilisers. This approach improves soil structure and microbial activity over time. If non-organic fertilisers are unavoidable, keep in mind that they should be applied in measured doses when and where the crop requires them, avoiding excessive contamination of the environment.	● Equipment for soil improvement with organic and bio-fertiliser. ● Equipment for composting. ● Tools and additives for composting practices
Replacement of slash and burn with	Adopt chop and mulch systems or mechanised sugarcane harvesting. Manage	Tools, labour, and electric, hybrid or biofuel-based

Title	Description	Eligible inputs
sustainable practices	sugarcane leaves and tops by selling them to processing operators, chopping into the soil, or use them as mulch to avoid burning.	machinery/accessories provide alternatives to burning waste, such as mechanised harvesters.
Advanced Practices		
Biodigesters	Implement biodigesters for compost and methane (biogas) production.	Equipment, supplies, and labour, *fixed dome digester,* including construction, improvement, and machinery for efficient wastewater treatment, such as sludge dewatering machines
Genetic improvement of seedlings and reproductive material	Plant-certified varieties adapted to the region.	Certified and adapted plant material.
Drones for agricultural use	Employ unmanned aerial vehicle used in agriculture operations, mostly in yield optimization and in monitoring crop growth and crop production. Agricultural drones provide information on crop growth stages, crop health, and soil variations.	Drones, auxiliary equipment, training
Precision agriculture equipment	Precision agriculture is a farming management strategy based on observing, measuring and responding to temporal and spatial variability to improve agricultural production sustainability. It is used in both crop and livestock production. Precision agriculture often employs technologies to automate agricultural operations, improving their diagnosis, decision-making or performing. The goal of precision agriculture research is to define a decision support system for whole farm	Any precision agriculture equipment contributing to the objectives of the Taxonomy. (Please refer to **Table 9** under Precision Agriculture Practices.)

Title	Description	Eligible inputs
	management with the goal of optimizing returns on inputs while preserving resources.	
Agrosilvopastoral systems (NBS)	Implement integrated farming systems that combine tree crops, annual crops, and livestock production on the same area of land. These systems aim to maximise the productivity and sustainability of land use by harnessing complementary interactions between different components.	Seeds, seedlings, fertilisers, animals, and other supplies.
Complementary Adoptions		
▪ Infrastructure and equipment to produce bio-inputs in general. ▪ Efficient pumping systems ▪ Energy saving and clean technology		▪ Efficient engines ▪ Modernisation of the cooling systems ▪ Establishment of forest plantations (NBS) ▪ Maintenance of forest plantations (NBS)

4. Sustainable oil palm production

Table 12 Eligible practices for sustainable oil palm production

Title	Description	Eligible inputs
Basic Practices		
Soil conservation	Reduce machinery use. Reduce any potential disturbance to the soil.	Light equipment for soil works.
Intercropping, cover cropping and mulching	Intercropping refers to the practice of growing different crops together to optimize land use, improve soil health, and enhance overall farm productivity. Planting cover crops or using mulch between palm oil rows helps to suppress weeds, retain soil moisture, and improve soil health. This reduces the need for herbicides and synthetic fertilisers while promoting natural nutrient cycling.	Seeds, fertilisers and other supplies, oil palm fronds, empty fruit bunches
Pest and disease control	Integrated pest and disease management. Biological control.	Materials required in biological control.
Intermediate Practices		
Composting, organic and bio-fertilisers	▪ Utilise compost and organic fertilisers derived from plant residues, animal manure, or other organic sources. It enhances soil fertility and reduces dependence on chemical fertilisers. ▪ Utilise bio-fertilisers. This approach improves soil structure and microbial activity over time. If non-organic fertilisers are unavoidable, keep in mind that they should be applied in measured doses when and where the crop requires them, avoiding excessive contamination of the environment.	▪ Equipment for soil improvement with organic and bio-fertiliser. ▪ Equipment for composting.
Machinery and accessories providing	Adopt machines and methods of processing residues that allow to completely eliminate burning of agricultural residues.	▪ Tools, labour, and electric, hybrid or biofuel-based machinery/accessories

Title	Description	Eligible inputs
alternatives to burning agricultural residues	Option: Pyrolysis of agricultural residues to produce biochar, which enhances soil quality and contributes to carbon sequestration.	provide alternatives to burning waste, such as mechanised harvesters. ▪ Machinery or kilns designed for the pyrolysis of agricultural residues to produce biochar. Such machines and kilns must have integrated emission reduction measures.
Traceability and certification	Traceability is a mechanism to ensure transparency in monitoring the environmental, economic, health and social consequences of agricultural production. It also allows exporters to quickly identify and withdraw any product with sanitary or phytosanitary problems or non-compliance with protocols. Certification of products can further enhance their safety, value and marketing potential.	Certification costs, technical assistance, monitoring systems, and internet connection costs
Advanced Practices		
Biodigesters	Implement biodigesters for compost and methane (biogas) production.	Equipment, supplies, and labour, fixed dome digester, including construction, improvement, and machinery for efficient wastewater treatment, such as sludge dewatering machines
Biodiversity conservation	Preserving and restoring natural habitats within and around oil palm plantations promotes biodiversity conservation and ecosystem resilience. This can include maintaining riparian buffers, establishing wildlife corridors, and planting native tree species.	Seedlings, fertilisers, equipment, and other supplies.
Plant genetic improvement	Certified plant varieties that have been developed and adapted to specific environmental conditions.	Plant materials that are certified and improved for suitability to the environment.

Title	Description	Eligible inputs
and propagation materials		
Drones for agricultural use	Employ unmanned aerial vehicle used in agriculture operations, mostly in yield optimization and in monitoring crop growth and crop production. Agricultural drones provide information on crop growth stages, crop health, and soil variations.	Drones, auxiliary equipment, training
Precision agriculture equipment	Precision agriculture is a farming management strategy based on observing, measuring and responding to temporal and spatial variability to improve agricultural production sustainability. It is used in both crop and livestock production. Precision agriculture often employs technologies to automate agricultural operations, improving their diagnosis, decision-making or performing. The goal of precision agriculture research is to define a decision support system for whole farm management with the goal of optimizing returns on inputs while preserving resources.	Any precision agriculture equipment contributing to the objectives of the Taxonomy. (Please refer to **Table 9** under Precision Agriculture Practices.)
Agrosilvopastoral systems (NBS)	Implement integrated farming systems that combine tree crops, annual crops, and livestock production on the same area of land. These systems aim to maximise the productivity and sustainability of land use by harnessing complementary interactions between different components.	Seeds, seedlings, fertilisers, animals, and other supplies.
Complementary Adoptions		
Nature-based water management (NBS)	▪ The activity is identified as a flood risk reduction or a drought risk reduction measure either in a water use and protection management plan at a river basin scale. ▪ The activity identifies and address the risks of environmental degradation related to the preservation of water quality and the prevention of water stress	

Title	Description	Eligible inputs
	and deterioration of the status of affected water bodies to achieve good water status and ecological potential. ▪ The activity includes nature restoration or conservation actions that demonstrate specific ecosystem co-benefits, which contribute to achieving good water status. Local stakeholders are involved from the outset in the planning and design phase. The activity is based on the principles outlined by the IUCN Global Standard for nature-based solutions. Note 1: the activity takes into account National Biodiversity Strategies and Action Plans for the setting of nature conservation and restoration targets and for the description of the measures to achieve these targets. Note 2: A monitoring programme is in place to evaluate the effectiveness of a nature-based solution scheme in improving the status of the affected water body, achieving the conservation and restoration targets and in adapting to changing climate conditions.	
▪ **Infrastructure and equipment to produce bio-inputs in general** ▪ **Establishment of forest plantations (NBS)** ▪ **Maintenance of forest plantations (NBS)** ▪ **Efficient engines** ▪ **Efficient pumping systems** ▪ **Modernisation of the cooling systems** ▪ **Energy saving and clean technology**		

5. Sustainable rubber trees production

Table 13 Eligible practices for sustainable rubber trees production

Title	Description	Eligible inputs
Basic Practices		
Soil conservation (NBS)	Implement erosion control measures such as contour planting, terracing, or vegetative barriers to prevent soil erosion and maintain soil fertility. Conserving soil health is critical for long-term rubber productivity.	Light equipment for soil works.
Responsible chemical use	When synthetic pesticides and fertilisers are necessary, use them judiciously and follow best management practices to minimise environmental impact and human exposure. Proper storage, handling, and disposal of chemicals are essential to prevent contamination of soil and water resources.	Precision equipment, storage facilities, disposal systems and other supplies.
Pest and disease control	Integrated pest and disease management. Biological control.	Materials required in biological control.
Intermediate Practices		
Composting, organic and bio-fertilisers	▪ Utilising compost and organic fertilisers derived from plant residues, animal manure, or other organic sources enhances soil fertility and reduces dependence on chemical fertilisers. ▪ Utilise bio-fertilisers. This approach improves soil structure and microbial activity over time. If non-organic fertilisers are unavoidable, keep in mind that they should be applied in measured doses when and where the crop requires them, avoiding excessive contamination of the environment.	Equipment for soil improvement with organic and bio-fertiliser. Equipment for composting.
Water resources management	Efficient water management practices, such as drip irrigation or rainwater harvesting,	▪ Drip irrigation and drainage systems.

Title	Description	Eligible inputs
	help optimise water use and minimise water wastage (loss). This is particularly important in regions where water resources are limited or prone to drought.	▪ Storage tanks and ponds.
Traceability and certification	Implement traceability systems and obtain certification from reputable organisations such as the Forest Stewardship Council (FSC) or the Rainforest Alliance. Certification ensures compliance with sustainability standards and demonstrates a commitment to responsible rubber production.	Verification and compliance costs.
Machinery and accessories providing alternatives to burning waste	Adopt machines and methods of processing residues that allow to completely eliminate burning of agricultural residues.	Tools, labour, and electric, hybrid or biofuel-based machinery/accessories provide alternatives to burning waste, such as mechanised harvesters.
Advanced Practices		
Biodigesters	Implement biodigesters for compost and methane (biogas) production.	Equipment, supplies, and labour, *fixed dome digester,* including construction, improvement, and machinery for efficient wastewater treatment, such as sludge dewatering machines
Biodiversity conservation	Preserving and restoring natural habitats within and around rubber plantations to promote biodiversity and ecosystem resilience. This can include maintaining riparian buffers, establishing wildlife corridors, and planting native tree species.	Seedlings, fertilisers, equipment, and other supplies.
Genetic improvement of reproductive material	Plant certified seedlings varieties adapted to the region.	Certified and adapted plant material.

Title	Description	Eligible inputs
Drones for agricultural use	Employ unmanned aerial vehicle used in agriculture operations, mostly in yield optimization and in monitoring crop growth and crop production. Agricultural drones provide information on crop growth stages, crop health, and soil variations.	Drones, auxiliary equipment, training
Precision agriculture equipment	Precision agriculture is a farming management strategy based on observing, measuring and responding to temporal and spatial variability to improve agricultural production sustainability. It is used in both crop and livestock production. Precision agriculture often employs technologies to automate agricultural operations, improving their diagnosis, decision-making or performing. The goal of precision agriculture research is to define a decision support system for whole farm management with the goal of optimizing returns on inputs while preserving resources.	Any precision agriculture equipment contributing to the objectives of the Taxonomy. (Please refer to **Table 9** under Precision Agriculture Practices.)
Agrosilvopastoral systems (NBS)	Integrate rubber cultivation with other crops, trees, and livestock to enhance biodiversity, soil health, and ecosystem resilience. Agroforestry systems can provide additional income sources for farmers while reducing the risk of soil erosion and nutrient depletion.	Seeds, seedlings, fertilisers, animals, and other supplies.
Complementary Adoptions		
Nature-based water management (NBS)	▪ The activity is identified as a flood risk reduction or a drought risk reduction measure either in a water use and protection management plan at a river basin scale. ▪ The activity identifies and address the risks of environmental degradation related to the	

Title	Description	Eligible inputs
		preservation of water quality and the prevention of water stress and deterioration of the status of affected water bodies to achieve good water status and ecological potential. ▪ The activity includes nature restoration or conservation actions that demonstrate specific ecosystem co-benefits, which contribute to achieving good water status. Local stakeholders are involved from the outset in the planning and design phase. The activity is based on the principles outlined by the IUCN Global Standard for nature-based solutions. Note 1: the activity takes into account National Biodiversity Strategies and Action Plans for the setting of nature conservation and restoration targets and for the description of the measures to achieve these targets. Note 2: A monitoring programme is in place to evaluate the effectiveness of a nature-based solution scheme in improving the status of the affected water body, achieving the conservation and restoration targets and in adapting to changing climate conditions.
▪ Infrastructure and equipment to produce bio-inputs in general. ▪ Establishment of forest plantations ▪ Maintenance of forest plantations		▪ Efficient engines ▪ Efficient pumping systems ▪ Modernisation of the cooling systems ▪ Energy saving and clean technology

6. Sustainable cassava production

Table 14 Sustainable practices for cassava production

Practice	Description	Eligible inputs
Basic Practices		
Soil conservation and contour planting	Implementing contour planting helps reduce soil erosion and water runoff in sloped areas, improving soil moisture retention. This practice involves planting cassava along natural land contours, slowing down water movement and preventing nutrient loss. It is a cost-effective approach to maintaining soil structure and long-term productivity.	Contour mapping tools, basic training for farmers, and stakes for marking planting rows.
Organic mulching	Applying organic mulch, such as crop residues or leaves, around cassava plants helps retain soil moisture, suppress weeds, and enhance soil organic matter. Mulching reduces temperature fluctuations, minimizing stress on plants and improving root development.	Crop residues, dried leaves, coconut husks, or straw.
Timely and balanced fertilization	Using appropriate amounts of organic and inorganic fertilisers at key growth stages ensures optimal cassava development while preventing nutrient imbalances and soil degradation. Proper fertilization enhances root yield and improves soil fertility over time.	Compost, farmyard manure, NPK fertilisers, and soil testing kits.
Intermediate Practice		
Intercropping with legumes	Growing cassava alongside nitrogen-fixing legumes (such as peanuts or cowpeas) improves soil fertility and reduces the need for synthetic fertilisers. This practice also enhances biodiversity and reduces the risk of pests and diseases by disrupting monoculture cycles.	Legume seeds, knowledge of compatible planting arrangements, and basic irrigation management.
Improved pruning techniques	Improved pruning techniques in cassava can enhance root quality and potentially increase tuber size and starch content by directing the plant's energy toward root development. Pruning also facilitates better air circulation and light penetration, reducing disease risk and supporting healthier plant growth. Additionally, timely pruning can	High-quality pruning tools, such as pruning saws and loppers. Demonstration plots to teach pruning techniques.

Practice	Description	Eligible inputs
	make harvesting easier and extend the shelf-life of cassava roots by minimizing postharvest deterioration.	Access to professional pruning services for initial farm setup.
Cover cropping	Growing cover crops, such as legumes or grasses, during the off-season helps prevent soil erosion, suppress weeds, and enhance soil organic matter. This practice also improves soil moisture retention and reduces the risk of pests and diseases by creating a more resilient soil ecosystem.	Cover crop seeds (e.g., cowpea), land preparation tools, and knowledge of rotation schedules.
Advanced Practice		
Precision agriculture and digital monitoring	Using remote sensing, drones, and soil sensors allows farmers to monitor crop health, detect nutrient deficiencies, and apply inputs precisely where needed. This approach optimizes yields while minimizing resource waste and environmental impact.	Drones, GIS software, soil sensors, and farmer training programs.
Bioinput-based pest and disease management	Implementing integrated pest and diseases management (IPM and IDM) using biopesticides, beneficial insects, and microbial inoculants reduces reliance on chemical pesticides. This practice enhances soil health and prevents pest resistance while supporting biodiversity in cassava fields.	Biopesticides, beneficial insect breeding stations, microbial inoculants, and training for farmers on IPM techniques.
Agroforestry systems	Integrating cassava cultivation with trees and shrubs enhances biodiversity, improves soil health, and provides additional income sources through diversified products. Agroforestry systems also help mitigate climate risks by increasing carbon sequestration and improving microclimate conditions.	Agroforestry species, tree seedlings, knowledge of planting arrangements, and pruning tools.
Complementary Adoptions		

Practice	Description	Eligible inputs
▪ Establishment and strengthening of organizations for implementing basic sustainable practice. ▪ Energy savings and clean energy ▪ Electric, hybrid or biofuel-based machinery and accessories for minimum and conservation tillage ▪ Biodigester machinery and equipment		▪ Efficient engines ▪ Efficient pumping systems ▪ Modernization of cooling systems ▪ Live fences ▪ Conservation tillage ▪ Silvopastoral systems

7. Sustainable livestock production

Table 15 Eligible practices for Sustainable livestock production

Title	Description	Eligible Inputs
Basic Practices		
Compliance with agricultural standards	Implement actions required to obtain sustainable agriculture certification from **Table 5**.	Inputs required to transform the farm in line with the requirements for the said certifications
Efficient management and protection of water sources	Collect, store, and conserve water to provide livestock with a clean and reliable source during seasonal and climatic variations. Harvest water and build livestock aqueducts.	Drinking troughs, hoses, floats, buoys, pumps, storage tanks and piping; construction of water ponds, reservoirs, water storage tanks, or other systems that promote efficient water use, enabling production to continue during water shortages.
Water management	Protect natural water sources from direct access by livestock, e.g. by isolating riparian forest areas, planting native species for stream restoration, preventing diversion of rivers and streams, and preserving springs and wetlands.	Inputs required to implement the practice
Intermediate Practices		
Animal welfare (excluding health aspects)	Following the above practices provides a favourable environment for livestock, through sufficient and varied diet, shade, accessible watering places, natural windbreaks, vaccination for livestock and space for herd social activities.	Technical assistance on animal welfare, vaccination, and related inputs.
Organic and green manures, manure, and effluent utilisation	Seize good management of manure, urine, and other organic residues (especially on specialised dairy farms) under a manure management plan.	Equipment, material, tools, and inputs (e.g. composting, seedlings, seeds, labour, vermicomposting).

Title	Description	Eligible Inputs
	Use cover crops and crops (sorghum, maise, potato) as green manure. Instant dung loads on grassland, together with fodder trees and shrubs, promote soil biodiversity (e.g. dung beetles, earthworms, etc.); incorporating faeces and urine fertilises and decompacts the soil. Decrease nitrous oxide and methane emissions from manure. Reduce accumulation in animal manure pits, focusing on minimizing contamination at the initial stage before it enters the treatment system.	
Pasture and fodder management	Improve the quality and quantity of pastures and forages with nutritional and metabolic benefits for livestock (FAO principles / tailored to the type of livestock being raised). Stable native pastures allow natural regeneration through rotational grazing. Where conditions are more degraded, new grasses and varieties of grasses and legumes should be introduced to increase forage supply. Incorporate shrubs and trees that provide browseable (edible) fruits and leaves for livestock, accelerating soil recovery and favouring the wildlife population. If pasture cover is less than 80% of the land and there is minimal tree and shrub cover, the soil is considered degraded. With pasture and forage management, an increase in average annual yield of at least 30% per rai is expected within three years compared	Purchase and sowing of seeds of improved or natural varieties of grasses and native creeping legumes, selected according to soil and climatic conditions in the region. Network of nurseries (including on-site nurseries) of native or focal tree material for protection. ▪ Soil suitability with composted material ▪ Irrigation systems, if applicable.

Title	Description	Eligible Inputs
	to the baseline scenario, using the supply calculation based on gauging (i.e. in kg dry biomass per m2 per year).	
Balanced nutrition and local feed sources	Providing a well-balanced diet with locally available feed ingredients optimizes growth rates and feed conversion efficiency while reducing dependency on imported feed. Using alternative protein sources such as cassava meal or insect-based feeds can lower costs and environmental impacts.	Locally sourced grains, mineral supplements, feed formulation guidelines, and feed mixers.
Advanced Practices		
Biodigesters, aquatic plant and aquaculture channels, oxidation ponds, composting and vegetative systems	Integrated management of manure and urine from livestock barns and enclosures with biodigesters, composting, and other technologies, thus avoiding pollution, effectively managing waste and minimising methane emissions. Produce gas, fertilisers, and compost from manure and other organic waste.	Biodigesters, *fixed dome digester,* supplies and installation. Construction, upgrade, and procurement of machinery to enhance wastewater treatment efficiency, such as sludge dewatering presses.
Capacity building on sustainable livestock models	Strengthen training and capacity building of farmers on sustainable livestock models, including through farmers' field schools	Reinforcement of capacity-building programmes on sustainable livestock models; promotion of technological development agreements with private sector and human capital formation
Crop residues utilisation	Crop residue utilisation in livestock feeding is an important climate-smart agricultural practice, especially for	Crop residue utilisation in livestock feeding

Title	Description	Eligible Inputs
	farmers doing integrated crop production and livestock.	
Fodder hedges	Plant shrub species at high densities in linear rows, which act as fodder for livestock while retaining soil and soil moisture. They are often combined with live fences in the division of paddocks.	▪ Planting of hedges of proven species (e.g. Sesbania, Leucaena, Erythrina, Pterocarpus, and Gliricidia, among others). ▪ Drought-tolerant fodder crops ▪ Fodder conservation by: - Silage technology - Hay technique - Hydroponic fodder systems
Improved breeds	Genomic-based improvement of cattle and other livestock in response to climate change can contribute to the increase of productivity, resiliency, and reduction of GHG.	Genomic improvement programs: genetically improved cattle or other livestock whose improvement is aimed at limiting climate footprint
Intensive silvopastoral systems (SSPI)	Encourage a more integrated agroforestry arrangement, combining the practices mentioned above, such as forage hedges and trees in high densities under fixed rotation patterns. Fodder banks, mixed fodder banks, and fodder hedgerows are types of arrangements that allow for a greater variety of species, high protein benefits, nutrient recycling, soil moisture retention, and biodiversity.	Purchase and planting of species proven in various regions and conditions (e.g. Leucaena), adaptation of paddocks, watering troughs and related inputs.
Live fences	Establish lines of trees or shrubs to delimit a property in place of poles; this provides by-products such as fodder, firewood, timber, flowers for honey, fruit, etc. Based on experience,	Seeds, seedlings, planting, pruning equipment, and inputs for tree care.

Title	Description	Eligible Inputs
	the recommended distance between trees is 3 metres or more in the case of wide canopy species.	
Mixed fodder banks	Designate an area of the farm where forage material is sown to feed livestock throughout the year, which can be "saved" and conserved for use during critical periods (such as storms and droughts) that affect pasture production on the farm. In this area, intensive crops are established in which herbaceous, arboreal, and shrub species of high nutritional value are associated with obtaining high-quality fodder that is rich in proteins, minerals, sugars, fibre, and vitamins for animal feed.	Planting of fodder, materials, equipment, and labour for storage, including inputs for silage and other forms of fodder conservation.
Reducing methanogens and improving animal diet	Incorporating a reasonable share of carbohydrates and/or amino acid-containing feed in a cattle diet, increasing feed intake, processing forages, and offering a diet that includes unsaturated fat may contribute to reducing methanogens or other microbes involved in methanogenesis. The same is achieved through immunisation against methanogens, use of special feed additives (such as cattle methane suppression feed containing cashew nut shell liquid (CNSL) and general changes in a cow's diet. Enhance food quality for easier digestion.	Carbohydrates, amino acid-containing feed, dietary supplements, immunisation materials; *precision nutrition diet*

Title	Description	Eligible Inputs
Scattered paddock trees	Strengthen the presence of trees by natural regeneration or direct planting that provides shade and feed for livestock. Ensure the maintenance and development of the trees. This practice protects pastures and crops from the wind, increases decompaction and nutrient recycling, strengthens organic matter, biogenesis, and runoff and prevents wind erosion. Based on successful projects, minimum densities of 30 trees per 6.25 rai in the low and middle tropics and up to 25 trees per 6.25 rai in the high tropics, with a minimum height of 2 metres, are recommended.	Network of nurseries and dissemination of native species at the territorial level. Awareness-raising is needed in the management of material identification, planting, and pruning for the formation of plant material.
Improved housing and ventilation	Ensuring proper housing with adequate space, ventilation, and temperature control reduces stress, improves animal welfare, and prevents respiratory diseases. Well-ventilated housing also reduces ammonia buildup, lowering the risk of infections and improving overall productivity.	Fans, ventilation systems, shading materials, and appropriate stocking density guidelines. Introduction of evaporative house (EVAP) farm system
Complementary adoptions		
Clean energies (solar, wind, gravity) and energy efficiency	Harness renewable energy sources, such as photovoltaic cells and biogas from biodigesters. Optimise the use of energy and fuels in equipment and machinery with good maintenance and usage control.	Gas-fired generators are derived from biodigesters, as well as photovoltaic and wind power systems.
Nature-based water management	Nature-based solutions (NBS) for water resources management involve the planned use of ecosystem services to improve water quantity and quality and increase resilience to climate change.	▪ The activity is identified as a flood risk reduction or a drought risk reduction measure either in a water use and

Title	Description	Eligible Inputs
	Including measures to help prevent and protect against floods or droughts.	protection management plan at a river basin scale. ▪ The activity identifies and address the risks of environmental degradation related to the preservation of water quality and the prevention of water stress and deterioration of the status of affected water bodies to achieve good water status and ecological potential. ▪ The activity includes nature restoration or conservation actions that demonstrate specific ecosystem co-benefits, which contribute to achieving good water status. Local stakeholders are involved from the outset in the planning and design phase. The activity is based on the principles outlined by the IUCN Global Standard for nature-based solutions. Note 1: the activity takes into account National Biodiversity Strategies and Action Plans for the setting of nature conservation and restoration targets and for the description of the measures to achieve these targets. Note 2: A monitoring programme is in place to evaluate the effectiveness of a nature-based solution scheme in improving the

Title	Description	Eligible Inputs
		status of the affected water body, achieving the conservation and restoration targets and in adapting to changing climate conditions.
Parametric Insurance for mitigating climate risks	Parametric insurance or insurance based on climatic indexes are contracts that stipulate compensation based on the occurrence of specified climatic events (hurricanes, floods, among others).	Insurance based on climatic indexes
Weather monitoring and forecast systems	Satellite analysis systems and aerial systems have been put in place. Monitoring, control systems and warning protocols for early warning actions.	Early warning systems, software, hardware, analysis services, drones, licenses, and communication equipment, including real-time data collection

8. Sustainable aquaculture production

Table 16 Eligible practices for sustainable aquaculture production

Title	Description	Eligible inputs
	Basic Practice	
Compliance with agricultural standards	Implement actions required to obtain sustainable agriculture certification from Table: List of eligible certification schemes. (**Table 5**)	Inputs required to transform the farm in line with the requirements for the said certifications
Aquatic animal bank	The aquatic animal bank project aims to restore biodiversity in water sources, allowing local communities to catch aquatic animals for use. This reduces fishing in natural water sources and conserves species that are important to the ecosystem and at risk of extinction. It also mitigates the impacts of climate change that threaten the survival of certain species in changing environments.	Costs for Improving Community Water Sources, Fry Nursery Cages, Agricultural Materials
Biosecurity system	Implement biosecurity systems for aquaculture facilities such as hatcheries, nurseries, and farms to mitigate the risks of disease outbreaks and emerging infectious diseases that are becoming more severe due to climate change.	Hatcheries, management and quarantine facilities, disinfection systems, filtration and water treatment systems, monitoring tools and equipment, and cleaning and sterilization materials.
Closed-system aquaculture technology with recirculating water and wastewater management	Closed Recirculating Aquaculture Systems (RAS) are a method of farming aquatic animals in confined space. This approach, encompassing both indoor and outdoor RAS, combines with water quality control through recirculating systems that reuse water. This helps to reduce water resource consumption and minimizes wastewater discharge into the environment. Consider implementing simple water reuse practices.	Greenhouses, pond, heat domes, RAS System (Recirculating Aquaculture System), Water Filtration and Treatment Systems, Water Quality Testing Equipment

Title	Description	Eligible inputs
Disease control and monitoring in aquaculture farms	Reducing the risk of aquatic animal diseases in aquaculture farms by enhancing the efficiency of disease control and monitoring systems. This involves the establishment of laboratories and disease tracking systems to manage potential widespread and severe outbreaks that may be exacerbated by climate change due to global warming.	Scientific instruments for aquatic animal laboratories, reagents and chemicals for analysis, and reporting and monitoring systems.
Mobile hatchery	Using mobile hatcheries to breed fish in both natural and community water sources reduces the need for fuel energy in transporting fry from hatcheries. It also increases the survival rate of fry that can be directly released into the water, helping to restore aquatic resources depleted by overuse and conserve species in these water sources.	Costs for Materials and Equipment for Mobile Hatcheries
Production of microorganisms for biological aquaculture	Producing high-quality microorganisms for aquaculture helps farmers reduce production costs by decreasing the use of drugs and chemicals. It also aids in maintaining appropriate water quality, reducing energy costs for water exchange, and lowering hidden costs associated with aquatic animal diseases. Farmers who consistently use these microorganisms achieve greater success in aquaculture and lower the risk of antibiotic-resistant infections.	Scientific Materials, Agricultural Materials, Laboratories, Microbial Culture Production Center, Microbial Cultures
Intermediate Practice		
Energy saving and the use of clean energy (Solar cells)	Using solar cells in aquaculture farms allows for the generation of electricity from solar energy during the day to power aeration machines and various electrical equipment within the farm. This helps farmers significantly reduce energy costs. To	Install Solar Cell Systems, Equipment Maintenance Services to improve efficiency, Automatic Aerator Control Systems (Smart Aerator Control), Install Energy Storage Systems (Batteries),

Title	Description	Eligible inputs
	store solar energy for nighttime use, additional batteries for energy storage are required. This approach represents a development in environmentally friendly technology and innovation, reducing reliance on coal energy, which contributes to global warming.	Purchase High-Efficiency Electrical Equipment to save energy for use on the farm
Improving aquatic animal breeds to withstand environmental conditions	Improving aquatic animal breeds using environmental data from the farming location, such as temperature, salinity, and disease resistance, helps produce resilient strains that can withstand diseases and climate changes caused by global warming.	Greenhouses, Breeding Stock, Biosecurity Systems, Water Treatment Systems, Breeding Feed, Aquatic Disease Testing Tools, Laboratories, Sterile Natural Feed Production Greenhouses, Other Production Factors
Integrated multi-trophic aquaculture (IMTA) system	Integrating aquaculture systems by farming various species together, such as marine fish with seaweed and shellfish, shrimp with freshwater snails, or farming shrimp with tilapia, and other combinations like grass carp with other plant-eating fish.	Greenhouses, Ponds, Production Factors, Aquatic Species, Agricultural Materials, Tools, Materials and Equipment
Production and feeding to produce low-carbon aquatic animals	Improving food production methods and reducing fossil fuel use in feed manufacturing helps lower greenhouse gas emissions. This includes producing low-protein food, using alternative ingredients, supplementary feed, prebiotics, and enhancing feeding methods in aquaculture farms through automatic feeders, food intake tracking systems, and growth monitoring systems to reduce greenhouse gas emissions from aquaculture.	Capital expenditure for Feed Manufacturing: Alternative Energy Systems, Clean Energy, Feed Production Equipment, Raw Materials, Feed Production Plants, Raw Material Silos, Research Investment, Prototype Factory Construction Investment Expenses for Aquaculture Farms: Raw Materials, Automatic Feeders, Systems and Materials, Equipment, Tools
Promotion of aquatic animal health	Practices to ensure the health of aquatic animals and reduce mortality within farms, such as vaccinating animals, feeding with	Knowledge in Vaccine Production and Immune Stimulators, Scientific Materials and Equipment, Vaccine

Title	Description	Eligible inputs
	immune-boosting additives, or using probiotics during cultivation.	Production Centers, Immune Stimulators and Probiotics
Traceability and quality certification standards for aquatic products	Using traceability systems and certification standards for aquatic products to ensure consumer confidence in purchasing products with verified sources and environmental friendliness. This includes improving production processes for efficiency and standards to reduce production losses and greenhouse gas emissions, while avoiding harmful chemicals that affect consumers and the environment.	Expenditure for Traceability Systems, Expenses for Certification, Inspection, and Compliance, Expenses for Farm Improvements, Aquaculture Systems, Waste Treatment Systems
Transportation of live aquatic animals	▪ **Option 1: Live Aquatic Animal Transport for Aquaculture**: Developing live aquatic animal transport technology to reduce the use of plastic bags for packing and transporting animals by switching to environmentally friendly packaging, such as aerated transport tanks with temperature control systems. ▪ **Option 2: Live Aquatic Animal Transport for Consumption**: Developing live aquatic animal transport technology to control and maintain animal quality by using electric vehicles with temperature control for transport.	Aquatic Animal Transport Tanks with aeration and temperature control systems, Electric Vehicles for Transport, Environmentally Friendly Packaging
Advanced Practice		
Aquaculture insurance	Aquaculture insurance covers risks related to diseases and emerging diseases, which may be caused by climate change.	Aquatic Product Insurance for damage caused by aquatic animal diseases, Development of Aquatic Insurance Prototypes
Aquaculture warning system	Aquatic animals are sensitive to environmental changes. Climate variability can cause damage and loss of property	Early Warning Systems, Database Management Systems, Network Systems, Computers, Software,

Title	Description	Eligible inputs
	because farmers are unable to anticipate and prepare for potential hazards. The application of various detection systems (sensors) to measure parameters affecting aquaculture, combined with machine learning and artificial intelligence (AI), along with satellite imagery and external data sources, allows for predicting environmental conditions impacting aquaculture. This helps in providing early warnings so that farmers can prepare for and mitigate potential damage.	Hardware, Analytical Services, Drones, Licenses and Communication Equipment, Real-Time Data Collection
Precision aquaculture system	Utilizing IoT technology to connect data between sensors, devices, and users helps in controlling aquaculture systems. For instance, smart aerators, automatic feeders, real-time water quality measurement devices, and surveillance cameras in aquaculture ponds represent innovations using sensors to monitor real-time changes in water quality. These systems can control aerator operation to ensure optimal performance, with notifications sent via smartphones or sound alarms when oxygen levels or water quality fall below critical thresholds. This optimizes aerator operation to avoid unnecessary energy consumption, thus reducing energy use and costs.	Various Detection Systems (Sensors), Electrical Equipment, Equipment for System Installation, Internet of Things (IoT) Technology, Artificial Intelligence (AI) Systems

THAILAND TAXONOMY

Construction & Real Estate Sector

May 2025

THAILAND TAXONOMY BOARD

Table of Contents

List of Figures

List of Tables

Thailand Taxonomy Boad Phase 2

Construction and real estate sector

1. Department of Climate Change and Environment, Ministry of Natural Resources and Environment
2. Bank of Thailand
3. Securities and Exchange Commission
4. Stock Exchange of Thailand
5. Department of Alternative Energy Development and Efficiency (DEDE), Ministry of Energy
6. Thailand Greenhouse Gas Management Organization
7. Office of Natural Resources and Environmental Policy and Planning, Ministry of Natural Resources and Environment
8. Department of Public Works and Town & Country Planning, Ministry of Interior
9. Industrial Estate Authority of Thailand
10. Board of Trade of Thailand
11. Federation of Thai Industries
12. Renewable Energy Industry Club, Federation of Thai Industries
13. Thai ESCO Association
14. Council of Engineers
15. Thai Condominium Association
16. Thai Green Building Institute
17. Thai Bankers' Association
18. Association of International Bank
19. Government Financial Institutions Association

Sponsored by

Supported by: Federal Ministry for Economic Affairs and Climate Action, on the basis of a decision by the German Bundestag; IKI; giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Developed by Climate Bonds Initiative

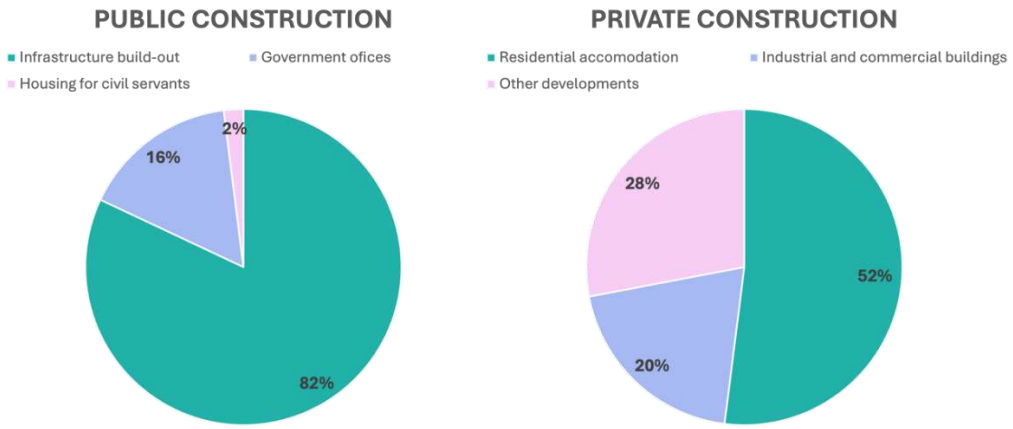
In cooperation with CREAGY

Local Consultant TDRI Thailand Development Research Institute

Construction and real estate sector background

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

Figure 1 Compositions of public and private construction investment in Thailand



Source: Data from NESDC[5]

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

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

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

[4] Ibid.

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

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

1. Major climate and environment-related issues

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

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

---

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

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

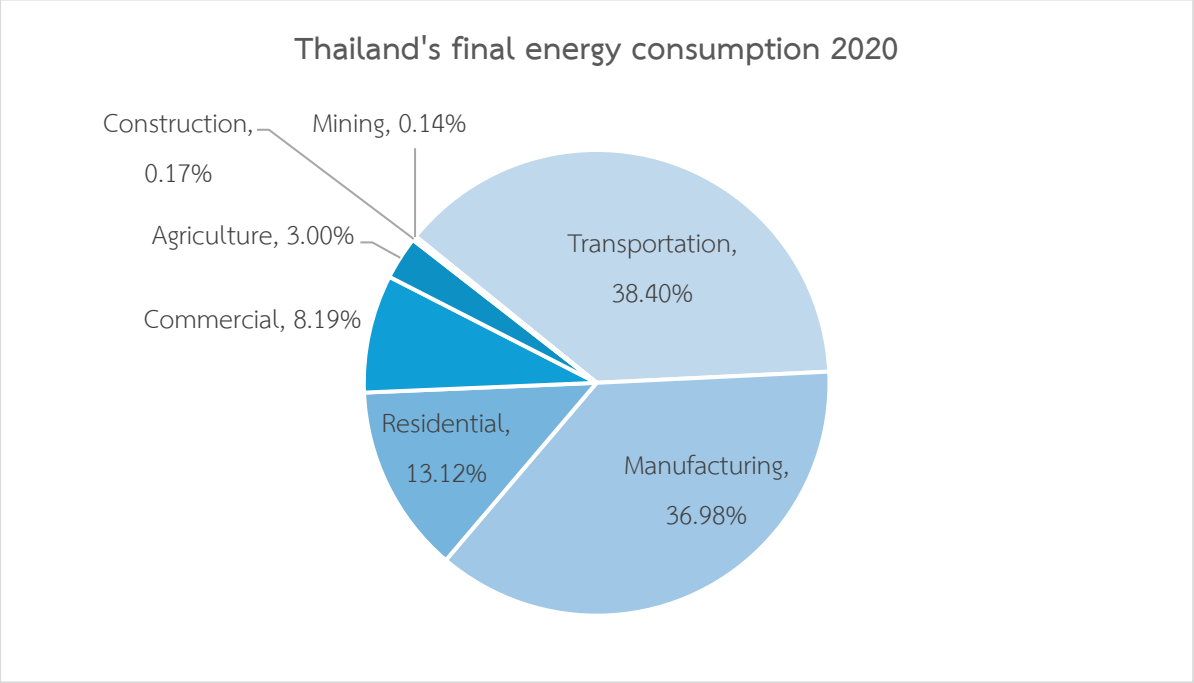
[7] Office of the National Economic and Social Development Council, "Gross Domestic Product:Q4/2023," 2024, https://www.nesdc.go.th/nesdb_en/article_attach/บทวิเคราะห์ภาษาอังกฤษ%20Q4-2566.pdf

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

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

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

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



Source: DEDE (2024)[11]

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

[10] Ibid.

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

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

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

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

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

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

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

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

[15] Ibid.

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

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

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

---

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

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

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

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

2. Key sectoral climate policies

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

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

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

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

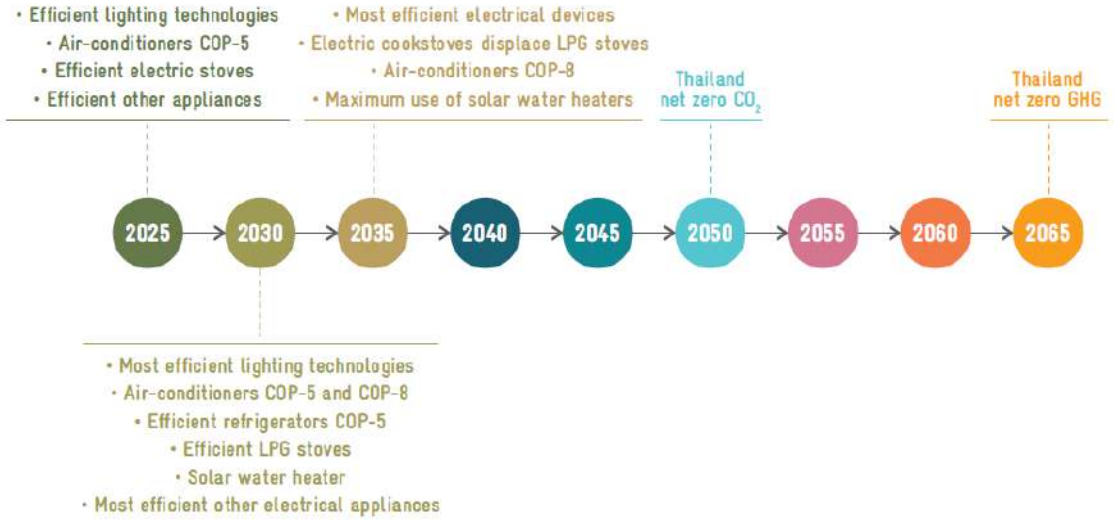
Consistent with the CCMP and LT-LEDS further elaborates a clear net-zero timeline for implementing mitigation actions related to buildings.

2.1. Residential buildings

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

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

Figure 3 Emission reduction timeline for the residential buildings sector



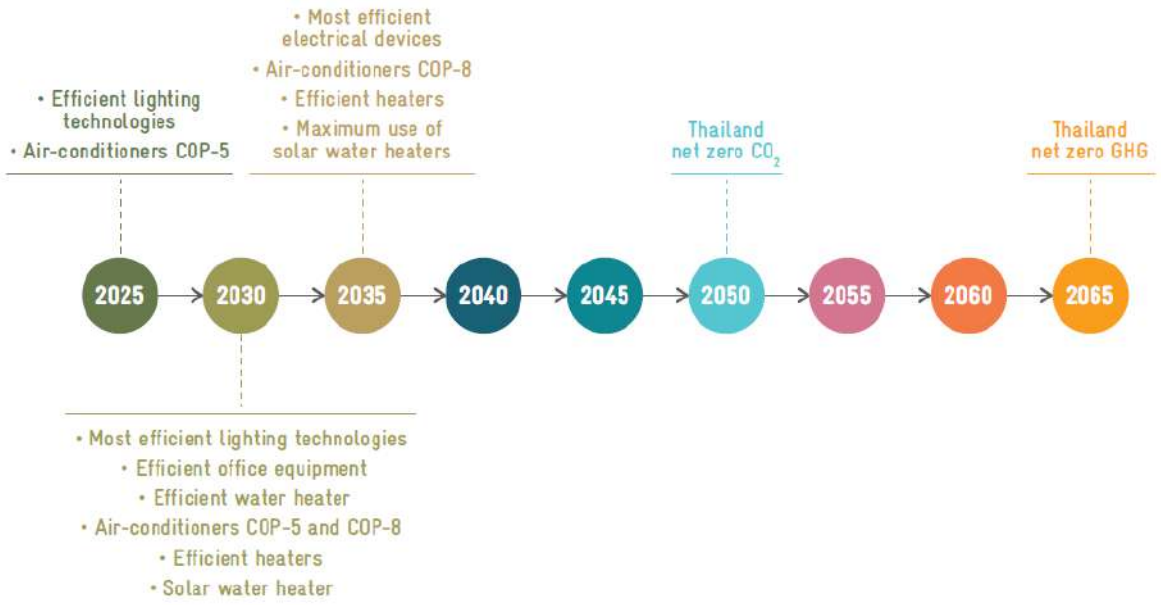
Source: ONEP (2022)[22]

2.2. Commercial buildings

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

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

Figure 4 Emission reduction timeline for the commercial buildings sector



Source: ONEP (2022)[23]

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

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

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

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

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

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

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

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

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

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

Construction and real estate activities climate materiality

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Construction and real estate criteria scope

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

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

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

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

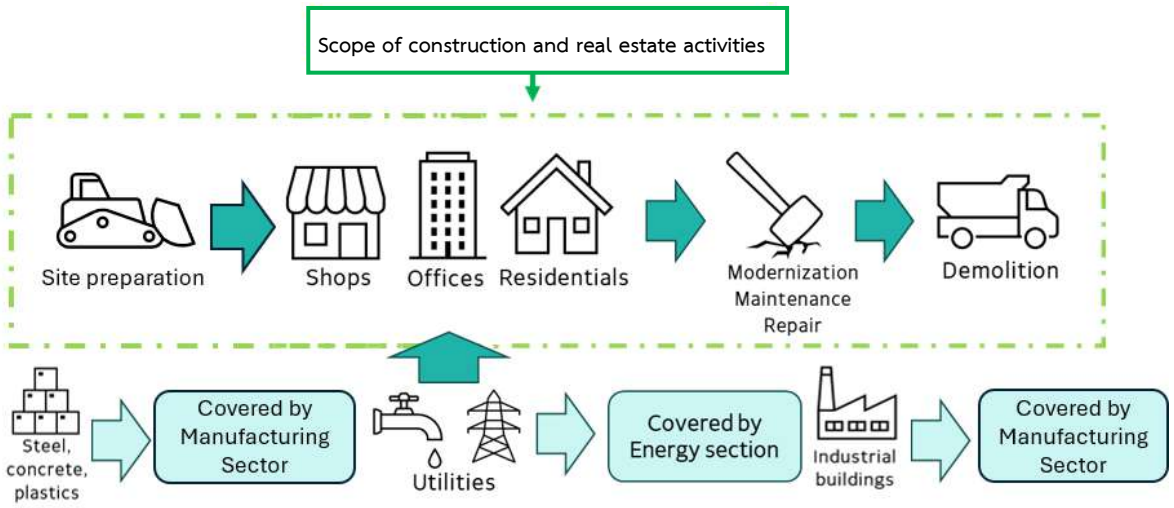
The following objects, projects and activities are outside of the scope of the present criteria:

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

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

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

Figure 5 Scope of construction and real estate section activities



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

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

Construction and real estate criteria methodological approach

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

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

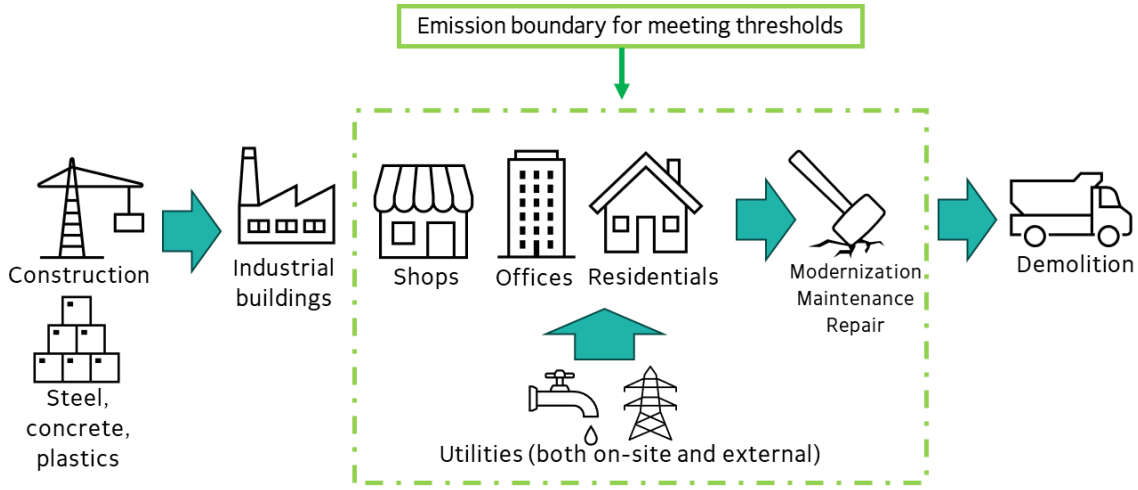
For this reason, Thailand Taxonomy uses emission per square metre (carbon intensity) as the metric for evaluating a building's performance. In practical terms, this includes the following scope of emissions, as defined in the Greenhouse Gas Protocol methodology[29]:

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

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

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

Figure 6 Emission calculation boundary for construction and real estate activities



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

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

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

Option 1: Thailand buildings national decarbonisation pathways

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

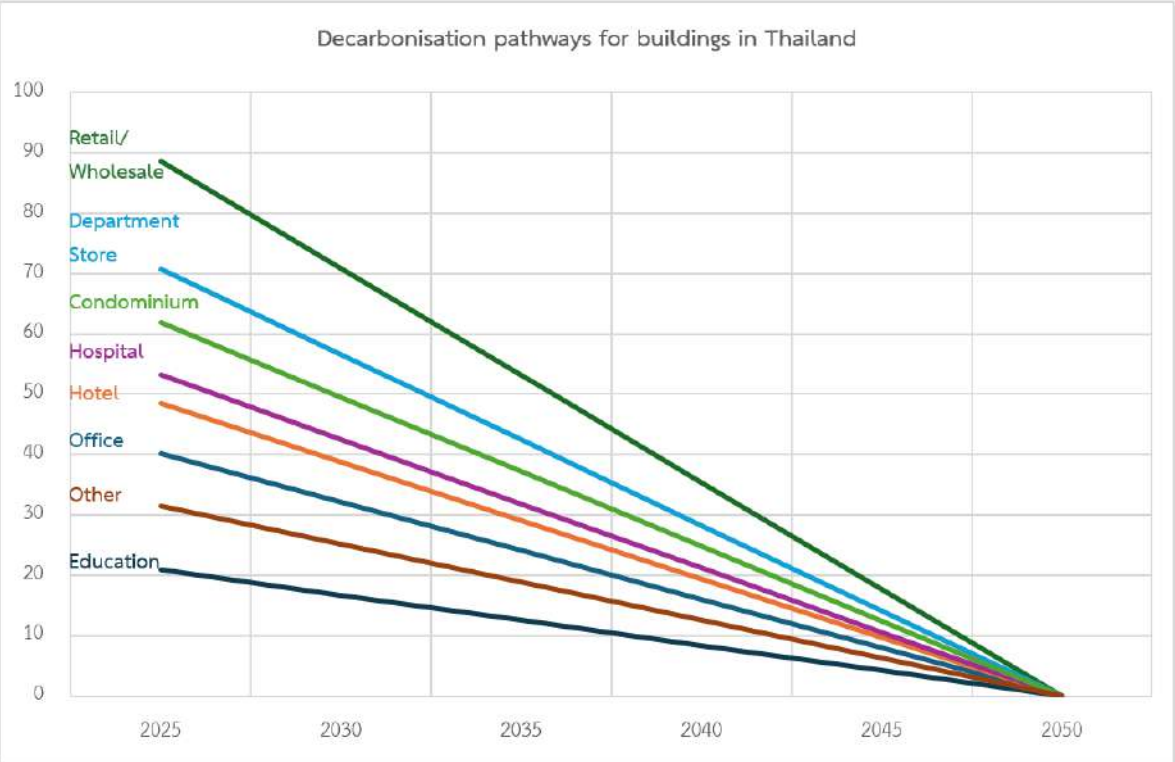
In order to use this option, the building must comply with the operational CO2 intensity figure. For new buildings targeted operational intensity must be achieved for the date of building commissioning. For example, if the manager is seeking a green loan for the building due to be commissioned in 2029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

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

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

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

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



Source: calculation from DEDE

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

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

Source: calculation from DEDE

Option 2: Proxy certification labels and additional requirements

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

Table 2 Proxy certification labels and additional requirements for residential buildings

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

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

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

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

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

Table 3 Proxy certification labels for commercial buildings

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Construction and real estate criteria methodological approach for climate change adaptation

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

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

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

Adaptation guiding principles of Buildings Sector activities are as follows:

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

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

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

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

Criteria application scheme

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

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

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

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

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

Construction and real estate subsector criteria and thresholds

1. Construction of new buildings

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

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

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

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

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

2. Renovation of existing buildings

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

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

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

[39] Ibid.

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

3. Acquisition or ownership of buildings

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

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

[40] Ibid.

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

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

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

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

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

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

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

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

5. Demolition and site preparation

Sector	Construction and Real Estate
Activity	Demolition and site preparation
ISIC Code	4310
Description	Individual measures and professional services aimed at helping the building to achieve the minimum percentages of energy savings indicated in this taxonomy, as well as enabling other activities[42] included in the Taxonomy
Objective	Resource resilience and promotion of circular economy
Green	In order to comply with the green category, both of the following criteria must be fulfilled: 1. Prior to the start of the demolition or wrecking activity, at least the following aspects are discussed and agreed upon with the client: • definition of key performance indicators and target ambition level[43]; • identification of project-specific constraints that may compromise the target ambition level (such as time, labour and space) and how to minimise these constraints; • details of the pre-demolition auditing procedure; • an outline waste management plan that prioritises selective deconstruction, decontamination, and source separation of waste streams. Where these actions are not prioritised, an explanation is provided to justify why selective deconstruction, decontamination, or source separation of waste streams are not technologically feasible in the project. Cost or financial considerations are not an acceptable reason to avoid complying with this requirement; 2. The operator of the activity conducts a pre-demolition audit: • All demolition waste generated during the demolition or wrecking activity is treated in accordance with regional waste legislation; • At least 90% (by weight) of the non-hazardous demolition waste generated on the demolition site is prepared for reuse or recycling.

[42] This activity is counted as both contribution to GHG mitigation and enabling as it includes installation of electric charging stations for electric cars

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

	This excludes naturally occurring material. Alternatively, at least 95% of the mineral fraction and 70% of the non-mineral fraction of nonhazardous demolition waste is separately collected and prepared for reuse or recycling. **Definitions:** • Building demolition material reuse is the practice of salvaging and repurposing construction materials and components from a demolished structure. These materials are then either incorporated into the development of the same site or made available for use in other construction projects. • Building demolition material recycling is the process of collecting, sorting, and reprocessing materials and components that are removed during the demolition of a building. These materials, such as concrete, wood, metal, and other construction materials, are treated to remove contaminants and then transformed into new construction materials or products.
Amber	N/A
Red	Demolition works that are not compliant with the green category are harmful to the objective of resource resilience and promotion of circular economy.
Criteria Reference	ASEAN Taxonomy v.3

6. Early Warning System

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

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

THAILAND TAXONOMY

Manufacturing Sector

May 2025

THAILAND TAXONOMY BOARD

Table of Contents

List of Figures

List of Tables

Thailand Taxonomy Boad

Manufacturing sector

1. Department of Climate Change and Environment, Ministry of Natural Resources and Environment
2. Bank of Thailand
3. Securities and Exchange Commission
4. Stock Exchange of Thailand
5. Department of Alternative Energy Development and Efficiency, Ministry of Energy
6. Thailand Greenhouse Gas Management Organization
7. Office of Natural Resources and Environmental Policy and Planning, Ministry of Natural Resources and Environment
8. Department of Industrial Works, Ministry of Industry
9. Thai Industrial Standards Institute, Ministry of Industry
10. Industrial Estate Authority of Thailand
11. Board of Trade of Thailand
12. Federation of Thai Industries
13. Renewable Energy Industry Club, Federation of Thai Industries
14. Thai ESCO Association
15. Thai Bankers' Association
16. Association of International Bank
17. Government Financial Institutions Association

Sponsored by

GB-TAP Green Bond Technical Assistance Program
IFC International Finance Corporation
Creating Markets, Creating Opportunities
IN PARTNERSHIP WITH
Kingdom of the Netherlands
Australian Aid

Developed by

Climate Bonds Initiative

In cooperation with

CREAGY

Local Consultant

TDRI Thailand Development Research Institute

1. Manufacturing sector background

The manufacturing sector contributes 27% to Thailand's GDP in 2022, rising from 13% in 1960.[1] The sector will account for 73% of Thailand's total exports in 2022 and employ almost 5.84 million workers in 2021, or roughly 15% of the total labour force.[2] Office of Industrial Economics identifies and tracks the performance of Thailand's economically important manufacturing industries, given their shares in the country's production, domestic consumption, and exports and imports. As for the most climate-material manufacturing subsectors, their economic status is as follows:

- **Petrochemicals:** Thailand's petrochemical industry is the largest in ASEAN with a total production capacity in 2021 of 35 million tons, comprising 13.4 million tons of upstream products, 8.5 million tons of intermediate goods and 13.3 million tons of downstream outputs. [3] Over 80% of Thai upstream and intermediate production is for domestic use as inputs for further downstream processes.[4] Naphtha is the main feedstock (68% of total feedstock consumption). Ethylene is the world's most widely produced olefin and accounts for 41% of Thailand's total upstream production, with the country's capacity to produce ethylene being ranked 9th in the world.[5]
- **Cement:** Thailand is among the largest producers of cement in Asia. Cement production (excluding clinker) in Q1/2023 reached 10.92 million tons, representing a quarter-on-quarter (QoQ) increase of 8.05 % from Q4/2022 but a year-on-year (YoY) decrease of 3.49% from the same quarter in 2022.[6] Approximately 91% of cement produced is for the domestic market, with 9% of production exported. Around 60%

[1] World Bank, "World Bank Open Data," World Bank Open Data, n.d., https://data.worldbank.org/indicator/NV.IND.MANF.ZS?locations=TH.

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

[3] Thian Thiumsak, "Industry Outlook 2023-2025: Petrochemicals," krungsri research, n.d., https://www.krungsri.com/en/research/industry/industry-outlook/petrochemicals/petrochemicals/io/io-petrochemicals-2023-2025.

[4] Ibid.

[5] Ibid.

[6] Office of Industrial Economics, "Report on the Industrial Economics Status in Q1-2023 and Outlook for Q2- 2023,"n.d., https://www.oie.go.th/assets/portals/1/files/quarterly_industrial/Q1_2023andOutlookQ2_2023_en.pdf.

of the output is used in private sector construction (mostly in residential and commercial properties), and the remaining 40% in public sector projects.[7]

- **Iron and steel**: Thailand produces more long steel products than flat ones. As of November 2023, Thailand's production of finished steel products stood at 472,545 tons, contracting 20.5% (YoY) from 2022.[8] Thai steel products are consumed more domestically than exported, roughly at a 91:9 ratio. Long products (deformed bar and structural steel) are mainly used in the construction business, while flat products tend to be used in sectors such as automobiles and electrical appliances.[9]

- **Aluminium:** As of 2022, Thailand had a total production capacity of over 710,000 tons but actually produced only 571,000 tons, or 80% of the production capacity, with a total market value of approximately 80 billion baht.[10] Thai aluminium producers can be divided into two categories: flat roll, with a combined production capacity of up to 410,000 tons, and extrusion, with a production capacity of up to 300,000 tons. Thailand ranks second in the world in terms of the complete closed-loop recycling of aluminium cans at 91%.[11]

- **Plastic products:** Thailand is the world's 11th biggest exporter of plastics and the 2nd biggest in the ASEAN.[12] The Thai plastics industry benefits from the large and competitive domestic petrochemicals sector. Around 59% of the produced output is exported, and the remaining 41% is used to manufacture products for domestic industries, most notably in auto assembly, electronics and electrical appliances and

---

[7]Puttachard Lunkam, "Industry Outlook 2023-2025: Construction Materials," krungsri Research, n.d., https://www.krungsri.com/en/research/industry/industry-outlook/construction-construction-materials/construction-materials/io/construction-materials-2023-2025.

[8] IRON & STEEL INTELLIGENCE UNIT and IRON AND STEEL INSTITUTE OF THAILAND, "THAILAND STEEL INDUSTRY REPORT – September 2023 - OIE," report, September 2023, https://km.fti.or.th/wp-content/uploads/2023/10/4.ภาวะอุตสาหกรรมเหล็กและเหล็กกล้า-โดยสถาบันเหล็กและเหล็กกล้าแห่งประเทศไทย-28-ก.ย.66.pdf.

[9] Taned-Mahattanalai, "Industry Outlook 2019-2021: Steel Industry," Krungsri Research, n.d., https://www.krungsri.com/en/research/industry/industry-outlook/construction-construction-materials/steel/io/io-steel-20.

[10] ฐานเศรษฐกิจ and ฐานเศรษฐกิจ, "จีนทุ่มตลาดหนัก อะลูมิเนียมไทยป่วน! จี้เร่งใช้เอดีปกป้อง," Thansettakij, March 9, 2023, https://www.thansettakij.com/columnist/exclusive-area/558442.

[11]Reedtradex, "Thai Aluminium to Reach Global Market and Save the Planet / เตรียมพร้อมอลูมิเนียมไทย ก้าวไกลและรักษ์โลก," n.d., https://www.reedtradex.co.th/enews/mtx23enews12/index_en.html.

[12] Aphinya Khanunthong, "Industry Outlook 2021-2023: Plastics," krungsri.com, n.d., https://www.krungsri.com/en/research/industry/industry-outlook/petrochemicals/plastics/io/io-plastics-21.

construction.[13] Polypropylene (PP), Polyethylene Terephthalate (PET), Low-Density Polyethylene (LDPE)/ Linear Low-Density Polyethylene (LLDPE) and High-Density Polyethylene (HDPE) represent 78% of all resins consumed in Thailand, with around 18% of key resins being recycled as of 2018.[14]

The primary plastics production industry in Thailand is witnessing significant growth, driven by robust demand across various sectors such as packaging, automotive, and construction. As of 2024, the market size is expected to grow by approximately USD 10.75 billion from 2023 to 2028, reflecting a compound annual growth rate of 5.18%[15]. Key factors contributing to this growth include advancements in plastic manufacturing technologies, increased investments, and a rising demand for lightweight, durable materials. The packaging sector remains the largest segment, fueled by the booming e-commerce market and the need for sustainable packaging solutions. Key factors contributing to this growth include advancements in plastic manufacturing technologies, increased investments, and a rising demand for lightweight, durable materials. The packaging sector remains the largest segment, fueled by the booming e-commerce market and the need for sustainable packaging solutions[16].

- **Automotives:** Thailand is the largest automotive producer in Southeast Asia and is ranked 10th globally as a production base.[17] The Thai automotive industry is structured in a pyramid, with car makers on top and auto parts makers in lower layers. As of 2022, there were 27 motor vehicle makers and 18 motorcycle makers. [18] In 2022, Thailand's car production totalled 1.88 million cars, of which 44.7% (around 0.84 million cars) were assembled for the domestic market and the remaining portion (around 1 million cars) for export. Pickups represented 62% of total car production in

[13] Ibid.

[14] Open Knowledge Repository, "Market-Study-for-Thailand-Plastics-Circularity-Opportunities-and-Barriers," n.d., https://openknowledge.worldbank.org/bitstreams/76c48f2a-d0c2-5a70-b801-43e37d851fc1/download.

[15] Mordor Intelligence, "Thailand Plastic Market Size & Share Analysis - Growth Trends & Forecasts (2024 - 2029)", n.d., https://www.mordorintelligence.com/industry-reports/thailand-plastics-market

[16] Industry Team, Bank of Ayudhya Public Company Limited,"Thailand Industry Outlook 2024-2026", January 10, 2024, https://www.krungsri.com/en/research/industry/summary-outlook/industry-outlook-2024-2026

[17] Thailand Board of Investment, "Thailand Automotive Industry, situation from ICE to Next-generation vehicle," July 6, 2023, https://www.boi.go.th/upload/content/20230706%20EN%20TAI_.pdf.

[18] Thai Automotive Industry, "Thai Automotive Industry - Facts and Figures," 2022, https://data.thaiauto.or.th/images/PDF/Navigator/Thai_Automotive_Industry-Facts_and_Figures_2022.pdf.

Thailand, while passenger cars accounted for a 35% share and other commercial vehicles (trucks, vans, and buses) for the remaining share. Battery electric vehicles remain the newcomer in Thailand's motor vehicle market, which is currently dominated by internal combustion engine vehicles. [19]

- **Electrical appliance Industry**: Thailand is a major producer and exporter of electrical appliances such as refrigerators, microwave ovens, thermos pots, household fans, washing machines, air-conditioners, compressors, rice cookers etc. In Q1/2023, exports of electrical appliances were valued at USD 8.2 billion, an increase of 18.5% (QoQ) compared to the previous quarter and an increase of 8.1% (YoY) from the same quarter last year. Products that experienced an increase in exports were air conditioners (43.1%), refrigerators (27.3%), and washing machines (26.4%).[20] The production index of the electrical appliance industry is expected to expand by approximately 4.0%.[21]

While being a main driver of the Thai economy, the manufacturing sector has recently experienced weakening conditions due to declining exports. In 2023, the manufacturing industries, particularly those associated with exports, contracted by 3 % (YoY) on average for the first three quarters of the year.[22] Exceptions were the automotive and petroleum refining sectors, which expanded in 2023.[23] From the investment perspective, manufacturing is driving foreign direct investment (FDI) flows into Thailand.

FDI in 2022 proved largest in metal products and machinery, followed by electrical and electronic products as well as services, with recent investment applications approved by the Board of Investment of Thailand in 2023 shifting towards electrical appliances and electronics

[19] Ibid.

[20] Office of Industrial Economics, "Report on the Industrial Economics Status in Q1-2023 and Outlook for Q2- 2023,"n.d., https://www.oie.go.th/assets/portals/1/files/quarterly_industrial/Q1_2023andOutlookQ2_2023_en.pdf.

[21] Ibid.

[22] World Bank, "Thailand Economic Monitor - Thailand's Path to Carbon Neutrality: The Role of Carbon Pricing," World Bank, Bangkok December 2023, https://documents1.worldbank.org/curated/en/099121223123018912/pdf/P5010091ef52cc09d1b46c1af1a43820def.pdf

[23] The office of Industrial Economics, "Montly Report Industrial Index April 2023 - April 2024," n.d., https://www.oie.go.th/view/1/industrial_indices/EN-US.

as well as electric vehicles.[24] Investments in the manufacturing of EV batteries are also rising in Thailand, due partly to the "30@30" policy --which sets the goal for 30% of vehicles made in Thailand to be zero-emission vehicles (ZEV) by 2030[25], and to related government support measures aimed at enabling Thailand to become a hub of electric vehicles manufacturing in ASEAN. Ahead of the 2030 target, ZEV production is expected to reach 225,000 units/year in 2025.[26]

1.1 Major climate and environment-related issues

Climate change presents key transition and physical risks for Thailand's manufacturing industries, calling for the adoption of climate change mitigation and adaptation strategies across sub-sectors.

As a major contributor to Thailand's GHG emissions, Thailand's manufacturing sector is developing strategies to accelerate decarbonisation. The sector currently produces a large amount of GHG emissions from chemical and physical processes, accounting for 37% of the country's final energy consumption. Cement production is Thailand's second highest emitting individual activity after rice cultivation. While traditionally focused on growth and production efficiency, Thai manufacturers are increasingly recognising the urgent need for sustainable practices. Many are adopting cleaner technologies, implementing energy-efficient processes, and optimising resource usage to minimise their carbon footprint.

Recognising the need to accelerate mitigation actions, the Ministry of Industry (MIND) implements the Bio, Circular and Green economic model to drive economy-wide decarbonisation and sustainable growth of Thai manufacturing industries.[27] External factors also act as an additional driver for the low-carbon transition of the manufacturing sectors. For

---

[24] World Bank, "Thailand Economic Monitor - Thailand's Path to Carbon Neutrality: The Role of Carbon Pricing," World Bank, Bangkok December 2023, https://documents1.worldbank.org/curated/en/099121223123018912/pdf/P5010091ef52cc09d1b46c1af1a43820def.pdf

[25] TDRI, "Clean Energy Needs Far Clearer Policy," TDRI: Thailand Development Research Institute, September 2, 2022, https://tdri.or.th/en/2022/08/clean-energy-needs-far-clearer-policy/.

[26] S&P Global, "Thailand braces to make a big splash in EV sector," Nov 8 ,2023, https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/metals/110823-thailand-braces-to-make-a-big-splash-in-ev-sector

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

example, the introduction of the Carbon Border Adjustment Mechanism (CBAM) by the European Union in October 2023 is expected to accelerate mitigation actions in aluminium and steel, which are the two current Thai CBAM goods, and potentially in more sectors in the future.[28] Moreover, partnerships with governmental bodies and international organisations are fostering the development of eco-friendly regulations and incentives. However, challenges persist, including ensuring the inclusivity of small and medium-sized enterprises in decarbonisation and sustainability efforts.

Apart from contributing to climate change, manufacturing industries suffered tremendous damage from the severe floods in 2011, which hit seven industrial parks in the northern suburbs of Bangkok, affecting 730 companies and disrupting global supply chains of electronic components, disk drives and auto parts.[29] Physical risks from climate change can also affect the manufacturing sector through other channels, such as changes in the quantity and quality of water supply and higher frequency of extreme heat events affecting workers' welfare. More investment in adaptation and resilience measures is needed to reduce the vulnerability of the manufacturing sector to physical risks from climate change.

Waste is another important problem associated with the manufacturing sector (for more on that please read Waste Sector information). During the coronavirus epidemic, industrial waste volumes fell sharply due to quarantines at factories, falling demand and supply chain disruptions, but have since recovered and even increased. For example, it was 18.05 million tonnes in 2020 but rose to 35.55 million tonnes by 2022. However, the government's efforts to reduce the total volume of industrial waste are yielding results compared to 2015, when

[28] In the short term, the effects of the CBAM on the Thai industry are expected to be slight. Among the CBAM goods, the most important ones for Thailand are iron and steel (around 1.5% of exports to the EU) and aluminium (around 0.4% of exports), while the sales of other CBAM goods to the EU are either very low or non-existent. However, the list of CBAM goods will gradually expand to match those covered under the EU ETS, while other countries (such as the US and Canada, etc.) are also considering measures similar to CBAM. This will likely significantly amplify the impacts of carbon border adjustments on Thai manufacturers and exporters across more sectors in the long run. For more information see: Prapan Leenoi, “Countdown to the CBAM: How prepared is Thailand for the introduction of the EU carbon tax?,” krungsri Research, August 03, 2023, https://www.krungsri.com/en/research/research-intelligence/cbam-2023.

[29] Nikkei Editorial, “Global Companies Must Learn From Thai Floods That Upended Supply Chains,” Nikkei Asia, October 13, 2021, https://asia.nikkei.com/Opinion/The-Nikkei-View/Global-companies-must-learn-from-Thai-floods-that-upended-supply-chains.

the volume of waste was 37.4 million tonnes[30]. Industrial waste management, key challenges remain in enhancing the monitoring of the renewal of factories that lack industrial waste management, mandating them to carry out industrial waste management systematically and legally, and enforcing the law on industrial factories that have not been legally entered into the industrial waste management system[31].

Another problem is the country's production and consumption of plastics, a large portion of which, due to mismanagement, often end up in the oceans. Approximately 51,000 tons of uncollected and improperly disposed plastic waste in Thailand gets washed into the sea each year, and the country is ranked sixth in the world on this indicator[32]. According to a World Bank study, despite a high municipal solid waste collection and recycling rate of 88.8% in Thailand, remaining uncollected plastic waste and many unsanitary disposal facilities result in an estimated 428 ton/year of mismanaged plastic waste[33]. Only about 25% of the country's plastic waste is recycled. For used plastic packaging, the current obstacles in recycling are the lack of recycling facilities for soft plastic bags, while the beverage boxes still have no proper systems for collection and value-adding.[34] To address this problem more systematically, Thailand is in the process of drafting the Extended Producer Responsibility (EPR) Law, which promotes the sustainable management of plastic waste with the participation of the plastic manufacturing industry[35].

[30] Office of Natural Resources and Environmental Policy and Planning"ปริมาณกากของเสียอุตสาหกรรม (อันตรายและไม่อันตราย) (2558-2565),"n.d., http://env_data.onep.go.th/reports/subject/view/153

[31] Pollution Control Department, "Thailand State of Pollution Report," 2022, https://www.pcd.go.th/wp-content/uploads/2022/08/pcdnew-2022-08-08_08-30-05_795080.pdf.

[32] United Nations Environment Programme, "Circular solutions for plastic pollution,"n.d., https://wedocs.unep.org/bitstream/handle/20.500.11822/41861/behavior_change.pdf?sequence=3&isAllowed=y.

[33]World Bank, "Plastic Waste Material Flow Analysis for Thailand- Summary Report," 2022, https://documents1.worldbank.org/curated/en/099515103152238081/pdf/P17099409744b50fc09e7208a58cb52ae8a.pdf.

[34] Nationthailand, "Packaging Producers Push for Enactment of EPR Law," Nationthailand, August 11, 2023, https://www.nationthailand.com/thailand/general/40030126.

[35] Ibid.

1.2 Key sectoral climate policies

The Department of Industrial Works (DIW), Ministry of Industry (MINDI) has prepared **the NDC Sectoral Action Plan for the IPPU Sector (2021 – 2030)** to reduce GHG emissions in the manufacturing sector by setting targets for implementation in two phases:

- The preparation phase (2019 – 2020) supports the implementation of measures according to the NDC roadmap starting in 2021;
- The action phase (2021 - 2030) has targets for driving key measures and supporting measures to reduce GHG emissions in the manufacturing sector to achieve the goal within the year 2030, according to the NDC Roadmap and Action Plan.

As major GHG emissions from the manufacturing sector are from the cement, chemical, refrigeration, and air conditioning industries, respectively, key mitigation measures in the sector focus mainly on clinker substitution and substitution of high global warming potential (GWP) refrigerants.[36] Specifically, the NDC Sectoral Action Plan for IPPU includes two main mitigation measures:

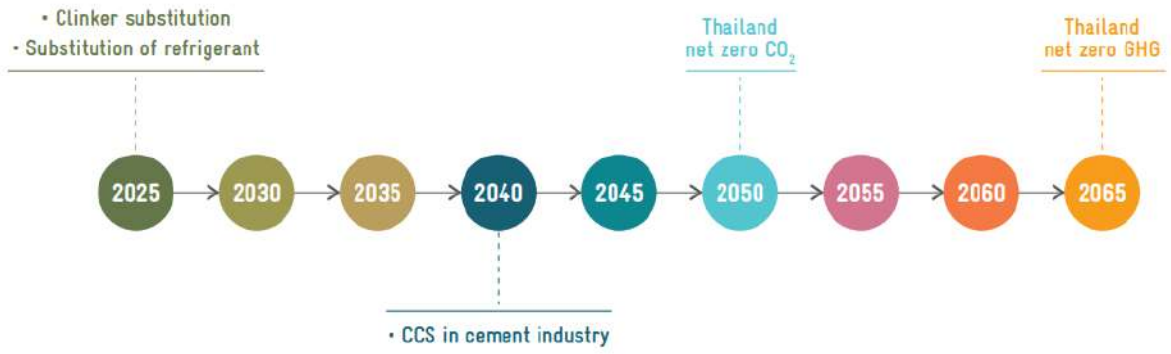
- **Clinker substitution measures** with two sub-activities: the use of clinker substitutes in the hydraulic cement production process and the increased use of cement substitutes in ready-mixed concrete.
- **Refrigerant replacement measures** with two sub-activities: refrigerant modification under the Thailand Refrigeration and Air Condition Nationally Appropriate Mitigation Actions (RAC NAMA) project[37] and the proper disposal of waste and deteriorated refrigerant.

By 2040, it is also expected that carbon capture utilization and storage (CCS/ CCUS) technologies will contribute substantially to further carbon removal from the cement industry.

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

[37] Thailand RAC NAMA, "Thailand Refrigeration and Air Conditioning Nationally Appropriate Mitigation Action (RAC NAMA)," n.d., https://www.egat.co.th/home/wp-content/uploads/2023/11/4.-Factsheet-RACNAMA_EN.pdf.

Figure 1 Manufacturing sector decarbonisation timeline



Source: ONEP (2022). Thailand's Long-Term Low Greenhouse Gas Emission Development Strategy (Revised Version November 2022)

Energy efficiency, fuel-switching, and electrification of end-use technologies are also key to the decarbonisation of manufacturing industries. According to LT-LEDS**,** the electrification of end-use technologies in the industrial sector includes replacing non-electricity-based technologies with electricity-based ones. The potential to replace fossil fuels partially or completely with renewables, such as biomass and solar, in heating applications also exists in the manufacturing industries. Green hydrogen produced using renewable-based electricity will also play an important role in the decarbonisation of hard-to-abate sectors that cannot be electrified easily, such as iron and steel, aluminium, and cement. Hydrogen burners could be used in conjunction with electric heating to generate the high temperatures required in many heavy industrial processes and replace fossil fuel burning.[38]

Apart from national climate policy goals in the IPPU sector, several industry-level climate actions have also been implemented to accelerate decarbonisation in various manufacturing sectors in Thailand. For example:

- Thai cement manufacturers have begun to invest in green technology, including in the production of hydraulic cement, to help cut CO2 emissions. The Thai Cement Manufacturers Association (TCMA) has set the "Mission 2023" for cutting GHG emissions by at least 1 million tons of CO2 by 2023 by encouraging all sectors to use hydraulic

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

cement in all types of construction projects.[39] The Thai cement industry has also pledged to reach net zero emissions by 2050. The TCMA has published the Thailand Net Zero Cement & Concrete Roadmap 2050, which seeks to halve GHG emissions by 2030 and ultimately achieve net zero by 2050.[40]

- An MOU was signed between the Aluminium Industry Club of the Federation of Thai Industries (FTI), the National Metal and Materials Technology Center, and 11 aluminium producers to mutually determine the median GHG emission value to serve as a baseline for decarbonisation. In addition, the industry is increasingly using solar-powered electricity generation and recycled aluminium scraps as raw materials.[41]

- The National Electric Vehicle Policy Committee sets the vision for Thailand to be one of the most important EV production bases and component parts in 2035. Current EV promotion measures include supply-side measures (e.g., EV and charger standards, testing facility[42], supply chain transition program, End-of-Life Vehicle program, investment promotion scheme) and demand-side measures to incentivise EV purchases (e.g., customs tax, excise tax, subsidy, and annual road tax) and infrastructure development.[43]

- The bioplastics industry in Thailand is expanding rapidly, driven by both domestic and international demand for sustainable materials. As the country strives to reduce its environmental footprint, the production and use of bioplastics have been prioritized. In 2023, Thailand was one of the largest producers of bioplastics in the ASEAN region, with a production capacity of approximately 95,000 tons per year. The industry is expected to grow at a rate of around 20% through 2025, reflecting increasing

[39]Asia Cement, "TCMA Together With 25 Alliances Announced 'Mission 2023' on Greenhouse Gas Mitigation," Asia Cement, March 31, 2022, https://www.asiacement.co.th/en/tcma-together-with-25-alliances-announced-mission-2023-on-greenhouse-gas-mitigation#:~:text=We%20therefore%20announced%20%22MISSION%202023,gas%20emission.%22%20stated%20Mr.

[40] TCMA, "Thailand 2050 Net Zero Cement & Concrete Roadmap," n.d., https://www.thaicma.or.th/th/ebook_detail/3/197.

[41] Prachachat.net, "ส่องอุตฯอะลูมิเนียมปี'65 ต้นทุนสิ่งแวดล้อมดันราคาขายพุ่ง," Prachachat.Net, February 18, 2022, https://www.prachachat.net/economy/news-865746.

[42] The Automotive and Tyre Testing, Research and Innovation Center (ATTRIC)

[43] Clement Choo and Leah Chen, "Thailand braces to make a big splash in EV sector," S&P Global, November 8, 2023, https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/metals/110823-thailand-braces-to-make-a-big-splash-in-ev-sector.

investments and favorable government policies[44]. Economic incentives from the Thai government, such as tax benefits and subsidies, are bolstering the bioplastics sector. These measures aim to promote the use of renewable resources, which in Thailand include locally available agricultural products like cassava, sugarcane, and corn.

The government has introduced initiatives like the "Thailand 4.0" model, which supports the development of bioplastics as part of the country's shift towards an innovation-driven economy. Challenges remain, however, including higher production costs compared to conventional plastics and the need for greater consumer awareness and infrastructure to handle bioplastic waste effectively.

2. Manufacturing activities climate materiality

Manufacturing activities in GHG inventories are covered by the Industrial Process and Product Use (IPPU) category under Thailand's GHG inventory. It is important to note that this category only accounts for the emissions accompanying the chemical processes of manufacturing and does not cover the emissions accompanying the generation of electricity for the production processes (except for the captive power plants situated within the factory)[45]. The national GHG inventory data will be used to assess the mitigation potential of the inclusion of activities in the Taxonomy. The table below includes only activities that contribute more than 1% to the overall IPPU sector emission volume and compares them to the proposed activities to be covered under the manufacturing sector under this Taxonomy.

Table 1 Industrial Process and Product Use sector emission profile

Subsector	IPCC 2006 Code	Manufacturing sector GHG Emission, total in GgCO2eq (share of total sectoral emission, %)	Corresponding proposed activities under the Thailand Taxonomy
Cement Production	2A1	15,803.16 (38.99%)	Manufacturing of cement
Chemical Industry	2B	11,668.31 (28.79%)	Manufacturing of hydrogen

[44] Mordor Intelligence, "Thailand Plastic Market Size & Share Analysis - Growth Trends & Forecasts (2024 - 2029)", n.d., https://www.mordorintelligence.com/industry-reports/thailand-plastics-market

[45] Please note that IPCC methodology that serves as a basis for creating GHG inventories is not . The Taxonomy itself mostly requires measurement of Scope 1+2 emissions (see particular activity cards and Business Guide for clarifications).

Subsector	IPCC 2006 Code	Manufacturing sector GHG Emission, total in GgCO2eq (share of total sectoral emission, %)	Corresponding proposed activities under the Thailand Taxonomy
			Manufacturing of carbon black Manufacturing of soda ash Manufacturing of chlorine Manufacturing of ethylene, propylene, butadiene Manufacturing of aromatics (acetylene, benzene, xylene, and toluene) Manufacturing of anhydrous ammonia Manufacturing of nitric acid Manufacturing of plastics in primary form
Iron and Steel Production	2C1	425.32 (1.05%)	Manufacturing of iron and steel
Refrigeration and Air conditioning	2F1	10,383.15 (25.62%)	Covered in the Energy sector of Phase I (4.1.9; 4.1.10; 4.1.11)
Electrical Equipment	2G1	756.09 (1,86%)	Covered by five activity cards in the Enabling activities as well as by the auxiliary transitional activity

Source: Thailand's First BIennial Transparency Report [46]

The largest proportion of emissions from the manufacturing sector for Thailand is the production of cement and chemicals, both of which have been proposed to be included in the Taxonomy. In addition, almost all international taxonomies include activities such as the production of aluminium, iron, and steel because these activities consume a lot of electricity and have significant associated emissions.

[46] "Thailand's First Biennial Transparency Report under the United Nations Framework Convention on Climate Change." UNFCCC. Published December 26, 2024. https://unfccc.int/documents/645098

Furthermore, manufacturing of hydrogen involves the production of low-carbon hydrogen, which can subsequently be used for energy production, in transport or in industry.

In addition to activities directly aimed at reducing production-related emissions in the climate-material manufacturing activities above, it is also proposed to include a number of enabling manufacturing activities in the Taxonomy:

1. **Manufacturing of batteries**. This activity includes the production of batteries capable of storing electricity and thereby increasing the potential use of renewable energy sources as opposed to non-renewable ones.
2. **Manufacturing of renewable energy technologies and products**. This activity includes the production of technologies and components necessary for the operations of renewable facilities and the production of low-carbon energy as defined by the Taxonomy, such as solar panels, blades of wind generators, turbines for hydroelectric power plants, etc.
3. **Manufacture of low-carbon technologies for transport**. This activity includes the assembly and production of components for vehicles that meet the criteria of this taxonomy (zero tailpipe emissions).
4. **Manufacturing of energy efficiency equipment for buildings**. This activity includes the production of various components and machines that help reduce the emission of buildings and their consumption of basic resources (water or energy).
5. **Manufacturing of other low-carbon technologies**. This activity includes the manufacturing of electronics and household appliances that meet the highest performance level of the energy rating system introduced by the National Energy Authority, as well as machinery needed to decarbonise other sectors of the economy.
6. **Carbon capture-related activities.** These are important for the manufacturing sector as they enable even the most emitting of hard-to-abate activities to reduce their emission intensity. The following activities are covered here:
    - **Point-source capture of CO2.** This activity clarifies the rules for using carbon capture technology within the framework of this taxonomy.
    - **Transportation of captured CO2.** This activity determines the rules for transporting carbon captured in the carbon capture process.

- **Permanent sequestration of captured CO2**. This activity determines the rules for the disposal of carbon captured in industrial and other processes.
- **Utilisation of captured CO2**. This activity determines how the captured CO2 can and cannot be used.

3. Manufacturing criteria scope

The criteria for manufacturing cover a heterogeneous group of activities in nature and technological structure, which will be specifically defined in the respective subchapter.

Eligible expenditure also covers the costs of the facilities and supporting infrastructure associated with the production process. In practice, this means that not only revenues associated with the production of low-carbon cement, or upgrades of facilities are considered aligned with the Taxonomy, but also a project to construct a new cement plant that will produce low-carbon cement is eligible.

4. Manufacturing criteria methodological approach

Unlike the energy sector, which can be decarbonised fairly quickly given the availability of capital, for many high-emitting activities in the manufacturing sector, there is simply no available technology way to do so. All activities in this sector can be divided into five groups:

- **Hard-to-abate activities**. These are the activities that the economy needs in the long term, but cannot be decarbonised overnight and need gradual decarbonisation;
- **Interim** (only production of plastics). This activity has a definite role in the economy until 2050[47], but in their present form must be gradually phased out completely by this date. The main production processes in it should be transformed to such an extent that it is no longer a threat to the fulfilment of the objectives of the Taxonomy.

[47] This statement is given for methodological reasons and does not affect the activity cards that serve as the only source of technical screening criteria. Interim activities activity cards are still usable after 2050.

- **Enabling**[48]. Activities in the second category (for example, the production of low-emission cars or batteries) may involve significant emissions, but the products they produce are considered critical for the decarbonisation of the economy as a whole, and thus their emissions are negligible compared to the overall benefit to climate.
- **Related to carbon capture and storage**. These activities help decarbonise the economy by capturing, transporting, and burying carbon that would otherwise be released into the atmosphere.
- **Auxiliary transitional activity**. This section includes the introduction of energy efficiency and decarbonisation measures in manufacturing activities not specified in the Thailand Taxonomy designed to enable as many businesses as possible to participate in the implementation of the Taxonomy.

Manufacturing sector activities often have complex production chains, and in order to use the Taxonomy it is very important to determine how much of these chains are covered by the criteria. For such activities, the Taxonomy offers the following definitions:

- **Activity coverage**. These diagrams or descriptions show the parts of an activity's production chain to which the Taxonomy's criteria and thresholds apply. This means that these elements of the production chain can be replaced during the application of the Taxonomy (e.g. through the application of amber-category measures) and funds coloured compliant (as adaptation or green finance) can be requested for them. Chain elements outside of this diagram or description CANNOT be subject to change within the Taxonomy criteria and funding defined by the Taxonomy categories cannot be requested for them.

[48] An enabling economic activity should qualify as contributing substantially to one or more of the environmental objectives when it directly enables other activities to make a substantial contribution to one or more of those objectives. Such enabling activities should not lead to a lock-in of assets that undermine long-term environmental goals, considering the economic lifetime of those assets, and should have a substantial positive environmental impact, on the basis of life-cycle considerations: European Union [EU], "REGULATION (EU) 2020/852 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 18 June 2020 on the Establishment of a Framework to Facilitate Sustainable Investment, and Amending Regulation (EU) 2019/2088," Official Journal of the European Union (EU, June 22, 2020), https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32020R0852.

- **Scope of emissions calculation**. These diagrams or descriptions show how the emission of an activity should be counted to calculate whether or not the activity meets the criteria and thresholds. Typically, the diagrams and descriptions are consistent with the sum of Scope 1 and Scope 2, but sometimes some elements of these scopes are not included because they are not climate-material for the activity. It is important to note that emission calculations are not important in all applications of the Taxonomy, but only when required to determine thresholds. In most cases, it is required to verify that the activity fits the green category, but not the amber or red categories, which are simpler to define and apply.

Important note 1: the Taxonomy aims to reduce emissions in sectors that are notable contributors to climate change via GHG emissions. Many other sectors and activities (e.g., textiles, food, paints, etc.) are important to the Thai economy, but are not themselves large emitters of greenhouse gases. Those parts of their value chains that are climate material (mostly production of steel, iron, aluminium, transportation etc.) are included in the relevant sections of the Taxonomy (manufacturing or transportation sections). For activities that do not have their own decarbonisation criteria, the activity "Introduction of energy efficiency and decarbonisation measures in manufacturing activities not specified in the Thailand Taxonomy" has been developed (read details below).
Important note 2: At the end of each activity card, there is a 'Criteria reference' line referring to a document that is the methodological basis for the criteria in the activity card (most commonly referring to Climate Bonds Initiative sectoral criteria[49]). These documents and their contents are not part of the criteria, and fulfilment of the conditions specified in these documents is not necessary for compliance with the Thailand Taxonomy. The purpose of this reference is to provide a source of criteria for those who wish to become more familiar with the theoretical and methodological framework, and to provide material for further updating of the criteria when the Taxonomy is revised.

[49] Climate Bonds Criteria are used as a major source of reference due to their status as a universal standard applied in the majority of the world's taxonomies

4.1 Hard-to-Abate Activities

This category includes the production of steel and iron, cement, basic chemicals, aluminium, and hydrogen. Individual decarbonisation trajectories have been developed for the green category for these activities taking into account data provided by Thai ministries and agencies that are in line with the Climate Bonds Initiative Standards Criteria[50]. The trajectory leads to net-zero emissions in 2050. Wherever possible, science-based transition pathways (or methodologies of their creation) have been adopted from other organisations:

- **Basic chemicals**: Teske et al. (2022); ICF and Fraunhofer ISI study for the EC (2021)
- **Cement**: Science-Based Targets Initiative
- **Iron and Steel**: IEA Net-Zero Emissions (IEA NZE)
- **Aluminum**: International Aluminum Institute based on IEA
- **Hydrogen**: MIT Energy Initiative's SESAME platform

In most cases, these pathways were modified in line with the country data provided by relevant Thailand government bodies and professional associations. For more information on calculation of individual decarbonisation pathways please see prefaces for specific manufacturing activities.

As for the amber category, given the scale of challenges associated with the decarbonisation of the selected manufacturing sectors and the lack of technologically and economically feasible low-carbon alternatives, these sectors have been defined as inherently "in transition." While in other sectors it is possible to delineate a boundary between red and amber, for most manufacturing activities, the boundary is harder to define because data is often not available to build a trajectory with any credibility or scientific basis, meaning that the line between ineligible and amber would be arbitrary.

This approach takes into account the objectives set by NDC Thailand wherever possible. It should be noted that the decarbonisation measures themselves (amber category) are not tied to any timeframe other than the sunset date defined by the ASEAN Taxonomy (2040) and can

[50] CBI, "The Standard," Climate Bonds Initiative, April 29, 2024, https://www.climatebonds.net/standard/the-standard.

be applied to achieve decarbonisation by any year, either 2050 or 2065, as defined by the current version of Thailand's NDC.

For this reason, specific provisions were introduced for the amber category in this class of activities:

- **Introduction of specific decarbonisation measures**: individual decarbonisation measures are proposed in order to circumvent the lack of availability of data. The adoption of those technologies acts as a proxy for decarbonisation. Application of these measures helps to reduce the emission intensity of industrial processes and move it closer to the established decarbonisation pathway.
- **Transition plans**: in order to qualify as transition, a credible transition plan towards net-zero must be adopted at the entity level. This is necessary to ensure that movement towards net-zero is not a one-off push of a single facility, but a consistent strategic course of the manufacturing entity. We recommend for the transition plans to be prepared in line with Transition Finance Principles outlined by the International Platform on Sustainable Finance[51] or ASEAN Transition Finance Guidance[52].

As for the red activities, they are absent from hard-to-abate subsectors activity cards (except for plastics where the red category includes the production of all types of plastics not mentioned in green or amber category due to their heavy environmental footprint) due to their significant environmental footprint. This is because the nature of this category prevents it from being fully decarbonized in a short time.

4.2 Interim activities

Financing credible transition paper[53] by Climate Bonds Initiative defines interim activities as "activities currently needed but should be phased out by 2050 – e.g. recycling of plastics or

[51] International Platform of Sustainable Finance [IPSF], "IPSF Transition Finance Report," European Commission (IPSF, November 2022), https://finance.ec.europa.eu/system/files/2022-11/221109-international-platform-sustainable-report-transition-finance_en.pdf.

[52] ASEAN Capital Markets Forum [ACMF], "ASEAN Transition Finance Guidance," ACMF (ACMF, October 17, 2023), https://www.theacmf.org/images/downloads/pdf/ASEAN%20Transition%20Finance%20Guidance%20Version%201%20-%20FINAL%2017%20Oct%202023.pdf.

[53] Climate Bonds Initiative. *Financing Credible Transitions*. London: Climate Bonds Initiative, 2021. https://www.climatebonds.net/files/reports/cbi_fincredtransitions_final.pdf.

production of energy from municipal waste". Manufacturing sector of the Thailand Taxonomy includes only manufacturing of plastics as such an interim activity. The criterion for this activity encourages the recycling of existing plastic by mechanical or chemical means and the subsequent production of new goods from recycled plastic.

4.3 Enabling activities

An enabling activity directly enables other activities to make a substantial contribution to one or more of those objectives. Such enabling activities should not lead to a lock-in of assets that undermine long-term environmental goals, considering the economic lifetime of those assets, and should have a substantial positive environmental impact, on the basis of life cycle considerations. The following activities are considered enabling:

- Manufacturing of batteries
- Manufacturing of renewable energy technologies
- Manufacturing of low-carbon technologies for transport
- Manufacturing of energy-efficiency equipment for buildings
- Manufacturing of other low-carbon technologies

Because of the intrinsic nature of enabling activities, there is only the green category available and no amber category.

4.4 Carbon capture, transportation, utilisation, and storage

Technologies such as Carbon Capture and Storage (CCS) and Carbon Capture, Utilisation and Storage (CCUS) have significant potential to contribute to the decarbonisation of industry, but only if carbon remains permanently stored and is either securely locked in geological structures or reused for manufacturing processes/durable[54] products manufacturing and does not get back into the atmosphere.

Thus, the green category in CCS/CCUS-related activities is related to the proper handling, transportation, and monitoring of leaks during the capturing process, transportation and

[54] The product is considered durable if its expected lifespan is longer than 3 years. Bureau of Economic Analysis. "Durable Goods." *U.S. Department of Commerce*. Accessed March 10, 2025. https://www.bea.gov/help/glossary/durable-goods)

storage of CO2, and the amber category is related to the retrofitting of existing pipelines. The thresholds themselves were constructed to match those applied by the European Union Taxonomy.

Captured CO2 may either be transported and stored or used on-site for other industrial processes that require a source of carbon. Huge quantities of CO2 are currently used each year, mainly in in the fertiliser industry and for enhanced oil recovery (which is not aligned with the objectives of Thailand Taxonomy) while new utilisation pathways in the production of CO2-based synthetic fuels, chemicals and building aggregates are gaining momentum.

4.5 Auxiliary transitional activity: Introduction of energy efficiency and decarbonisation measures in manufacturing activities not specified in the Thailand Taxonomy

This activity has been specifically designed to allow as many industrial companies as possible to participate in the application of the Taxonomy. It involves the introduction of energy efficiency measures, the electrification of production processes and the replacement of non-renewable energy sources with renewable ones. The activity can be applied to decarbonise and improve the energy efficiency of all activities that do not have a separate item in the Taxonomy.

This activity was developed specifically for Thailand Taxonomy and has no precedent in other taxonomies. As the wide variation in applications precludes the development of a single best practice for all types of activities, its activities in Green category should comply the international standards such as SBTi. The Amber category has two options:

- **Improve energy efficiency by at least 40% relative to the baseline energy intensity of the facility**. This threshold has been defined according to the Draft 2024 Energy Efficiency Plan, which aims to reduce the energy intensity of the Thai economy by 36% by 2037 (compared to 2010 baseline). Adapting this figure to the mechanisms of the taxonomy and the general sunset date (2040), this figure was raised to 40% and extrapolated to the baseline of a particular enterprise.
- **Electrification and replacement of energy sources with renewable energy**. Electrification is considered by climate science to be one of the most effective ways to decarbonise because it allows access to renewable energy connections. This activity

does not contain any targets or thresholds, as replacing any amount of energy consumption with renewable energy is a contribution to the Taxonomy targets. It is important to note that only the direct connection of an enterprise to renewable energy sources is taken into account, the purchase of PPA certificates is not included, as this does not lead to an actual reduction in the emission intensity of a particular enterprise.

This activity may not be applied to decarbonising industries associated with the extraction, transport or storage of hydrocarbons, or the production of components for these processes, or any other type of industry that promotes the use of hydrocarbons and their derivatives (e.g., prohibited for application to facilities producing internal combustion engine vehicles).

5. Criteria application scheme

Either the financial flows (CapEx and OpEx) associated with a production process or with the entire production facility can qualify as eligible.

The amber category that applies to investment measures (those for hard-to-abate subsectors) cannot be used to assess revenues. It can only be used to define the alignment of CapEx. Such an approach has a major upside in that it rewards individual decarbonisation efforts whilst also facilitating emissions reduction from hard-to-abate sectors in the absence of available data. However, the amber category for these activities has a sunset date of 2040, limiting the timeframe of the eligibility of measures. Following this date, the amber category will no longer be applicable, as the target year for achieving net-zero emissions approaches. All legacy high-emission industries are expected to be progressively phased (all amber activities become out-of-scope after this date). This period aims to offer an opportunity to reward positive climate impacts while low or zero-emission technologies remain underdeveloped and expensive.

Table 2 Usability implication of the measures-based approach

	Green	Measures-based amber	Activity-based ("traditional") amber
Taxonomy is used to define the alignment of CapEx	CapEx is eligible if a given activity currently meets the green criteria, and the measure will help to	Financing of specific measures (each of them might have additional measure-	CapEx is eligible if a given activity currently meets the amber criteria, and the measure will help to

	Green	Measures-based amber	Activity-based ("traditional") amber
	keep below the future green criteria (so assume need to assess the transition plan/CapEx plan)	specific criteria) is eligible as amber	achieve green criteria (so assume the need to assess transition plan/CapEx plan)
Taxonomy is used to define the alignment of revenues associated with activities.	Revenue is eligible if the activity meets green criteria	Not available	Revenue is eligible if the activity meets the Amber criteria

Note: this distinction between measures-based and activity-based amber is important for the methodology of the chapter but does not affect application scheme. Only three statuses are available for the taxonomy: green activities, amber activities, and red activities.

6. Manufacturing subsector criteria and thresholds

6.1 Hard-to-Abate Activities

1. Manufacture of basic chemicals

The scope of the activity defined under Thailand taxonomy includes assets and activities involved in the production of a number of eligible organic and inorganic basic chemicals. The eligible basic chemicals that are under the scope of the Taxonomy are defined in Table below.

Table 3. Eligible basic chemicals under the scope of Thailand Taxonomy

Chemical groups	Eligible assets
Inorganic basic chemicals	• Ammonia • Chlorine • Disodium carbonate/Soda ash • Nitric acid • Carbon black
Organic basic chemicals	• High-value chemicals (ethylene, propylene, butadiene) • Aromatics BTX (acetylene, benzene, toluene and xylene) • Methanol

Decarbonisation trajectories for nitric acid, high value chemicals and aromatics BTX were calculated based on the Climate Bonds Initiative methodology, which integrated data provided by the Federation of Thai Industries (FTI). The thresholds for 2025 were calculated as follows: 15% was subtracted from the average emission intensity data for each product type obtained from FTI (to aim for the "best in class" installations), and then the values for 2030 and 2035 were calculated as a proportional reduction in emission intensity to values compliant with the Climate Bonds Basic Chemicals Criteria. Although technologies to decarbonise the chemical industry to Climate Bonds Criteria-aligned thresholds exist today, applying these thresholds only from 2040 onwards will give the Thai chemical industry sufficient time to prepare and make the necessary capital investments.

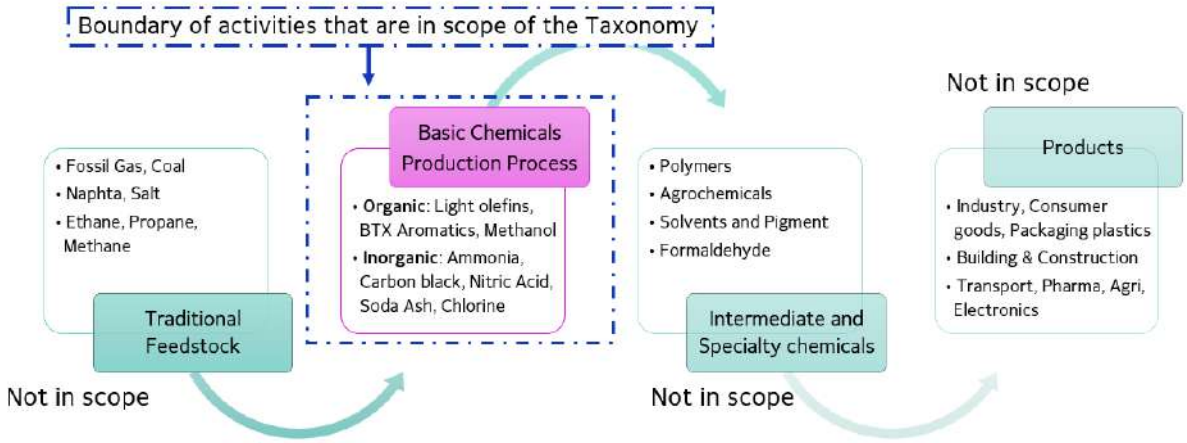
For ammonia, chlorine, soda ash, carbon black and methanol, their decarbonisation pathways, requirements and thresholds are taken directly from the Climate Bonds Basic Chemicals Criteria and are compliant with the best available technology in the world.

Thresholds and pathways for all mentioned chemicals except chlorine in these criteria are based on the alignment to Paris Agreement-aligned decarbonisation pathways for the entire chemical sector published by Teske et al. (2022)[55] With the reduction rates from Teske et al.'s pathway and taking as basis the thresholds for 2022, the thresholds were extrapolated to 2025 first using the 4.7% annual reduction to have the 2025 base value. Afterwards, the aforementioned reduction rates were applied to calculate the 2030, 2035, 2040, 2045 and 2050 threshold. For nitric acid, high value chemicals and aromatics Teske's values are applied only at 2040 and after.

The value chain of basic chemicals production, along with boundary of production activities within the scope of taxonomy is specified in Figure below.

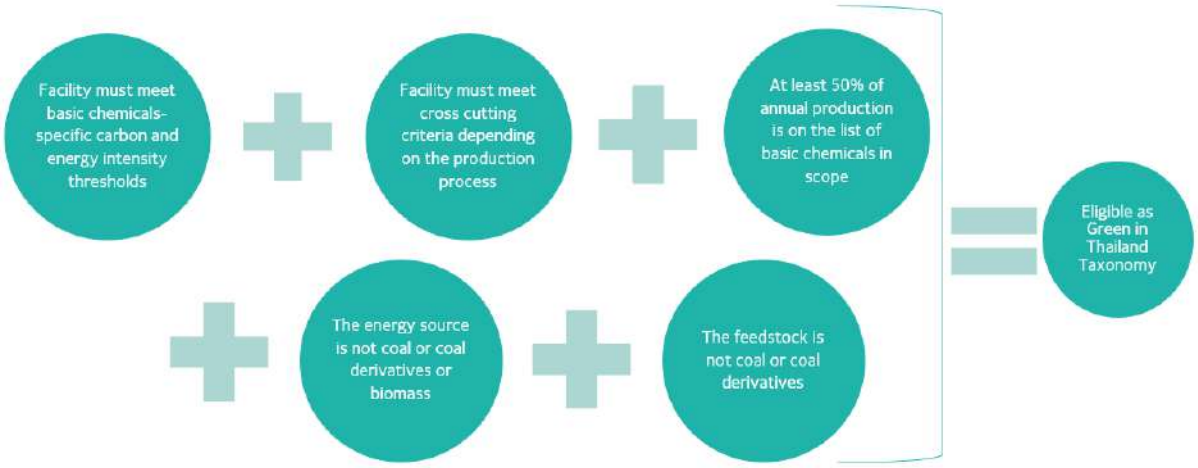
[55] Sven Teske et al., "1.5 °C Pathways for the Global Industry Classification (GICS) Sectors Chemicals, Aluminium, and Steel," SN Applied Sciences/SN Applied Sciences 4, no. 4 (April 1, 2022), https://doi.org/10.1007/s42452-022-05004-0.

Figure 2 Basic Chemicals production value chain and activities within the scope of the Taxonomy criteria



In order to be compliant with green criteria, all important elements of the facility and technological process should correspond to the criteria stipulated in the respective activity card. An overview of that list is given in Figure below.

Figure 3 Green criteria overview for manufacturing of basic chemicals



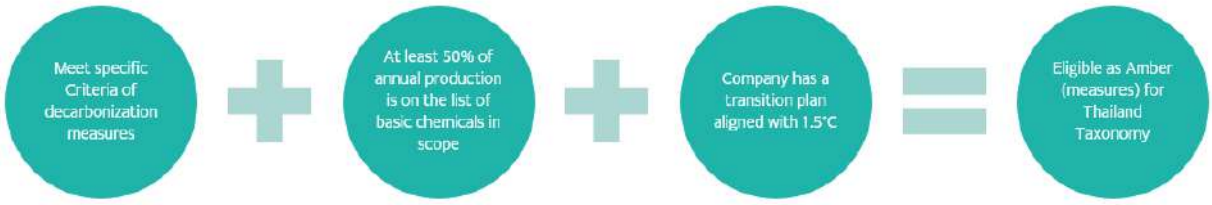
The scope of emissions calculations for the production of the basic chemicals is as follows:

- **Nitric acid and soda ash**: scope 1 emissions, which include all direct emissions from the production processes, such as emissions generated during the chemical reactions and emissions from fuel combustion on-site.
- **Carbon black, high value chemicals and aromatics**: scope 1 as defined above plus scope 2 emissions which includes indirect emissions from the energy imported from off-site.

- **Methanol and ammonia**: associated GHG emissions counted as the life cycle emissions of hydrogen used as feedstock.
- **Chlorine**: only electricity consumption intensity is within the scope. No separate GHG accounting for the whole production process is required for chlorine, as all emissions in its production chain are associated with electricity consumption.

Amber criteria of the activity include decarbonisation measures that are applicable within the basic chemical production facility where the **entity has a transition plan aligned with the commitments under the Paris Agreement.** The framework for the Amber criteria is specified in the Figure below.

Figure 4 Amber criteria framework for manufacturing of basic chemicals



Manufacture of basic chemicals criteria and thresholds

Sector	Manufacturing
Activity	Manufacturing of basic chemicals
ISIC code	C201
Description	Production of carbon black, soda ash, chlorine, anhydrous ammonia, nitric acid, ethylene, propylene, butadiene, benzene, acetylene, xylene, toluene, methanol
Objective	Climate change mitigation; Resource resilience and circular economy promotion
Green	For the activity of production of a certain listed chemical or a facility as a whole to be aligned with the green category of Thailand Taxonomy, it must comply with the following requirements: • More than 50% of the facility's production (by volume) is made up of chemicals included in the scope of the present article (listed in the "Description" line under manufacture of basic chemicals criteria and thresholds;

	• All activities carried out on the facility that fall within the scope of the present article need to meet specific carbon or energy intensity thresholds defined in Table 4 (see below the present activity card); • Facility operators must check whether Additional requirement 1 or Additional requirement 2 listed below apply to their activities. If yes, these requirements must be further fulfilled. • **Additional requirement 1:** applicable if the facility is using fossil gas, hydrogen, biomass, or heat supplied from alternative sources as a fuel source. These facilities are eligible only if they meet the following criteria: • Fossil gas or naphtha: only eligible for existing unabated GHG facilities prior to 2040; • If facilities use biomass or hydrogen as a fuel source, they should meet Taxonomy's green criteria of these activities; • Facilities using heat supplied from alternative sources, such as geothermal, solar thermal, and waste heat recovery: The heat source must comply with the green category of the Taxonomy's most up-to-date criteria for each source of energy. • **Additional requirement 2:** applicable if the facility is using fossil gas, hydrogen, biomass, or heat supplied from alternative sources as a fuel source. These facilities are eligible only if they meet the following criteria: 1. Fossil gas or naphtha: Only eligible for existing unabated[56] GHG facilities prior to 2040; 2. If facilities use biomass or hydrogen as a fuel source,it should meet Taxonomy's green criteria of these activities; 3. Facilities using heat supplied from alternative sources, such as geothermal, solar thermal, and waste heat recovery: The heat source must comply with the green category of the Taxonomy's most up-to-date criteria for each source of energy.
Amber	In order to be aligned with the amber category, the manager of the facility must implement at least one of the measures mentioned in Table 5. By implementing this measure, the manager of the activity must, as a minimum, achieve the result indicated in the "Mitigation criteria" column of Table 5. If the application of the

[56] Unabated industrial facilities refer to industrial facilities that continue to emit greenhouse gases without any significant mitigation measures, such as carbon capture, utilization, and storage or other emissions-reduction technologies.

	listed measure does not lead to the result indicated in the column, the application of this measure cannot be considered eligible. In addition: ● Eligible decarbonisation measures or retrofitting activities (CapEx) should be implemented prior to the designated sunset date (2040). ● More than 50% of the facility's production is made up of chemicals included in the scope of the present article (listed in the "Description" line under manufacture of basic chemicals criteria and thresholds); ● A company that owns the facility should have a transition plan aligned with the commitments under the Paris Agreement and/or net zero GHG emissions target of Thailand.
Red	Activities that do not comply with the green or amber category are harmful to the objective of climate change mitigation.
Criteria reference	Climate Bonds Basic Chemicals Criteria

Table 4 Basic chemicals decarbonisation pathways[57]

Asset type	2025	2030	2035	2040	2050
Production of ammonia	● Uses hydrogen as feedstock that meets the Taxonomy criteria for hydrogen production (green category) OR Ammonia is recovered from wastewater. AND ● CO_2 from ammonia production should not be used for urea production.				
Production of nitric acid[58] (t CO2e /t nitric acid)	0.527	0.263	0.131	0.007	0
Production of chlorine	2.45 MWh electricity/t chlorine OR carbon intensity of the electricity used meets the Taxonomy criteria for electricity	1.85 MWh electricity/t chlorine OR carbon intensity of the electricity used meets the Taxonomy criteria for electricity	Carbon intensity of electricity used meets the Taxonomy criteria for electricity generation (green category)		

[57] CBI, "Basic Chemicals Criteria", April, 2023 https://www.climatebonds.net/files/files/standards/Chemicals%20-%20Basic/Sector%20Criteria%20-%20Basic%20Chemicals%20%28April%202023%29.pdf

[58] Modelled proxy data is used here instead of real data due to limited availability. The number will be updated in the future.

Asset type	2025	2030	2035	2040	2050
	generation (green category)	generation (green category)			
Production of carbon black (t CO2e/t carbon black)	1.141	0.63	0.34	0.20	0
Production of disodium carbonate/soda ash	0.789 t CO_2e/t disodium carbonate/ soda ash AND carbon intensity of the electricity used meets the Taxonomy criteria for electricity generation (green category)	0.44 t CO_2e/t disodium carbonate/ soda ash AND carbon intensity of the electricity used meets the Taxonomy criteria for electricity generation (green category)	0.23 t CO_2e/t disodium carbonate/ soda ash AND carbon intensity of the electricity used meets the Taxonomy criteria for electricity generation green category)	0.14 t CO_2e/t disodium carbonate/ soda ash AND carbon intensity of the electricity used meets the Taxonomy criteria for electricity generation (green category)	0 t CO_2e/t disodium carbonate/ soda ash AND carbon intensity of the electricity used meets the Taxonomy criteria for electricity generation (green category)
Production of high-value chemicals (ethylene, propylene, butadiene)[59]	0.77	0.68	0.60	0.43 in 2040 and 0.26 in 2045	0.09
Production of aromatics BTX[60]	0.348	0.174	0.087	0.0012	0

[59] The data and decarbonization pathway on the production of high-value chemicals (ethylene, propylene, butadiene) have been obtained from the Petrochemical Industry Club, the Federation of Thai Industries. As the data is sample data from Thai producers, the pathway will be considered once more comprehensive data becomes available and/or significant technological advancements.

[60] The current GHG data on the production of aromatics BTX (only benzene, xylene, and toluene) has been obtained from the Petrochemical Industry Club, the Federation of Thai Industries. Due to the data limitation of Thai manufacturers in

Asset type	2025	2030	2035	2040	2050
(acetylene, benzene, xylene, and toluene) (t CO2e/t aromatics BTX)					
Production of methanol	Uses hydrogen as feedstock that meets the Taxonomy criteria for hydrogen production (green category)				

Table 5 Decarbonisation measures for the chemical industry[61]

Area	Activity	Mitigation criteria
General Measures		
Energy efficiency measures	Revamps, modifications, or acquisition of equipment (boilers, furnaces, reactors, heat exchanger, distillation columns and other separation units, etc.)	At least a 30 % improvement in energy efficiency.
Switching to low-carbon process technologies	Revamps, modification and acquisition of equipment and other infrastructure needed for the implementation and operation of low carbon process technologies.	The technology does not release direct process CO_2 emissions, e.g., methane pyrolysis catalytic partial oxidation of methane to methanol.
Carbon Capture and Storage	Infrastructure related to CO_2 capture of emissions from the basic chemicals production, transportation, and storage	• The minimum capture rate from the entire facility should be 90% (capture only, without transportation or storage). • There is evidence[62] that demonstrates the CO_2 will be suitably transported and stored in line with the

specific product categories, proxy data is used for pathway calculations. A data review will be considered once more comprehensive data becomes available and/or significant technological advancements.

[61] CBI, "Basic Chemicals Criteria", April, 2023 https://www.climatebonds.net/files/files/standards/Chemicals%20-%20Basic/Sector%20Criteria%20-%20Basic%20Chemicals%20%28April%202023%29.pdf

[62] Either directly from the issuer or through contracts or agreements with a third party

Area	Activity	Mitigation criteria
		Taxonomy criteria (green category)
Relating to the feedstock used		
Using hydrogen as a feedstock	Infrastructure for production using hydrogen that is aligned with the Thailand Taxonomy (green category) OR Refurbishment and retrofitting of facilities to use hydrogen that is aligned with the Thailand Taxonomy (green category) OR Acquisition of equipment to produce basic chemicals using hydrogen that is aligned with the Thailand Taxonomy (green category)	Hydrogen used as a feedstock meets the thresholds set out in the Taxonomy for green category (green category)
Using biomass as a feedstock	Infrastructure for production using biomass OR Refurbishment and retrofitting of facilities to use biomass OR Acquisition of equipment to produce basic chemicals using biomass	The biomass used complies with the criteria applicable for biomass sourcing set out in the Taxonomy Bio-energy criteria (green category)
Using CO_2 as a feedstock[63]	Infrastructure for production using CO_2 as a feedstock OR Refurbishment and retrofitting of facilities to use CO_2 as a feedstock OR	1. The source of CO_2 sources is either: ● Direct emissions from chemical production; OR ● Direct emissions from other industrial activities

[63] Please refer to Waste management sector for more details

Area	Activity	Mitigation criteria
	Acquisition of equipment to produce basic chemicals using CO_2 as a feedstock	2. The basic chemical produced is used for the manufacture of durable products (e.g. construction materials stored in buildings or recyclable products, e.g. PET). 3. If the basic chemical produced is used for products that release CO_2 immediately when the products are used (such as in urea, carbonated beverages, or fuels), the capital investment is not eligible. 4. CO_2 is not used for enhanced oil recovery, and the production of other forms of fossil energy sources. 5. This measure may involve the need for electricity when electrochemical processes are used, and also the need for hydrogen as a feedstock. If so, that hydrogen must comply with the Taxonomy criteria (green category)
Use of recycled material as feedstock (e.g. using olefins recovered from plastics chemical recycling processes)	Infrastructure for the production using recycled feedstock OR Refurbishment and retrofitting of facilities using recycled feedstock OR Acquisition of equipment to produce basic chemicals using recycled feedstock	Recycled material should: ● represent at least 20% of the feedstock in regions without local recycling regulations or with lower recycled content requirements. ● represent more than 20% of the feedstock in regions with local recycling regulations. If the region has a higher recycled content percentage, it should prevail.

Area	Activity	Mitigation criteria
		• have lower cradle-to-gate emissions than the virgin material OR Recycled feedstock is certified by International Sustainability and Carbon Certification (ISCC)
Relating to energy used		
Electrification of the processes	Revamps, modifications, and acquisition of equipment (furnaces, reactors, separators, etc.) and other infrastructure necessary for electrification of the processes	Electricity must be low-carbon and comply with the most up-to-date Taxonomy criteria for electricity grids (green category)
Heat supplied from geothermal, solar thermal or waste heat recovery systems	New heat exchange equipment, such as evaporators, furnaces, boilers, etc., OR Revamps or modifications to heating-related equipment in the existing process	Heat supply complies with the most up-to-date Taxonomy criteria for the relevant source of energy (green category)
Using hydrogen as an energy source	Revamps or modifications to equipment (boilers, furnaces, burners, etc.) in existing utility systems required for the use of hydrogen as fuel OR Infrastructure for the production of a basic chemical in scope using hydrogen as an energy source	The hydrogen to be used meets the Taxonomy criteria for hydrogen production (green category)
Using biomass or biogas as an energy source	Revamps or modifications to equipment (boilers, furnaces, burners, etc.) in existing utility systems required for the use of biomass as fuel OR	The bioenergy complies with the Taxonomy Bio-energy criteria (green category). Primary organic

Area	Activity	Mitigation criteria
	Infrastructure for the production of a basic chemical in scope using biomass as an energy source	streams[64] are only eligible if certified as sustainable by Roundtable on Sustainable Biomaterials or International Sustainability and Carbon Certification. Wood is eligible only if produced on a sustainable plantation as defined by the Thailand Taxonomy's Forestry Criteria when using biomass as a reducing agent and/or for energy generation.

2. Manufacture of cement

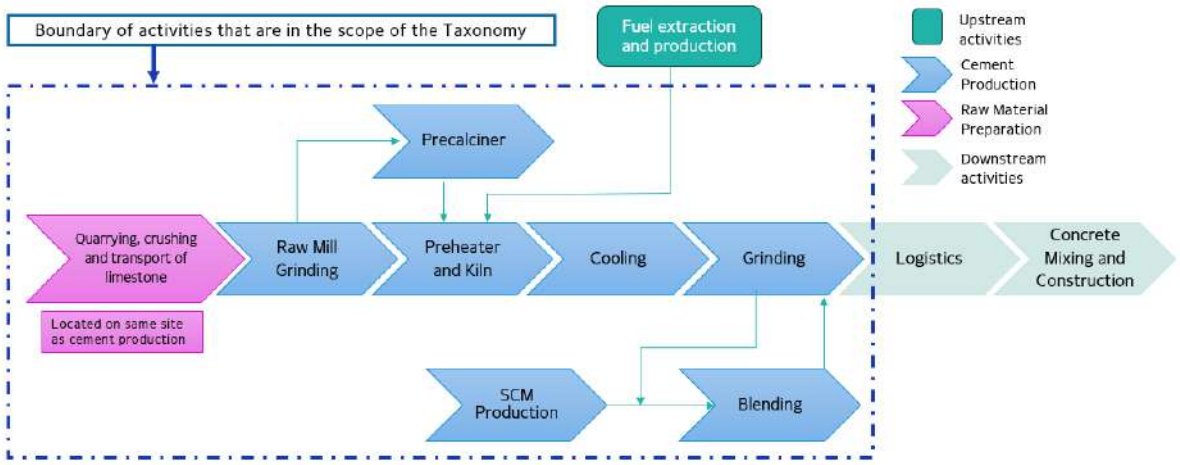
Decarbonisation trajectories for cementitious products were calculated according to data provided by Thai Cement Manufacturers Association (TCMA). TCMA has adopted Thailand 2050 Net Zero Cement and Concrete Roadmap [65], compliant with the Paris Climate Agreement and assuming full decarbonisation of the sector by 2050.

The scope of the activity included under Thailand Taxonomy covers assets and activities involved in the production of cement, with the scope boundary beginning at the quarry of limestone and ending at the final blended cement product. The quarrying activity is included in the scope only if it is integrated into the same geographical location as cement production facilities and operations (separate quarries can't be assessed against the Taxonomy). The cement production facilities themselves may be integrated from quarries to blended cement, or they may be responsible for only one stage of production, for example, clinker production, grinding, or blending. The boundary is illustrated in the figure below

[64] Primary organic streams or sources are those which come directly from the land and without having undergone any processing, apart from cleaning. They maintain all the biological qualities they had when they were still on the plants. Secondary organic streams or sources are those that have undergone processing or have been used.

[65] Thai Cement Manufacturers Association. *Thailand 2050 Net Zero Cement & Concrete Roadmap*. Bangkok: Thai Cement Manufacturers Association, October 2024. https://www.thaicma.or.th/en/ebook_detail/3/197

Figure 5 Cement production activities within the scope of the Taxonomy criteria



Apart from the activities defined in the boundary in the figure above, the activities and assets in the cement production value chain that are **out of the scope** of the Taxonomy activity are as follows:

- **Production of fly ash and blast furnace slag**: Production of these through coal power or steel production is not eligible. However, the processing of such materials extant from a power plant that no longer functions can be eligible.
- **Concrete**: the production of concrete itself and associated activities (mix design, mixing itself, transportation to site, quality control, etc.) are out of scope.
- **Quarrying**: quarrying in and of itself (i.e., that is separate from a cement plant or is a pure-play quarry company) is not within scope.

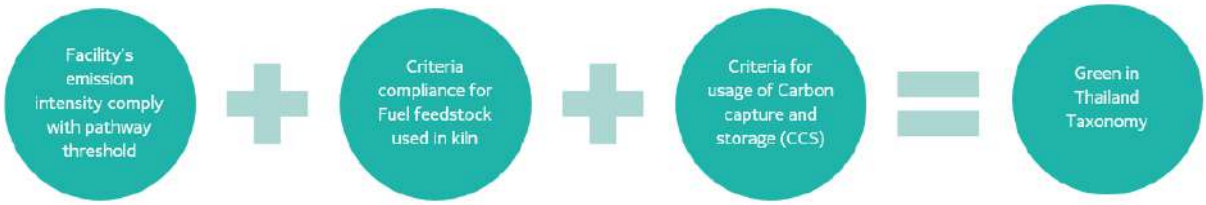
Additionally, the entities in the cement production value chain that are **out of the scope** of the Taxonomy activity are as follows:

- **Pureplay concrete producers:** Companies whose sole activity is the production of concrete itself and associated activities (mix design, mixing itself, transportation to site, quality control, etc.).
- **Pureplay quarrying companies:** Companies whose sole activity is quarrying (i.e., separate from a cement production company).
- **Pureplay clinker production companies:** Companies that solely produce clinker, which is then sold downstream for further processing into cement. Note: companies

that produce clinker and cement are within the scope of a company that purchases clinker.

In order to be compliant with green criteria, all important elements of the facility and technological process should correspond to the criteria stipulated in the respective activity card. An overview of that list is given in the figure below.

Figure 6 Green criteria framework for manufacturing of cement



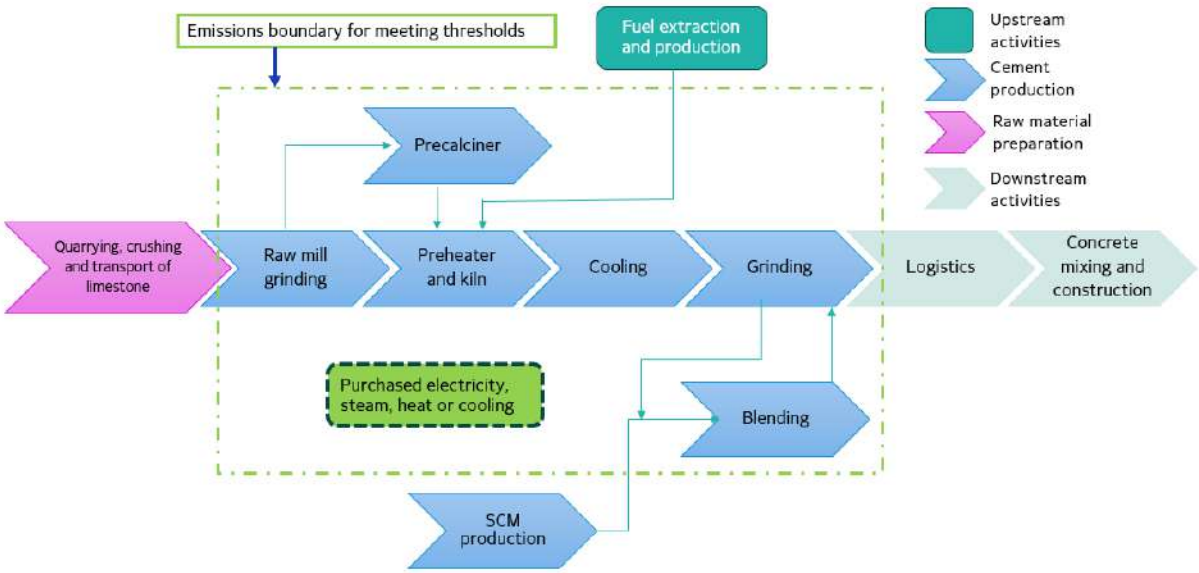
The facility level emission intensity threshold is in terms of t CO2/ t cementitious product or t CO2/ t cement (equivalent), wherein "cementitious product" means clinker, cement and cement substitutes produced by the reporting entity.

The scope of emissions that must be covered when assessing compliance with the Taxonomy is detailed in the figure below and includes the following:

- **Direct (scope 1) emissions from cement production**
  - Burning fossil fuels to heat kilns (thermal emissions);
  - Calcination emissions (process emissions);
  - Emissions from alternative fuels and raw materials;
  - On-site power generation.
- **Indirect (scope 2) purchased energy emissions.**
  - Purchase of electricity, steam, heat, or cooling.
- **Off-site (scope 3) indirect impacts in the value chain not owned or controlled by the reporting entity (upstream)**
  - As the carbon intensity of the final cement product is the metric, facilities responsible for one specific production stage (for example, grinding facilities) must partially incorporate scope 3 emissions;

- However, this is only scope 3 emissions up to the point of the finished cement, not downstream emissions associated with transporting or using the clinker/cement product.

Figure 7 Emission boundary for meeting the thresholds of manufacturing of cement activity card



Amber criteria of the activity include decarbonisation measures that are applicable within the cement production facility where the entity **has a transition plan aligned with the commitments under the Paris Agreement.** These eligible decarbonisation measures or retrofitting activities (capital investments) must be implemented prior to a defined sunset date of 2040.

Manufacturing of cement criteria and thresholds

Sector	Manufacturing
Activity	Manufacturing of cement
ISIC code	2394
Description	Production of cementitious products
Objective	Climate change mitigation
Green	For the cement production activity to be aligned with the Taxonomy, the activities need to meet specific emissions intensity thresholds for cementitious products defined in Table: Cementitious products decarbonisation pathway. Additional requirement to align with other activities in Thailand Taxonomy:

	• If facilities use biomass or hydrogen as a fuel source, they should meet the green criteria for these activities. • If facilities use waste as a fuel source, including municipal solid waste, they should meet the following criteria: ▪ Align with the green criteria in waste management sector ▪ Maximum of waste of recycling potential[66] must be removed prior to burning; ▪ Municipal solid waste will not be eligible as a fuel type after 2050. • If the plant uses CCS/CCUS equipment on site, it should meet the green criteria of CCS/CCUS.
Amber	Eligible decarbonisation measures or retrofitting activities (capital investments) must: • Be implemented prior to 2040 (sunset date); • Constitute one or more of the following actions: - Installation, upgrade, and operation of pre-calciners; - Installation, upgrade, and operation of heat recovery systems; - Installation, upgrade, and operation of digitised control equipment or infrastructure. This may include: ▪ Sensors and measurement tools (including software to allow real-time and close control of processes to improve efficiency); ▪ Communication and control (including advanced software and control rooms and automation of plant processes). - Installation, upgrade, and operation of testing equipment. For example (but not limited to): ▪ Automated X-ray diffractometer systems - Electrification of heat (for example, electrified kiln processes); - Installation, upgrade, retrofit and operation of measures which achieve emissions savings equivalent to the emissions decrease for facilities over the lifespan of the debt instrument;

[66] A list of waste of recycling potential can be found here or similar Thailand definition can be used: "How Do I Recycle Common Recyclables | US EPA," US EPA, December 1, 2023, https://www.epa.gov/recycle/how-do-i-recycle-common-recyclables.

	- Installation, upgrade, and operation of carbon capture and storage equipment that is aligned with Taxonomy criteria for CCS/CCUS: Point-source capture of CO2 (green category); - Infrastructure, revamps, or modifications of equipment needed for the production of cement using hydrogen as a fuel that is aligned with Taxonomy criteria for hydrogen (green category). • The facility must have net-zero plan aligned with the commitments under the Paris Agreement.
Red	Activities that do not comply with the green or amber category are harmful to the objective of climate change mitigation.
Criteria Reference	Climate Bonds Cement Criteria

Table 6 Clinker decarbonisation pathway

Year	2025	2030	2035	2040	2045	2050
Carbon intensity (t CO2/ t cementitious or t cementitious product)	0.556	0.445	0.418	0.293	0.147	0

3. Manufacturing of basic iron and steel

International Energy Agency Net-Zero Emissions (IEA NZE)[67] decarbonisation pathway adjusted in line with the ClimateAligned Finance Framework for Steel[68] approach has been utilised to construct these criteria. The IEA NZE Benchmark utilised by the Sustainable STEEL Principles is a modified version on the "Net Zero by 2050" scenario published by the IEA in 2021, with the following modifications:

- Yearly emissions and scrap utilisation data was interpolated using the decadal emissions and scrap utilisation data published by the IEA in the "Net Zero by 2050" report;
- Scope 1 emissions were taken directly from the IEA's "Net Zero by 2050" report, while Scope 2 emissions were estimated using the technology shares of total production

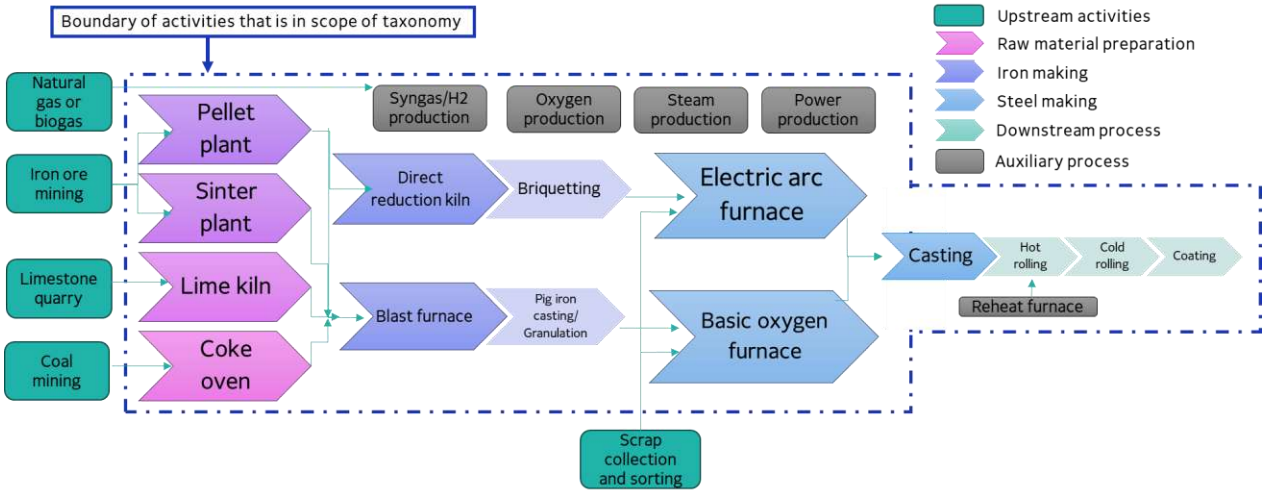
[67] IEA, "Iron & Steel - IEA," n.d., https://www.iea.org/energy-system/industry/steel.

[68] Climate Alignment, "Sustainable Steel Principles Framework," June 2022, https://climatealignment.org/wpcontent/uploads/2022/06/sustainable_steel_principles_framework.pdf.

included in the report paired with the corresponding emissions factors included in the Mission Possible Partnership model[69].

The scope of the activity involves assets and activities associated with the production of iron and steel, with the scope boundary beginning at the raw material preparation stage and ending at the final steel product coming out of the rolling and coating stages. The stages of steel production that are under the scope of the Taxonomy are defined in the figure below.

Figure 8 Steel production value chain and activities within the scope of the Taxonomy criteria.



Apart from the activities and facilities defined in the figure 8, the activities and assets in the cement production value chain that are **out of scope** are as follows:

- **Iron mining:** Mining in and of itself (i.e., separate from a steel plant) is not certifiable under these criteria;
- **Coal mining:** a coal mine cannot be certified. However, producers using coal need to comply with the additional qualitative criteria specific to the use of coal;
- **Steel alloying (alloying is not a climate-material process that can be separated from steelmaking);**
- **Steel scrap collection and sorting (it is defined by the Waste Sector);**
- **Raw material preparation and downstream processes:** assets and activities dealing solely with the production of coke, iron ore pellets and other raw materials that are

[69] "Steel," Mission Possible Partnership, n.d., https://www.missionpossiblepartnership.org/action-sectors/steel/.

not part of an iron or steel production facility are out of the scope, as are assets only dedicated to downstream activities such as rolling, and finishing.

Additionally, the entities in the iron and steel production value chain that are **out of scope** are as follows:

- **Pureplay iron ore mining companies:** companies whose sole activity is the mining of iron ore (i.e., separate from a steel production company);
- **Pureplay coal companies:** companies whose sole activity is coal mining (i.e., separate from a steel production company);
- **Pureplay stainless and high alloy steels production companies:** companies whose sole activity is the production of stainless and high alloy steels and associated activities;
- **Pureplay steel scrap collection and sorting companies:** Companies whose sole activities are the collection and sorting of steel scrap.

Usability notes

In order to be aligned with the green category, steel facilities must comply with two sets of criteria: facility-specific (based on the major technological process utilised by the facility, for example blast furnace or direct reduction of iron facilities) and cross-cutting (related to feedstock used by the facility regardless of the main technological process utilised on it). Since steel production facilities can operate for many years, new facilities should already be built with CO2 emissions mitigation technologies in place or avoid CO2 generation entirely by limiting the use of fossil fuels. The technical challenges are such that this is very important at the design stage – if a plant is not designed to have, for example, CCS/CCUS implemented, it is very difficult to retrofit later.

The amber criteria of the activity include decarbonisation or retrofitting measures that are applicable within the steel production facility. To acknowledge and promote the decarbonisation efforts, new and existing facilities that do not meet criteria designed for the green category at the outset but have been designed to envisage full alignment over time and by 2040 at the latest can be classified as amber. Apart from that, a measures-based approach is also included.

Manufacturing of iron and steel criteria and thresholds

Sector	Manufacturing
Activity	Manufacture of basic iron and steel
ISIC code	2410
Description	Operations of conversion by reduction of iron ore in blast furnaces and oxygen converters or of ferrous waste and scrap in electric arc furnaces or by direct reduction of iron ore without fusion to obtain crude steel, which is smelted and refined in a ladle furnace and then poured and solidified in a continuous caster in order to produce semi-finished flat or long products
Objective	Climate change mitigation
Green[70]	In order to be eligible as green, activities and facilities where they take place must comply with all of the following: • Applicable facility-specific mitigation criteria (**Table 7**) • Applicable cross-cutting criteria (**Table 8**) Facilities using hydrogen as a fuel or reductive agent are eligible only if hydrogen complies with Taxonomy criteria for hydrogen (green category)
Amber	**Option 1** Eligible facilities and assets that are mentioned in **Table 7** but do not meet the criteria identified in this table can be classified as amber only if (must comply with all criteria): • The facility has been designed to and is implementing all necessary actions to meet the criteria for the green category by 2040 at the latest; • The facility, from the onset of its operations, is using CCS/CCUS, which operates to capture at least 20% of emissions; • A facility has a transition plan aligned with the commitments under the Paris Agreement.
	Option 2 Specific technological measures can be implemented to decarbonise steel and iron production if they: 1. are implemented prior to the sunset date (2040); 2. enable the eligible assets to meet the criteria identified in **Table 7** (examples of compliant measures are listed in **Table 8);**

[70] Green activity threshold does not require any specific decarbonisation threshold as emission is limited by the technical solutions suggested for each particular facility type

	3. comply with applicable cross-cutting criteria listed in **Table 8.**
Red	Activities that do not comply with the green or amber category are harmful to the objective of climate change mitigation. CCUS for the production of products that release CO2 immediately when these are used (such as in urea, carbonated beverages, or fuels), for enhanced oil recovery, and the production of other forms of fossil energy sources is harmful to the objective of climate change mitigation.
Criteria Reference	Climate Bonds Steel Criteria

Table 7 Eligible iron and steel production facilities

Facility technology type (eligible assets)	Facility-specific mitigation criteria
BF-BOF (Blast Furnace – Basic Oxygen Furnace)	• Has to have CCS/CCUS meeting taxonomy criteria for CCS/CCUS; • CCS/CCUS should capture at least 70% of all emissions.
Smelting reduction	• Has to have CCS/CCUS meeting Taxonomy criteria for CCS/CCUS; • CCS/CCUS should capture at least 70% of all emissions.
Direct Reduced Iron (DRI)	If fossil gas-based: • Has to have CCS/CCUS meeting Taxonomy criteria for CCS/CCUS; • CCS/CCUS should capture at least 70% of all emissions. If 100% hydrogen-based: • hydrogen meets carbon intensity thresholds and specific Taxonomy criteria for hydrogen (green category).
Electric Arc Furnace (EAF)	• Needs to use 70% of scrap as total annual inputs; OR • The combined scrap and (100%) hydrogen-based DRI meeting taxonomy criteria for DRI (green category) should add to at least 70% of the EAF's total annual inputs.
DRI – EAF	If fossil gas-based: • Has to have CCS/CCUS meeting taxonomy criteria for CCS/CCUS; • CCS/CCUS should capture at least 70% of all emissions. If 100% hydrogen-based: • hydrogen meets carbon intensity thresholds and specific taxonomy criteria for hydrogen (green category).

Table 8 Cross-cutting criteria for iron and steel

Eligible assets	Cross-cutting mitigation criteria
Facilities that use fossil gas as a reducing agent and/or for energy generation	Using fossil gas both as a reducing agent and for energy generation is only eligible for existing facilities prior to 2040. To qualify after 2040, such facilities would have to use fossil gas combined with CCS/CCUS measures that meet the Taxonomy criteria for CCS/CCUS and: • Utilisation of direct CO2 emissions from steel production is used for the manufacture of durable products and does not lead to enhanced oil recovery and the production of other forms of fossil energy sources. • Projects using fossil gas (even if) combined with CCS/CCUS should demonstrate that on-site activities: MRV (Monitoring, Reporting and Verification), and mitigation measures for methane leaks as per the best practice recommended[71]. Any venting or burning within the limits of the steel plant shall be avoided, except in emergency situations, in such case it shall be reported and accounted for in the GHG assessment. • Projects using fossil gas (even if) combined with CCS/CCUS should demonstrate that upstream activities provide evidence of having MRV (Monitoring, Reporting and Verification) and mitigation measures for methane leaks as per the best practice recommended[72].
Facilities that use coal as a reducing agent and/or for energy generation	Using coal, both as a reducing agent and fuel in the steelmaking process, is only eligible for existing facilities prior to 2040. After 2040, facilities would have to use coal combined with CCS/CCUS measures that meet the Taxonomy criteria for CCS/CCUS and utilisation of direct CO2 emissions from steel production is used for the manufacture of durable products and does not lead to enhanced oil recovery and the production of other forms of fossil energy sources.

[71] Best practice can be found in the report: Best Practice Guidance for Effective Methane Management in the Oil and Gas Sector. Monitoring, Reporting and Verification (MRV) and Mitigation. United Nations Economic Commission for Europe. 2019: United Nations Economic Commission for Europe, "Best Practice Guidance for Effective Methane Management in the Oil and Gas Sector," ECE ENERGY SERIES (UNITED NATIONS, 2019), https://unece.org/fileadmin/DAM/energy/images/CMM/CMM_CE/Best_Practice_Guidance_for_Effective_Methane_Management_in_the_Oil_and_Gas_Sector__Monitoring__Reporting_and_Verification__MRV__and_Mitigation-_FINAL__with_covers_.pdf

[72] ibid

Eligible assets	Cross-cutting mitigation criteria
	Projects using coal should demonstrate the following: • Upstream activities: Provide evidence of having MRV (Monitoring, Reporting and Verification) in place, as well as mitigation measures for methane leaks as per the best practice recommended[73].
Facilities that use biomass as a reducing agent	Facilities using biomass as a reducing agent are only eligible if they use the following sources of biomass: • **Food or feed crops:** If food crops are used, they must be certified as a renewable feedstock (defined as feedstock certified by Roundtable on Sustainable Biomaterials or International Sustainability and Carbon Certification) • **Plantation wood:** the wood plantation shall demonstrate to meet the requirements set out for "Forestry plantation" activities of the Taxonomy. • **Industrial crops.** AND Primary organic streams[74] are only eligible as fuel if certified as sustainable by Roundtable on Sustainable Biomaterials or International Sustainability and Carbon Certification. Wood is eligible only if produced on a sustainable plantation as defined by the Thailand Taxonomy's Forestry Criteria
Facilities using CCS/CCUS	Facilities using CCS/CCUS are only eligible if the CCS/CCUS meets Taxonomy criteria for CCS/CCUS and utilisation of direct CO2 emissions from steel production is used for the manufacture of durable products (e.g., construction materials stored in buildings or recyclable products, e.g., PET). CO2 should not be used for products that release the CO2 immediately when these are used (such as in urea, carbonated beverages, or fuels), nor for enhanced oil recovery and the production of other forms of fossil energy sources.

[73] ibid

[74] Primary organic streams or sources are those which come directly from the land and without having undergone any processing, apart from cleaning. They maintain all the biological qualities they had when they were still on the plants. Secondary organic streams or sources are those that have undergone processing or have been used.

Table 9 Criteria for capital investments in decarbonisation measures for steel facilities

Eligible Assets	Facility-specific mitigation criteria
Optimisation of electric arc furnaces, installation and operation of other mitigation measures associated with EAF facilities	Implement decarbonisation measures that: ● enable the facility to increase the scrap total annual input; OR ● enable the facility to increase the share of renewable energy used by the facility.
Measures associated to a production line with a blast furnace (BF)	● No relining; ● The emissions intensity of the facility should be below 1.8 tCO2/t steel by 2040; ● Decarbonisation measures should decrease emissions (tCO2/t steel) between 2024 and 2040 by: - by 15% if emissions < 2.0 tCO2/t steel and if the production line with BF became operational in 2007 or later; OR - by 20% if emissions >2.0 tCO2/t steel and if the production line with BF became operational in 2007 or later; OR - at least 50% of the production line with BF became operational prior to 2007.
Measures associated with a production line with a DRI or smelting reduction	● Implement decarbonisation measures to decrease emissions (tCO2/t steel) between 2024 and 2040 by: ○ If fossil gas based: 20%; OR ○ If coal based: 40%.
Installation of CCS/CCUS	CCS/CCUS must meet relevant CCS/CCUS criteria from Thailand Taxonomy
Measures involving biomass or bioenergy	Biomass and bioenergy must meet relevant criteria from Thailand Taxonomy.
Measures involving the use of hydrogen	Hydrogen must meet relevant hydrogen criteria from Thailand Taxonomy.

Table 10 A non-exhaustive exemplary list of decarbonisation measures that comply with the amber category

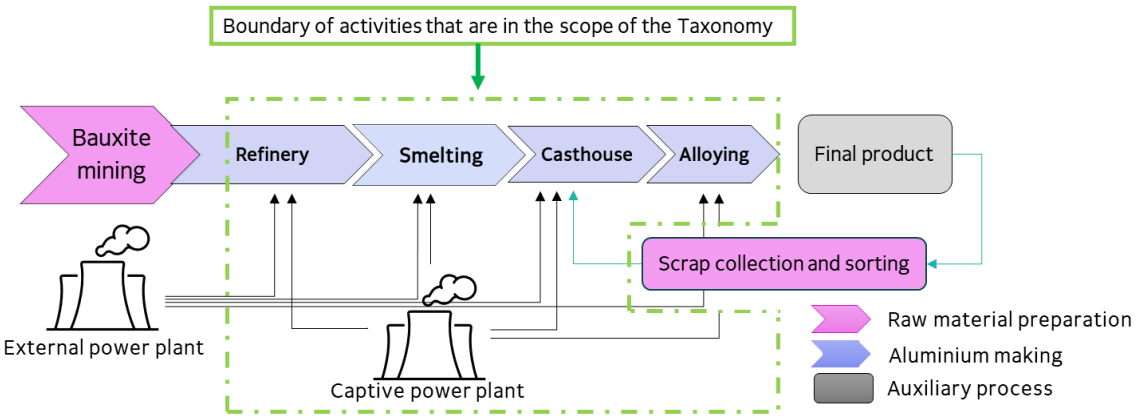
Asset and activity types	Example of compliant CapEx
Heat recovery	Installation, upgrade, and operation of heat recovery systems
Optimisation of blast furnace	Pulverise coke injection, top gas recycling, stove waste gas heat recovery
Optimisation of basic oxygen furnace	Recovery of basic oxygen furnace gas and sensible heat
Optimisation of coke plant	Coke dry quenching
Optimisation of sinter plants	Sinter plant heat recovery
Optimisation of EAF	Oxyfuel burners, EAF scrap preheating, CHP from waste heat
Optimisation of rolling finishing and reheating furnace	High-efficiency burner, flue-gas monitoring, combustion optimisation, exhaust gas heat recovery
Optimisation of casting	Near net-shape casting
Optimisation of monitoring and control systems	Installation, upgrade, and operation of advanced sensors and digitised control equipment and systems
Carbon capture and storage	Installation, upgrade, and operation of infrastructure and equipment related to CO2 capture of emissions from steel production.
Fuel switching	Infrastructure revamps or modifications of equipment needed for the production of steel using hydrogen or biomass as a reducing agent
Electrification of heat	Electrification of reheating furnacing

4. Manufacturing of aluminium

Aluminium is a critical metal with applications in a multitude of renewable energy technologies. Its special characteristic is that it can be recycled and reused without any loss of quality, and these criteria maximise the incentives for the use of recycled aluminium and its recycling.

Under the present criteria, both the aluminium production process and the financial flows associated with it (revenues), as well as the entire aluminium-producing enterprises that meet the parameters, can be verified.

Figure 9 Scope of activities covered by the manufacturing of aluminium criteria (primary aluminium)



Scoping for the production of secondary aluminium is not included as secondary aluminium is automatically aligned with the taxonomy without any additional criteria or requirements.

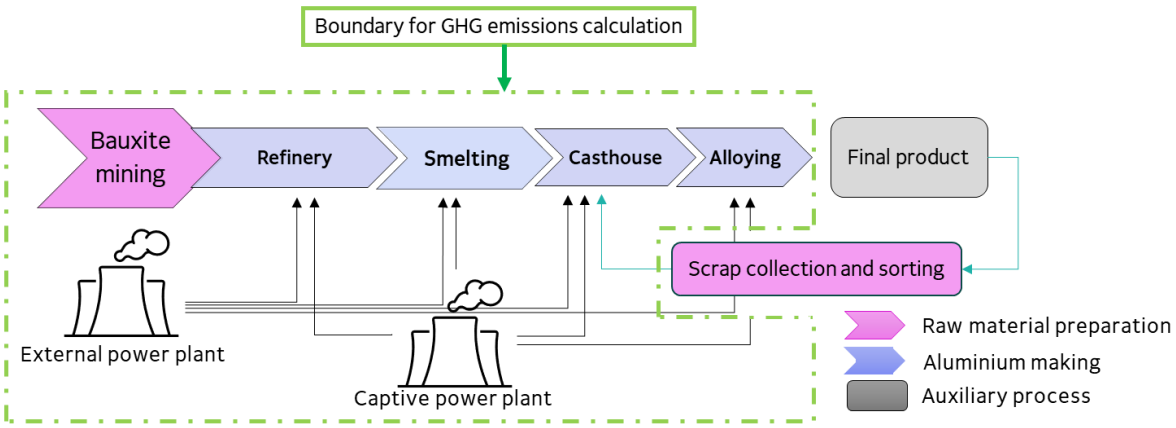
It is important to note that decarbonisation of the aluminium production chain is possible both in the case of primary aluminium production and secondary aluminium production (e.g., a project to replace generating capacity from hydrocarbon generation to renewable generation). This, however, is not a mandatory requirement.

Scoping boundaries for GHG calculation include scope 1 and scope 2 as defined by the International Aluminium Institute[75]:

- Scope 1: Fuel combustion in furnaces/boilers on-site, Coke calcination, Anode production, Anode consumption, PFC emission, Lime production
- Scope 2: Emissions from purchased electricity, heat, or steam

[75] International Aluminium Institute, "The Aluminium Sector Greenhouse Gas Protocol," 2006, https://ghgprotocol.org/sites/default/files/2023-03/aluminium_1.pdf.

Figure 10 GHG emission calculation scope for manufacturing of aluminium activities (primary aluminium)



Scoping for the production of secondary aluminium is not included as secondary aluminium is automatically aligned with the taxonomy without any additional criteria or requirements.

Methodological approach

The main emissions from aluminium production are emitted during electricity generation (60%). A further 15% or so are emitted from the combustion of fuel directly at the smelter, and a further 15% from physical and chemical processes at the smelter[76]. Decarbonisation of the aluminium production chain can, therefore, be carried out in three main ways[77]:

- Improving the energy profile: increasing the share of renewable energy consumption, installing CCS/CCUS, and improving the energy efficiency of technologies.
- Reduce fuel consumption in production through the introduction of CCS/CCUS, inert anodes, refinery, and cast house electrification.
- Increasing the share of recycled aluminium through the development of an aluminium waste collection system at all stages.

Aluminium production criteria

Sector	Manufacturing
Activity	Manufacturing of aluminium
ISIC code	2420

[76] International Aluminium Institute, "Aluminium Sector Greenhouse Gas Pathways to 2050," International Aluminium, September 2021, https://international-aluminium.org/resource/aluminium-sector-greenhouse-gas-pathways-to-2050-2021/.

[77] Ibid.

Description	Manufacture of aluminium through primary alumina (bauxite) process or secondary aluminium recycling.
Objective	Climate change mitigation; Resource resilience and circular economy promotion
Green	**Primary aluminium production** where the economic activity complies with all of the following criteria is aligned with the taxonomy if all of the following requirements are met: • the GHG emission intensity does not exceed thresholds presented in Table Aluminium decarbonisation pathway; • the average carbon intensity for the consumed electricity does not exceed parameters established for green electricity production as defined by Thailand Taxonomy; • the electricity consumption for the manufacturing process does not exceed 14.86MWh/t Al. **Secondary aluminium production** is automatically eligible
Amber	Specific technological measures can be implemented to bring aluminium production emission and energy intensity in line with the requirements of the green category if: • They are implemented before the established sunset date (2040); • They decrease either emission intensity or electricity consumption intensity of the production process; • The facility has a transition plan aligned with the commitments under the Paris Agreement.
Red	Activities that do not comply with the green or amber category are harmful to the objective of climate change mitigation.
Criteria Reference	EU Manufacture of Aluminium Criteria; Singaporean Taxonomy

Table 11 Aluminium decarbonisation pathway

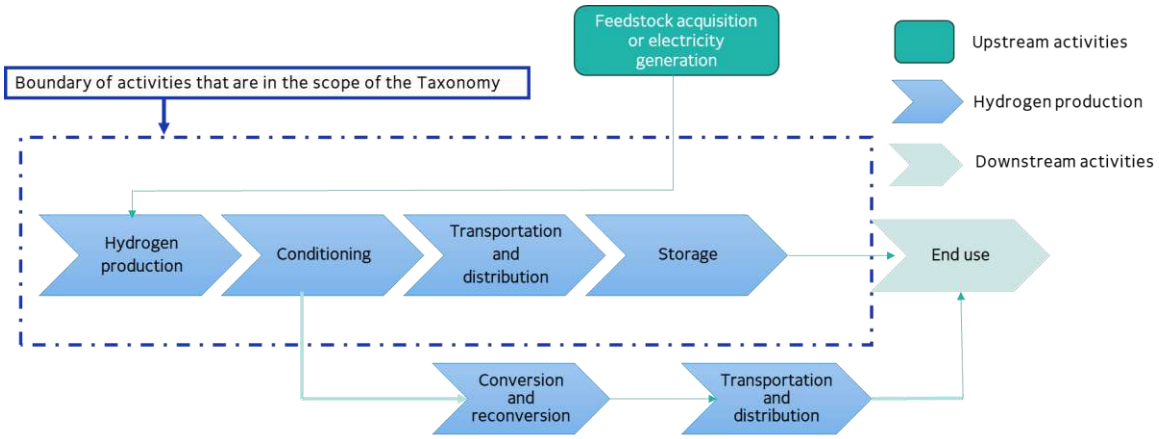
Asset Type	CO2e emissions intensity (tonnes CO2e per tonne of aluminium manufactured)				
	2025	2030	2035	2040	2050
Production of primary aluminium through electrolysis	1.484	1.185	0.826	0.520	0.311

5. Manufacturing of hydrogen[78]

There are numerous end-to-end hydrogen production pathways, however they are tailored to energy sources, conversion technology, and transport method selected. Thus, it is preferable to develop pathway-agnostic carbon emissions benchmarks. Climate Bonds suggests to use the projection of decreasing threshold values performed to ensure that assets and activities are aligned to a transition pathway that contributes to the 1.5°C target. These benchmarks have 2030, 2040 and 2050 targets that get stricter over time to offer guidance to investors and industry on how emissions should reduce in upcoming decades. Hydrogen production carbon intensity benchmarks can be met by different energy sources and technology options, as has been verified using carbon intensity values estimated by MIT Energy Initiative's SESAME platform[79].

The scope of the activity involves assets and activities associated with the production, conditioning, conversion, transportation, and storage of hydrogen. It covers activities across the hydrogen value chain, except for end-users, which are part of each end-use sector criteria. The stages of hydrogen production that are under the scope of the Taxonomy are defined in the figure below.

Figure 11 Hydrogen production value chain and activities within the scope of the Taxonomy criteria.



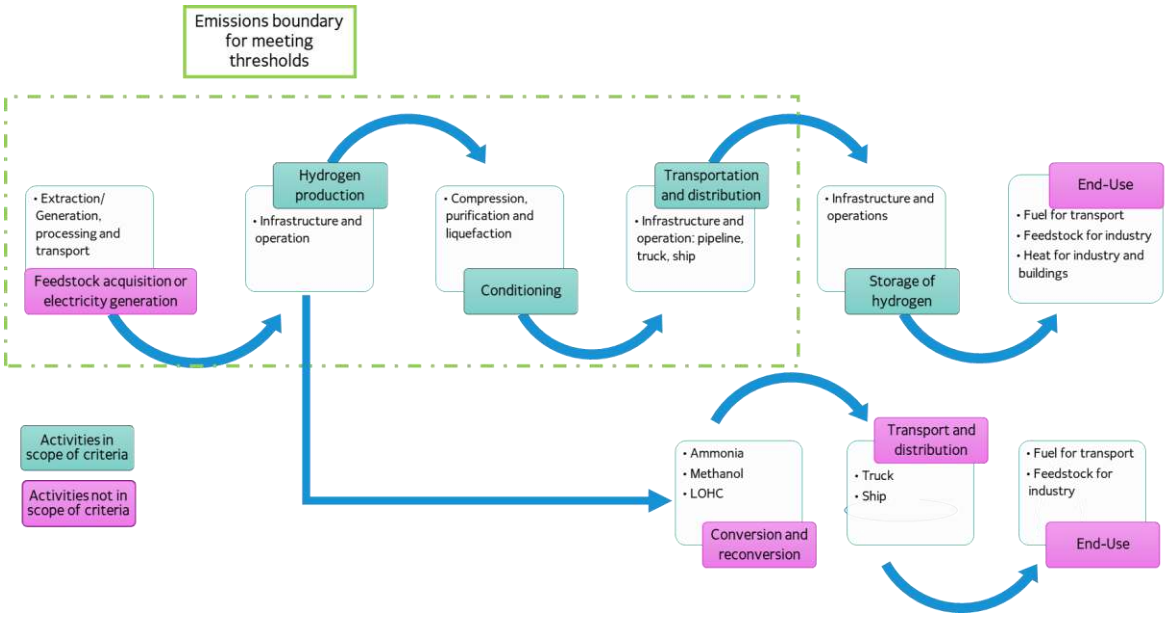
[78] The approach in this section does not categorize hydrogen as "green," "brown," or "blue," but instead specifies only the greenhouse gas emission intensity. For more information, please refer to the FAQ section under Thailand Taxonomy.

[79] MIT Energy Initiative, "SESAME," Main, April 30, 2024, https://energy.mit.edu/research/sesame/.

If hydrogen is converted to ammonia or other carriers before transportation, that conversion is out of scope and therefore, for these criteria, it is only up to the point before it is converted, which is relevant and should meet the proposed threshold. The conversion, transportation, and storage **are not currently in scope** due to a lack of global guidance, although additional research is going into developing criteria for those parts of the process separately.

The emission boundary within the hydrogen production value chain for the calculation of carbon intensity thresholds is defined on figure below.

Figure 12 Emission boundary for meeting the thresholds of manufacturing hydrogen



Hydrogen is not a primary energy source but an energy carrier whose production requires high amounts of energy. It can be produced from different energy sources, such as fossil fuels, biomass, renewables, nuclear, and via diverse conversion technologies. Nevertheless, most of its production today is based on fossil fuel-based alternatives: steam methane reforming (SMR) of natural gas and coal gasification; these production pathways have high carbon footprints; hence, making hydrogen production less emission intensive is essential to contribute to decarbonisation of the economy.

Traditionally, different processes used in hydrogen production were associated with certain colours, e.g., "green hydrogen" or "grey hydrogen". However, there is no scientifically verifiable separation of hydrogen by colour, so these criteria will use the traditional Thailand Taxonomy method of creating criteria based on limiting the emission intensity per unit of production.

Starting limitation of 3 kgCO2e/kgH2 sets a limit that effectively cuts off the overwhelming majority of fossil fuels-based hydrogen production that does not use CCS/CCUS.

To meet the green criteria, hydrogen must be produced according to a decreasing decarbonisation pathway over time, and technologies must meet specific criteria.

The amber criteria of the activity include decarbonisation or retrofitting measures that are applicable within the hydrogen production facility and those that are implemented before the established sunset date of 2040. The facility must also have a decarbonisation plan aligned with the commitments under the Paris Agreement.

Manufacturing of hydrogen criteria and thresholds

Sector	Manufacturing
Activity	Manufacturing of hydrogen
ISIC code	2011
Description	Manufacture of low-carbon hydrogen
Objective	Climate change mitigation
Green	The facility must comply with all of the following requirements: • Hydrogen production must meet specific carbon intensity thresholds (**Table 12**)[80]; • Facilities must meet relevant requirements listed in Table in the Annex depending on the feedstock, electricity source and application of CCS/CCUS; • Facilities that meet the specific intensity thresholds presented in Table in the Annex do not have to meet the following requirements associated with CCS/CCUS listed in Table in the Annex: minimum capture rate from process and energy emission streams should be 90% or emissions reduction at the facility level have to be at least of 50%. **Note**: The use of fossil gas as a feedstock by facilities following 2040 is not recommended but given substantial uncertainty regarding the availability of

[80] To demonstrate compliance with any of the emissions intensity thresholds set in the Table 12, issuers are required to carry out a life cycle assessment within the system boundary defined in the scope of the present criteria in line with recommendations given in Annex.

	hydrogen that is aligned with the Thailand Taxonomy (green category), it is not a criterion at this stage. This should be re-evaluated in future iterations.
Amber	Specific technological measures can be implemented to decarbonise hydrogen production if: • They are implemented before the established sunset date (2040); • They are included in the list and comply with the criteria stipulated in Table in the Annex; • A facility has a transition plan aligned with the commitments under the Paris Agreement.
Red	Facilities or measures for which: • The energy source is oil, coal, or coal derivatives; • The feedstock is coal or coal derivatives; • The energy source is biomass from primary sources; • The use of wood and other dedicated crops is enabled; are harmful to the objective of climate change mitigation.
Criteria Reference	Climate Bonds Hydrogen Criteria; Singapore Taxonomy

Table 12 Hydrogen carbon intensity thresholds

Asset Type	2025	2030	2040	2050
Production of hydrogen (kgCO2e/kgH2)	3	1.5	0.6	0

6.2 Interim activities

1. Manufacture of plastics in primary form

The proposed criteria only cover plastics in primary form and not the final products. For the guidance on plastic waste management please refer to the Waste section of the taxonomy.

Manufacturing of plastics in primary form criteria and thresholds

Sector	Manufacturing
Activity	Manufacturing of plastics in primary form
ISIC code	2013

ISIC description	Manufacture of resins, plastics materials and non-vulcanisable thermoplastic elastomers, the mixing and blending of resins on a custom basis, as well as the manufacture of non-customised synthetic resins.
Objective	Climate change mitigation; Resource resilience and circular economy promotion
Green	The activity must comply with at least one of the following: ● production of primary plastics from post-consumer recycled (PCR) plastic waste using mechanical recycling methods; ● In cases where primary plastic cannot be processed through mechanical recycling or is not economically viable, all primary plastic must be produced through environmentally sound[81] chemical recycling. However, it must have a lower life-cycle greenhouse gas (GHG) emission compared to production using fossil-based raw materials. ● Primary plastic produced partially or entirely from renewable raw materials must be certified (or domestic/ international certification equivalent) by: - Roundtable on Sustainable Biomaterials (RSB) or - International Sustainability and Carbon Certification (ISCC) Additionally, it must have a lower life-cycle GHG emission than production using fossil-based raw materials. Life-cycle greenhouse gas emissions must be calculated using ISO 14067:2018, ISO 14064-1:2018 or comparable. The activity must comply with both of the following: ● The activity does not use food or feed crops from the land that was converted from high-carbon stock land after 01.01.2010. ● Wood biomass must come from plantations that comply with “Forestry Plantation” criteria of the Thailand Taxonomy

[81] “Environmentally sound” manner means taking all practical steps to ensure that wastes are collected, transported, and disposed of (including after-care of disposal sites) in a manner which will protect human health and the environment against the adverse effects which may result from such wastes. Definition is taken from Basel Convention on the control of the transboundary movement of hazardous waste and their disposal https://www.basel.int/portals/4/basel%20convention/docs/text/baselconventiontext-e.pdf

Amber	N/A[82]
Red	• Primary plastic polymer production is harmful to the objective of climate change mitigation. • Activities that do not comply with the green or amber category are harmful to the objective of climate change mitigation.
Criteria Reference	EU Taxonomy Manufacture of Plastics in Primary Form Criteria

6.3 Enabling Activities

This section includes manufacturing activities that may emit some emissions themselves; however, their significant impact on the decarbonization of other sectors is substantial that these initial emissions can be neglected. During the transition from the current state of the economy and society to a sustainable society compatible with the objectives of the Paris Agreement and national decarbonisation targets, this type of activity can be most beneficial. In the future, as the economy develops and the products of these sectors become more widespread, it may be necessary to account for the production and initial issuance of these assets. Until then, the prevention of harm from their use will be achieved through adherence to the DNSH principles.

1. Manufacture of batteries

Sector	Manufacturing
Activity	Manufacturing of batteries
ISIC code	2720
Description	Manufacture or recycling of rechargeable batteries, battery packs and accumulators for transport, stationary and off-grid energy storage, and other industrial applications; manufacture of respective components (battery active materials, battery cells, casings, and electronic components).
Objective	Climate change mitigation; Resource resilience and circular economy promotion
Green[83]	The activity complies with one of the following criteria:

[82] The plastic production criteria do not contain an amber category because this type of production cannot be progressively improved by gradually replacing different elements of the production chain. It can only be completely modified according to the type of raw material consumed.

[83] The issue of raw material sourcing can't be currently addressed due to the absence of scientific criteria. The Taxonomy should be updated in this regard soon as these criteria are developed. For the time being, possible harm from the improper resource extraction is addressed through the DNSH principles

	• The economic activity manufactures rechargeable batteries, battery packs and accumulators (and their respective components), including from secondary raw materials. • The activity repurposes batteries that have been produced • Recycling of end-of-life batteries
Amber	N/A
Red	N/A
Criteria Reference	EU Taxonomy Manufacture of Batteries Criteria

2. Manufacture of renewable energy technologies

Sector	Manufacturing
Activity	Manufacturing of renewable energy technologies
ISIC code	Various codes
Description	Production of technologies, components and parts that are necessary for functioning of low-carbon or renewable energy technologies as defined by the Energy section of Thailand Taxonomy.
Objective	Climate change mitigation; climate change adaptation; sustainable use and protection of marine and water resources; pollution prevention and control
Green	The economic activity manufactures renewable energy technologies that meet the green criteria set out in Thailand Taxonomy (green category)
Amber	N/A
Red	Manufacturing of components, machinery and equipment used solely for the extraction, production, or distribution of fossil fuels is harmful to the objective of climate change mitigation.
Criteria Reference	EU Taxonomy Manufacture of Renewable Energy Technologies Criteria

3. Manufacture of low-carbon technologies for transport

Sector	Manufacturing
Activity	Manufacturing of low-carbon technologies for transport
ISIC code	Various codes
Description	Manufacturing, repair, maintenance, retrofitting, repurposing, and upgrade of low carbon transport vehicles, rolling stock and vessels, as well as components that help vessels to transition from amber to the green category
Objective	Climate change mitigation

Green	Manufacturing of low-carbon transport vehicles and their respective key components[84], fleets and vessels meeting the criteria set out in Thailand Taxonomy (Green and Amber categories) are eligible.
Amber	N/A
Red	Manufacturing of internal combustion engines-based vehicles is harmful to the objective of climate change mitigation.
Criteria Reference	EU Taxonomy Manufacture of Low-Carbon Technologies for Transport Criteria

4. Manufacturing of energy efficiency equipment for buildings

Sector	Manufacturing
Activity	Manufacturing of energy efficiency equipment for buildings
ISIC code	Various codes
Description	Manufacturing of energy efficiency equipment for buildings
Objective	Climate change mitigation; Climate change adaptation (depending on whether manufactured equipment supports mitigation or adaptation efforts)
Green	The economic activity manufactures one or more of the following products and their key components necessary to support activity "**Installation, maintenance and repair of special-purpose building equipment**" from Thailand Taxonomy, including (but not limited to): • light sources rated in the highest class of energy efficiency in accordance with local market standards[85]; • space heating and domestic hot water systems rated in the highest two populated classes of energy efficiency in accordance with local market standards; • cooling and ventilation systems rated in the highest two populated classes of energy efficiency in accordance with local market standards; • presence and daylight controls for lighting systems; • heat pumps compliant with the technical screening criteria set out in the Taxonomy (green category); • facade and roofing elements with a solar shading or solar control function, including those that support the growing of vegetation;

[84] Components intended solely for use in vehicles that fulfil the criteria of the taxonomy

[85] For Thailand hereinafter this benchmark is established as Energy Label No.5 Three Stars rating or Energy Saving Label (whichever is applicable)

	• energy-efficient building automation and control systems for residential and non-residential buildings; • zoned thermostats and devices for the smart monitoring of the main electricity loads or heat loads for buildings and censoring equipment; • products for heat metering and thermostatic controls for individual homes connected to district heating systems, for individual flats connected to central heating systems serving a whole building, and for central heating systems; • district heating exchangers and substations compliant with the district heating/cooling distribution activity set out in the Taxonomy (green category); • products for smart monitoring and regulating of heating systems and censoring equipment.
Amber	N/A
Red	Manufacturing of building equipment that facilitates the utilisation of fossil fuels is harmful to the objective of climate change mitigation.
Criteria Reference	EU Taxonomy Manufacture of Energy Efficiency Equipment for Buildings

5. Manufacture of other low-carbon technologies

Sector	Manufacturing
Activity	Manufacturing of other low-carbon technologies
ISIC code	Various codes
Description	Manufacturing of household goods that fall into the highest class of national energy efficiency scheme[86] and manufacture of technologies aimed at substantial GHG emission reductions in other sectors of the economy
Objective	Climate change mitigation
Green	The activity manufactures one of the following:

[86] For Thailand hereinafter this benchmark is established as Energy Label No.5 Three Stars rating or Energy Saving Label (whichever is applicable)

	• Household goods that meet the highest performance level for a given good according to the Energy Label No.5[87] rating system or Energy Saving Label rating system[88]. • Technologies that are aimed at and demonstrate substantial life cycle GHG emission savings[89] compared to the best performing alternative technology/product/solution available on the market (including technologies and equipment needed to make substantial contribution to the objectives of the Thailand Taxonomy). • Equipment for waste treatment in line with the Taxonomy criteria for Waste management sector
Amber	N/A
Red	N/A
Criteria Reference	EU Taxonomy Manufacture of Other Low-Carbon Technology Criteria

6.4 CCS/CCUS-Related Activities

1. CCS/CCUS: Point-source capture of CO2

Sector	CCS/CCUS
Activity	Point-source capture of CO_2
ISIC code	No code
Description	Capture of CO_2 from a point source in an industrial or power generation facility
Objective	Climate change mitigation
Green	The activity complies with all of the following criteria: • Point-source capture of CO_2 is eligible only as a supplementary activity for the activities in the Taxonomy (for example, in the Manufacturing section) • Point-source capture of CO_2 is eligible as green if it makes the target activity compatible with the green criteria for a specific activity. The applicability of this option to each individual sector can be found in a specific activity article (relevant to sections related to the production of cement, iron and steel, aluminium, hydrogen and basic chemicals).

[87] Energy Efficiency Standards Promotion Division and Energy and Environment Management Department, Electricity Generating Authority of Thailand, "โครงการฉลากประหยัดไฟฟ้าเบอร์ 5 -," EGAT, n.d., https://labelno5.egat.co.th/home/

[88] กรมพัฒนาพลังงานทดแทน และอนุรักษ์พลังงาน กระทรวงพลังงาน, "ฉลากประสิทธิภาพสูง," n.d., http://www.gmwebsite.com/upload/asiapackprint.com/file/D3.pdf.

[89] Life-cycle GHG emission savings are calculated using ISO 14067:2018, ISO 14064-1:2018 or similar standards.

Amber	The activity complies with all of the following criteria: • Point-source capture of CO_2 is eligible only as a supplementary activity for the activities in Thailand Taxonomy (for example, in the Manufacturing section) • Point-source capture of CO_2 is eligible as amber if it makes the target activity compatible with the amber criteria for a specific activity. Applicability of this option to each individual sector can be found in a specific activity article (relevant for sections related to the production of cement, iron and steel, aluminium, hydrogen, and basic chemicals as well as energy generation from fossil gas).
Red	N/A
Criteria Reference	Singaporean Taxonomy

2. Transportation of captured CO2

Sector	CCS/CCUS
Activity	Transportation of captured CO_2
ISIC code	No code
Description	Captured CO_2 transportation via pipelines, ships, railroad cisterns or trucks
Objective	Climate change mitigation
Green	The activity complies with all of the following criteria: • The CO_2 transported from the installation where it is captured to the injection point leads to: ○ **If transported by sea**: CO2 leakages[90] are less than 3% of the mass of CO2 transported regardless of the distance and less than 2% after 2040 OR ○ **If transported via pipeline**: CO2 leakages are less than 0.5% of the mass of CO2 transported. • The CO_2 is delivered to a permanent CO_2 storage site that meets the criteria for underground geological storage of CO_2 set out in the activity «Permanent sequestration of captured CO_2» article; • Appropriate leak detection systems are applied, and a monitoring plan is in place, with the report verified by an independent third party;

[90] Leakages are defined as fugitive losses due to equipment leaks, accidents, sabotage and exploitation issues.

	• The activity may include the installation of assets that increase flexibility and improve the management of an existing network.
Amber	The activity complies with all of the following criteria: • Retrofitting of the existing CO_2 transportation systems in order to bring down the leakage rate from the current rate to the rate specified in the green category is eligible as amber; • The starting leakage rate may not be above 10 % of the mass of CO_2 transported, regardless of the mode of transportation; • The CO_2 is delivered to a permanent CO_2 storage site that meets the criteria for underground geological storage of CO2 set out in Section «Permanent sequestration of captured CO2»; • Appropriate leak detection systems are applied, and a monitoring plan is in place, with the report verified by an independent third party; • The activity may include the installation of assets that increase flexibility and improve the management of an existing network. • The sunset date for this activity is designated as 2040.
Red	Transportation or retrofitting of transportation systems that do not comply with relevant green and amber criteria are harmful to the objective of climate change mitigation.
Criteria Reference	EU Taxonomy Transport of CO2 Criteria; Singaporean Taxonomy

3. Permanent sequestration of captured CO2

Sector	CCS/CCUS
Activity	Permanent sequestration of captured CO_2
ISIC code	No code
Description	Permanent storage of captured CO_2 in appropriate underground geological formations. This activity does not include nature-based sequestration activities.
Objective	Climate change mitigation
Green	Construction or operation of a permanent CO_2 storage facility is eligible if the facility complies with requirements and recommendations of ISO 27914:2017 (or any other comparable national or international standard) for geological storage of CO_2.
Amber	N/A

Red	Construction of new facilities that fail to comply with ISO 27914:2017 (or any other comparable national or international standard) is harmful to the objective of climate change mitigation.
Criteria Reference	EU Taxonomy Underground Permanent Geological Storage of CO2 Criteria; Singaporean Taxonomy

4. Utilisation of captured CO2

Sector	CCS/CCUS
Activity	Utilisation of captured CO_2
ISIC code	No code
Description	Utilisation of carbon captured by point-source capture or direct air capture of CO2
Objective	Climate change mitigation
Green	Captured CO2 can be used for the manufacture of durable products (e.g., construction materials stored in buildings, polymers or recyclable products that will not be incinerated as a final disposal alternative) or for implementing other Taxonomy-aligned activities (e.g. mixing it with cement or adding it to chemicals).
Amber	N/A
Red	• Use of CO2 for products that release the CO2 immediately when the products are used (such as in urea, carbonated beverages, or fuels) is harmful to the objective of climate change mitigation. • Use of CO2 for enhanced oil recovery, and the production of other forms of fossil energy sources is harmful to the objective of climate change mitigation.
Criteria Reference	Activity card is created for Thailand Taxonomy.

6.5 Auxiliary transitional activity

1. Introduction of energy efficiency and decarbonisation measures in manufacturing activities not specified in the Thailand Taxonomy

Sector	Manufacturing
Activity	Introduction of energy efficiency and decarbonisation measures in manufacturing activities not specified in the Thailand Taxonomy
ISIC code	Various codes
Description	Introduction of energy efficiency or electrification measures and change of energy sources in manufacturing activities that lead to substantial reduction of emission

Objective	Climate change mitigation
Green	Activities whose emission intensity figures are on the trajectory developed using the latest version of the SBTi methodology for this type of activity are compliant with the green category of Thailand Taxonomy. This option is only available for activities in the manufacturing sector that do not have their own activity card in this Taxonomy.
Amber	Measures to improve energy efficiency within the manufacturing sector (as defined by the last version of ISIC system) can be recognised as transitional (amber) under Thailand Taxonomy if the activity does not have specific criteria included in the taxonomy, and: **Option 1 (must comply with all three):** • The applied measures increase energy efficiency (energy input per unit of output) by at least 40% relative to the energy efficiency of facility baseline before the measures were applied. Final reduction of the emission intensity must be achieved no later than the Taxonomy sunset date for amber activities (2040). • If the production facility where the activity takes place uses hydrocarbons in any form (fuel or feedstock), the application of measures shall lead to a reduction in the use of hydrocarbons. • The facility has a transition plan that is consistent with the Paris Agreement commitments[91]. **Option 2 (must comply with both):** • Measures taken lead to electrification of the main production processes; • Measures implemented lead to change the type of electricity consumed by the enterprise from non-renewable to renewable (compliant with the green category of the Thai Taxonomy). Acquisition of PPA certificate does not count for this criterion, the manager of the facility must provide proof of direct connection to a renewable energy source or proof of in situ renewable installation. Any % of replacement of non-renewable electricity with renewable one is considered compliant with this criterion.
Red	Application of energy efficiency measures for the activities associated with:

[91] Applicable if a credible Paris-aligned reference pathway is developed by a scientific body or an industry organisation. In case if an activity in question does not have such a path developed, this requirement may be ignored

	• manufacture of equipment for the extraction of oil, gas, and coal; • manufacture of equipment for transportation, storage, and processing of any hydrocarbons; • manufacture of vehicles, ships, planes with internal combustion engines. • manufacture of weapons and weapon systems (ISIC Code 2520) is harmful to the objective of climate change mitigation.
Criteria Reference	Designed for Thailand Taxonomy, target is based on Draft Energy Efficiency Plan 2024

Annex: Additional information on sustainable hydrogen production

Table 13 Eligible measures for hydrogen production decarbonisation

Area	Activity	Mitigation criteria
General		
Equipment and components to produce low-carbon hydrogen	Acquisition and installation of electrolysers and membranes for electrolysers.	Automatically eligible
Carbon Capture and Storage	Installation / acquisition of infrastructure related to CO2 capture of emissions from hydrogen production.	• The minimum capture rate from process and combustion emission streams is 90%[92]. • A quantitative performance report of the CCS/CCUS operations, including the following information: - Intended capture rate capacity, maximum capture rate capacity, intended annual capture of CO2, transport of CO2, and storage of CO2. • Demonstrated MRV (Monitoring, Reporting and Verification) and mitigation measures for methane leaks on site and upstream. • There is evidence[93] that demonstrates the CO2 will be suitably transported and stored in line with the CCS/CCUS criteria of Thailand Taxonomy.
Carbon Capture and Utilisation	Infrastructure related to capture, transportation, and utilisation of CO2 emissions from hydrogen production.	• The minimum capture rate from process and energy emission streams should be 90% or emissions reduction at the facility level have to be at least 50%. [94]

[92] A minimum capture rate must be demonstrated only for specific investments on CCS/CCUS infrastructure. Entire facilities certification does not need to meet this requirement if the facility meet the total carbon intensity benchmark.

[93] Either directly from the facility or through contracts or agreements with a third party.

[94] A minimum capture rate must be demonstrated only for specific investments on CCS/CCUS infrastructure. Entire facilities that have CCS/CCUS embedded do need to meet this requirement if the facility meet the carbon intensity benchmark.

Area	Activity	Mitigation criteria
		• Issuers must present a quantitative performance report of the CCS/CCUS operations, including the following information[95]: - Intended capture rate capacity, maximum capture rate capacity, annual capture of CO2, annual transport of CO2, and annual utilisation of CO2. • Issuers must demonstrate MRV (Monitoring, Reporting and Verification), as well as mitigation measures for methane leaks on site and upstream[96]. • There is evidence[97] that demonstrates the CO2 will be suitably transported in line with the Taxonomy criteria for CCS/CCUS. • CO2 must be used for the manufacture of durable products (e.g., construction materials stored in buildings, or recyclable products that will not be incinerated as a final disposal alternative). • CO2 should not be used for products that release the CO2 immediately when the products are used (such as in urea, carbonated beverages, or fuels)

[95] CCS/CCUS performance report must be verified by an independent third party.

[96] Neil Slater, "DNV GL Launches Certification Framework and Recommended Practice for Carbon Capture and Storage (CCS/CCUS)," DNV, January 17, 2018, https://www.dnv.com/news/dnv-gl-launches-certification-framework-and-recommended-practice-for-carbon-capture-and-storage-CCS/CCUS--108096.

Monitoring alternatives include satellite-based or drone-based measurement. Additional guidance can be found in the report Best Practice Guidance for Effective Methane Management in the Oil and Gas Sector. Monitoring, Reporting and Verification (MRV) and Mitigation.

United Nations Economic Commission for Europe, "Best Practice Guidance for Effective Methane Management in the Oil and Gas Sector," ECE ENERGY SERIES (UNITED NATIONS, 2019), https://unece.org/fileadmin/DAM/energy/images/CMM/CMM_CE/Best_Practice_Guidance_for_Effective_Methane_Management_in_the_Oil_and_Gas_Sector__Monitoring__Reporting_and_Verification__MRV__and_Mitigation-_FINAL__with_covers_.pdf.

[97] Either directly from the facility or through contracts or agreements with a third party

Area	Activity	Mitigation criteria
		• CO2 is not used for enhanced oil recovery, and the production of other forms of fossil energy sources.
Electrification of processes	Revamps, modifications and acquisition of equipment and other infrastructure necessary for the electrification of the processes	Automatically eligible
Relating to the feedstock used		
Using biomass as a feedstock	• Infrastructure to produce hydrogen using biomass; • Refurbishment and retrofitting of facilities to use biomass; • Acquisition of equipment to produce hydrogen using biomass;	• The biomass used complies with the criteria applicable for biomass sourcing set out in the Taxonomy criteria for bioenergy. • Primary organic streams are only eligible if certified as sustainable by Roundtable on Sustainable Biomaterials or International Sustainability and Carbon Certification. • Wood is eligible only if produced on a sustainable plantation as defined by the Thailand Taxonomy's Forestry Criteria
Using landfill gas as a feedstock	• Infrastructure to produce hydrogen using landfill gas; • Refurbishment and retrofitting of facilities using landfill gas as a feedstock; • Acquisition of equipment to produce	Issuers must demonstrate MRV (Monitoring, Reporting and Verification) and mitigation measures for methane leakages on-site and upstream[98]. Landfill gas complies with the Taxonomy criteria for waste management and landfill gas recovery.

[98] Monitoring alternatives include satellite-based or drone-based measurement. Additional guidance can be found in the report United Nations Economic Commission for Europe, "Best Practice Guidance for Effective Methane Management in the Oil and Gas Sector," ECE ENERGY SERIES (UNITED NATIONS, 2019), https://unece.org/fileadmin/DAM/energy/images/CMM/CMM_CE/Best_Practice_Guidance_for_Effective_Methane_Management_in_the_Oil_and_Gas_Sector__Monitoring__Reporting_and_Verification__MRV__and_Mitigation-_FINAL__with_covers_.pdf.

Area	Activity	Mitigation criteria
	hydrogen using landfill as a feedstock;	
Using manure-biomethane	• Infrastructure to produce hydrogen using manure biomethane; • Refurbishment and retrofitting of facilities using manure biomethane; • Acquisition of equipment to produce hydrogen using manure biomethane;	• Issuers must demonstrate MRV (Monitoring, Reporting and Verification), as well as mitigation measures for methane leaks. • Manure biomethane complies with the Taxonomy criteria for waste management criteria for composting.
Relating to the electricity source		
Using wind, solar, hydro, and geothermal energy-based electricity	• Infrastructure to produce hydrogen using renewable energy sources • Refurbishment and retrofitting of facilities using renewable energy sources • Acquisition of equipment to produce electrolytic hydrogen using renewable energy sources	Renewable energy produced on-site must comply with the most up-to-date Taxonomy criteria for the relevant source of energy. Issuers must demonstrate the use of only additional renewable electricity. To do that, issuers can implement the following options: • Renewable-based[99] captive power generation, OR • A power purchase agreement demonstrating a commercial link of the electrolyser with new renewable power capacity; OR • Excess of renewable-based electricity that would have been otherwise curtailed. Further, the temporal and geographical correlation between the additional renewable

[99] Energy produced from renewable sources such as wind, solar, and small hydropower generation

Area	Activity	Mitigation criteria
		electricity generation and the electrolyser electricity consumption must be demonstrated. • **Temporal correlation**: Issuers must demonstrate that the electricity is produced and used simultaneously, on a monthly basis, using telemetry measurement techniques. Renewable electricity that has been locally stored can be used as well. • **Geographic correlation**: Issuers must demonstrate physical capacity to transport the electricity from the renewable generation plant to the electricity consumption site. The electricity must not pass a zone of grid congestion.
Using low-carbon electricity	Infrastructure for the production of hydrogen using electricity from the grid.	The carbon intensity of the electricity grid must ensure that the production process is in compliance with the total carbon intensity benchmark in Table: Hydrogen carbon intensity thresholds.

Life cycle assessment recommendations

Methodological notes for Life Cycle Assessment (LCA) of hydrogen emissions:

- The life cycle assessment should follow the latest releases of ISO std[100] (ISO 14040, ISO 14044 for life-cycle assessment, and ISO 14067 for product carbon footprint). The Recommendation 2013/179/EU will be acceptable for assets located in the EU. Results should be verified by an independent third party.

[100] ISO standards available at: ISO/TC 207/SC 5 [ISO], "ISO 14044:2006 - Environmental Management — Life Cycle Assessment — Requirements and Guidelines," ISO, 2006, https://www.iso.org/standard/38498.html.; ISO/TC 207/SC 5 [ISO], "ISO 14040:2006 Environmental Management — Life Cycle Assessment — Principles and Framework," ISO, 2006, https://www.iso.org/standard/38498.html.

- GHG emissions must be estimated for a purity of 99.9% vol, and a gauge pressure of at least 3 MPa using correction factors. For pressures higher than 3 MPa, additional energy compression emissions must be included as well.
- The methodology factor in a Global Warming Potential for a period of 100 years (GWP100) for methane should be 28[101].
- GHG emissions accounting:

$$Etotal = E1 + E2 + E3 + E4 + E5 - E6 + E7 + E8$$

E total: Total emissions

E1: Upstream feedstock-related emissions (including sourcing[102], processing, transport, and storage)

E2: Upstream energy-related emissions (including sourcing, processing, transport, and storage)

E3: Fugitive emissions (Including hydrogen emissions)

E4: Process emissions

E5: CCS/CCUS emissions related to energy consumption and leakages

E6: Carbon emissions captured

E7: Compression and purification emission (Energy required to compress and purify hydrogen)

E8: Transportation emissions to the site where hydrogen will be used (energy and electricity-related emissions and fugitive emissions during transportation)[103]

[101] Fifth Assessment Report- IPCC

[102] Depending on the feedstock, it can be extraction, cultivation, or collection

[103] Transportation infrastructure emissions are not included

Additional guidance for different production pathways up to the point of production[104]

The International Partnership for Hydrogen and Fuel Cells in the Economy (IPHE) methodology working paper contains guidelines for a calculation method for GHG accounting for the following production pathways up to the point of production[105]:

- Steam Methane Reforming combined with CCS/CCUS: **Appendix P1 of IPHE working document**
- Biomass as a feedstock combined with CCS/CCUS: **Appendix P5 of IPHE working document**
- Manure-based production: **P5.4** Bio-digestion
- Landfill gas-based production: **P5.4** Bio-digestion
- Biomass from secondary sources: **P.5.5** Biomass gasification.
- The IPHE working document also has guidelines for emission sources and allocation for biomass-based production:
- Emissions sources in Biomass-Based Hydrogen Routes/CCS/CCUS: **Appendix P.5.6**
- Allocation for the Biomass/CCS/CCUS pathway: **Appendix P.5.7**

[104] The IPHE methodology will develop guidelines for transport emissions accounting in the coming months.

[105] IPHE, "Methodology for Determining the Greenhouse Gas Emissions Associated With the Production of Hydrogen" (IPHE Hydrogen Production Analysis Task Force, November 2022), https://www.iphe.net/_files/ugd/45185a_6159cefcd88f4d9283ab0e60f4802cb4.pdf.

THAILAND TAXONOMY

Waste Management Sector

May 2025

THAILAND TAXONOMY BOARD

Table of Contents

List of Figures

List of Tables

Thailand Taxonomy Boad Phase II

Waste Management sector

1. Department of Climate Change and Environment, Ministry of Natural Resources and Environment
2. Bank of Thailand
3. Securities and Exchange Commission
4. Stock Exchange of Thailand
5. Department of Alternative Energy Development and Efficiency, Ministry of Energy
6. Department of Industrial Works, Ministry of Industry
7. Thai Industrial Standards Institute, Ministry of Industry
8. Department of Local Administration, Ministry of Interior
9. Wastewater Management Authority, Ministry of Interior
10. Office of Natural Resources and Environmental Policy and Planning, Ministry of Natural Resources and Environment
11. Pollution Control Department, Ministry of Natural Resources and Environment
12. Department of Health, Ministry of Public Health
13. Bangkok Metropolitan Administration
14. Energy Regulatory Commission
15. Thailand Greenhouse Gas Management Organization
16. Board of Trade of Thailand
17. Federation of Thai Industries
18. Renewable Energy Industry Club, Federation of Thai Industries
19. Thai Banker's Association
20. Association of International Bank
21. Government Financial Institutions Association

Sponsored by ADB

Developed by DNV

In cooperation with CBiS Carbon Institute for Sustainability

List of abbreviations

ADR	Agreement concerning the International Carriage of Dangerous Goods by Road
AEDP	Alternative Energy Development Plan
BCG	Bio-Circular-Green Economy
BOD	Biochemical Oxygen Demand
CEMS	Continuous Emissions Monitoring Systems
CBI	Climate Bonds Initiative
CRVA	Climate Risk and Vulnerability Assessment
DIW	Department of Industrial Works
DLT	Department of Land Transport
DNSH	Do No Significant Harm
EO	Environmental Objective
EPPO	Energy Policy and Planning Office
EPR	Extended Producer Responsibility
ESM	Environmentally Sound Management
EU	European Union
FiTV	Feed-in Tariff Variable
GHG	Greenhouse Gas
IPCC	Intergovernmental Panel on Climate Change
ISIC	International Standard Industrial Classification
ISO	International Organization for Standardisation
IQAir	Swiss air quality technology company
MONRE	Ministry of Natural Resources and Environment
MAS	Monetary Authority of Singapore
MRF	Material Recovery Facility
MSW	Municipal Solid Waste
NDCs	Nationally determined contributions
PCD	Pollution Control Department
PDD	Power Development Plan
P.E.	Population Equivalent
PM	Particulate Matter

SOP	Standard Operating Procedure
SUPs	Single-Use Plastics
SGT	Singapore Taxonomy
TEI	Thailand Environment Institute
TIPMSE	Thailand Institute of Packaging Management and Recycling for the Environment
TSC	Technical Screening Criteria
WEEE	Waste Electrical and Electronic Equipment
WtE	Waste-to-Energy

Summary

This report, "Thailand Taxonomy Phase II Waste Management Sector," addresses the critical issues and future outlook of waste management in Thailand. It is based on the Nationally Determined Contribution (NDC) Roadmap on Mitigation (2021-2030), formulated by the Office of Natural Resources and Environmental Policy and Planning (ONEP). The report aims to mitigate greenhouse gas emissions and enhance waste and wastewater management practices in alignment with international standards, particularly the European Taxonomy (EUT) and Green Finance Industry Taskforce Taxonomy (GFIT[1]) or the Singapore Taxonomy (SGT).

a. Key Findings:

- **Emissions from Waste**: Methane emissions from landfills and wastewater treatment are significantly more potent than CO2 at trapping heat. In 2022, the waste sector in Thailand emitted 22,172.96 ktCO2e, representing 5.75% of the country's total emissions. These emissions stem primarily from solid waste disposal and wastewater treatment.

- **Air Pollution (PM2.5)**: Open burning of agricultural waste and emissions from waste treatment contribute to severe air pollution, especially PM2.5, leading to significant health impacts. In 2023, Thailand ranked the fifth in Southeast Asia for poor air quality. Bangkok and Chiang Rai are notably affected, with pollution levels far exceeding WHO standards.

- **Environmental Contamination**: Illegal landfills and improper hazardous waste disposal contaminate soil and water, posing long-term risks to ecosystems and human health. Regulatory frameworks need strengthening to address these challenges effectively.

- **Municipal Solid Waste (MSW)**: In 2023, Thailand generated 26.95 million tonnes of MSW, with only 34% being recycled. The rest was either properly disposed of or mishandled. The report highlights the need for improved waste segregation and recycling practices.

[1] Established by Monetary Authority of Singapore.

- **Hazardous Waste**: Hazardous waste, including waste electrical and electronic equipment (WEEE), is poorly managed, leading to illegal dumping and environmental hazards. Industrial hazardous waste management also faces significant challenges.

- **Wastewater**: Inadequate wastewater treatment systems contribute to water pollution. Only 1% of surface water was rated as being in very good condition in 2023, emphasizing the need for better wastewater management infrastructure.

b. Interoperability with International Taxonomies:

- Thailand is working to align its waste management activities with international standards and existing Taxonomies, specifically the European Taxonomy (EUT) and Singapore Taxonomy (SGT). This alignment aims to foster global coherence in sustainability practices and support Thailand's transition to a circular economy.

c. Proposed Waste Management Activities:

- The report proposes thirteen activities, covering solid waste and wastewater. These activities may contribute to various Environmental Objectives (EOs) such as Climate Change Mitigation, Pollution Prevention, and Circular Economy. The technical screening criteria (TSC) promote these EOs as well as the adoption of best available technologies and waste management practices, such as anaerobic digestion, composting, and waste-to-energy. These technologies and practices can reduce GHG emissions, enhance resource efficiency, and minimise the impacts of waste on land, water, and air quality. By applying these TSC, waste management activities can contribute to the transition to a low-carbon and circular economy and support the conservation and enhancement of natural capital.

Thailand faces significant challenges in waste management, including emissions, pollution, and environmental contamination. By aligning its practices with international taxonomies and implementing the proposed activities, Thailand can enhance its waste management systems, reduce greenhouse gas emissions, and move towards a more sustainable and circular economy. The Taxonomy waste sector has been prepared for investors, financial institutions and issuers to have common understanding of green activities to catalyse financing needs to the green economy.

Waste management sector background

After the COVID-19 pandemic, consumer behaviour changed, leading to an increase in certain types of waste. In 2023, the use of single-use plastics rose to approximately 3.03 million tonnes, or 11.25% of the total waste generated, which is an increase of 0.2 million tonnes from 2022, when single-use plastics amounted to 2.83 million tonnes. Municipal Solid Waste recovery rate was 34% in 2023. (PCD, 2024b). Low municipal solid waste recovery rate can be attributed to a lack of awareness, failure to separate hazardous materials, and inadequate regulations (MONRE, 2022). Therefore, addressing proper waste management, including collection, transportation, and treatment, is essential not only to reduce environmental impact but can also unlock economic benefits, such as reduced disposal costs and increased income from new products or waste management-related services.

Wastewater is a significant pollution issue in Thailand. The main sources of wastewater are from community and industrial sectors. According to PCD, in 2022 Thailand had 203 cluster and centralised wastewater treatment facilities.These treatment plants have a total capacity of 2.77 million cubic meters per day. Seven different types of community wastewater treatment systems are used: stabilization ponds (26%), Activated Sludge (42%), Constructed Wetland (5%), Aerated Lagoon (10%), Anaerobic Digestion (4%), Rotating Biological Contractor (2%), and other (11%) (PCD, 2025). The type of treatment system used depends on the characteristics of the wastewater from each industry. Major constraints to wastewater treatment in Thailand include the high cost of investment and the lack of continuous operation and maintenance. (PCD, 2025)

This paper provides a summary about waste management in Thailand and the development of Thailand Taxonomy Waste Management.

1. Major Issues from Waste and Key Measures

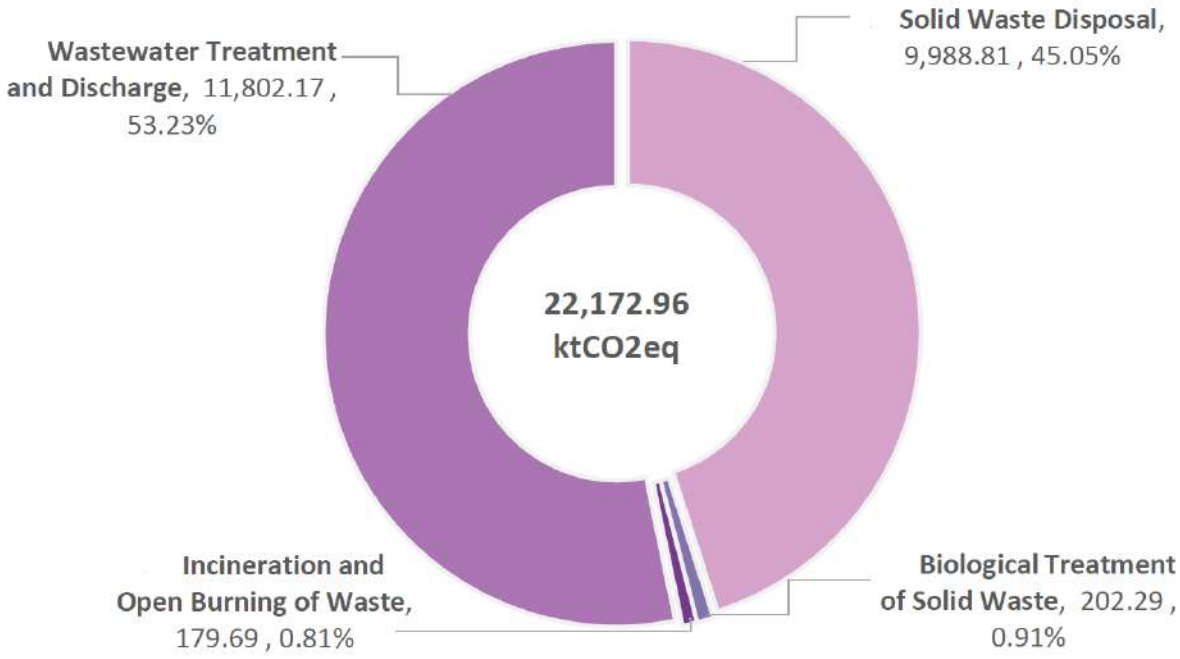
1.1 Emissions from Waste

Methane gas emitted from landfills and/or anaerobic digestion of organic waste is about 28 times more effective than CO2 at trapping heat in the atmosphere over a 100-year period (IPCC, 2021). Thailand's First Biennial Transparency Report: BTR1 shows that Greenhouse gas (GHG) emissions from the waste sector in Thailand were 22,172.97 ktCO2e, which represented

5.75% of the total 385,941.14 ktCO2eq emissions in 2022. GHG emissions primarily stemmed from:

- Solid waste disposal, contributing 45.05% or 9,988.81 ktCO2eq;
- Wastewater treatment and discharge, accounting for 53.23% or 11,802.16 ktCO2eq;
- Biological treatment of solid waste represents a smaller proportion at 0.91% or 202.29 ktCO2eq of total GHG emissions in this sector;
- Waste incineration and Open Burning constituted the smallest portion at 0.81% or 179.69 ktCO2eq; (MONRE, 2024)

Figure 1 Thailand Emissions from Waste Sector in 2022 (MONRE, 2024)



Whilst emissions from waste appear small compared to other sectors, waste management is crucial as it mitigates negative social and environmental impacts. Poor waste management, including inadequate collection systems and ineffective disposal, leads to air pollution, water and soil contamination. Open and unsanitary landfills contaminate drinking water and can spread infections and diseases. Debris dispersal pollutes ecosystems, while hazardous substances from electronic and industrial waste harm urban health and the environment. Indiscriminate waste disposal practices can introduce hazardous chemicals into soil, water bodies, and the air, causing long-term, potentially irreversible damage to local flora and fauna.

This negatively impacts biodiversity, harms entire ecosystems, and allows these chemicals to enter the human food chain.

To address waste management and environmental sustainability, Thailand has undertaken various efforts. The Thailand Nationally Determined Contributions (NDC) was formulated based on several roadmaps, including the first National Action Plan on Waste Management (2016-2021), which was approved by the Cabinet Resolution on 3 May 2016.

The Pollution Control Department (PCD) collaborated with relevant authorities to devise the NDC Sectoral Action Plan for the Waste Sector 2021-2030. The plan aims to decrease GHG emissions by 2.0 MtCO2eq from municipal solid waste and municipal/industrial wastewater. Approximately 65% of this reduction (1.3 MtCO2eq) is anticipated to result from implementing measures in the municipal solid waste sector, with the remaining 35% (0.7 M tCO2eq) expected from wastewater management measures (PCD, 2023c)

Table 1: Measures and potential to reduce greenhouse gases from Waste Management Sector (PCD, 2023c)

Unit: MtCO2eq

Sector	Sub-sector	Measures	2020	2025	2030
Waste Management Sector	Solid waste management	Waste reduction (reducing waste generation and increasing the reuse and recycling rates).	0.36	0.79	1.30
	Wastewater management	Increasing biogas production from industrial wastewater and utilisation thereof.	0.20	0.43	0.70
		Managing other industrial wastewater.			
		Managing domestic wastewater.			
	Total emissions reduction		0.56	1.22	2.00

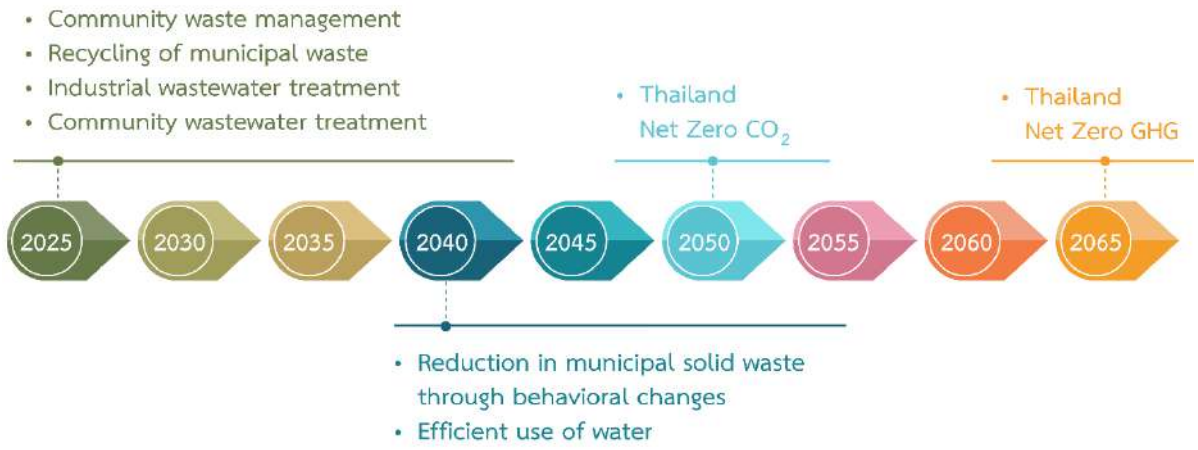
Since the first Waste Management National Plan ended in 2021, several problems and limitations in its implementation have been identified. The problems include illegally operating landfills, incomprehensive waste tracking and monitoring system, and lack of

hazardous disposal capacity leading to illegal dumping of hazardous industrial waste. The Pollution Control Department (PCD) has developed the second Action Plan (2022-2027) to provide a framework and guidelines for addressing pollution from waste (PCD, 2023b). Key objectives of the 2nd Plan include:

- Proper management of 80% of Municipal Solid Waste;
- Increasing the use of recycled materials in production lines from recyclable waste to achieve a range of 74% to 100%;
- Reduction of food waste to 28%;
- Proper management of not less than 50% of community hazardous waste; and
- Ensuring 100% proper management of infectious waste and hazardous industrial waste (PCD, 2022b)

To achieve carbon neutrality by 2050, and a net zero target by 2065, Thailand has established specific goals and implemented a variety of key mitigation strategies. These strategies encompass a broad range of waste management techniques designed to minimize environmental impact, including waste reduction, landfill gas, waste to energy, semi aerobic landfill, composting, anaerobic digestion, mechanical biological treatment, industrial wastewater management, and production of biogas from methane gas (MONRE, 2022). These activities are included in Thailand Taxonomy Waste Management.

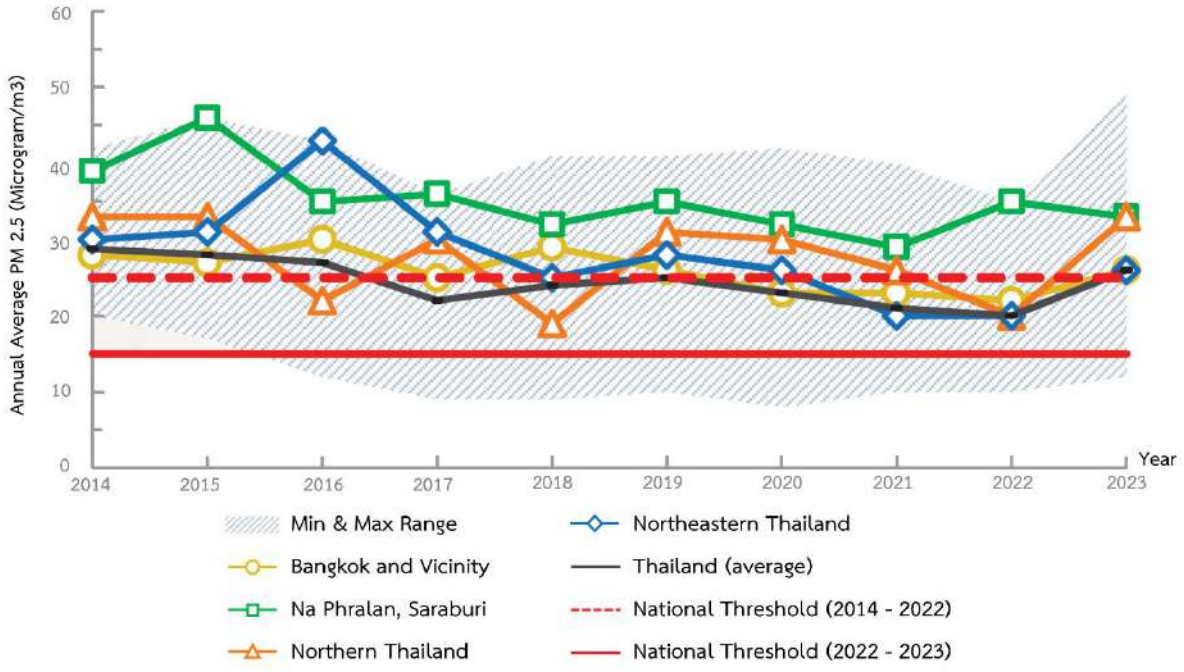
Figure 2 Thailand Net zero GHG emission timeline for waste sector (MONRE, 2022)



1.2 Air Pollution – PM 2.5

In Thailand, air pollution significantly impacted over 15.2 million residents, leading to more than 13,000 deaths. The majority of these fatalities occurred in Bangkok, where approximately 9,400 deaths in 2020 could have been avoided (IQAir, 2020). In 2023, Thailand ranked 36th globally and fifth in Southeast Asia for poor air quality. The report by IQAir highlighted that the average PM2.5 ultrafine dust concentration in Thailand was 23.3 micrograms per cubic meter of air (µg/m3), which exceeds the World Health Organization's recommended standard by 4.7 times. Bangkok was listed as the 37th most polluted city worldwide, with an average PM2.5 concentration of 21.7 µg/m3 in 2023 while Chiang Rai was fifth among the most polluted city in Southeast Asia (IQAir, 2024).

Figure 3 Thailand Annual Average PM 2.5 (Microgram/m3) 2014-2023 (PCD, 2024b)



In Thailand, PM 2.5 levels peak seasonally from winter to early summer, influenced by various factors, including high atmospheric pressure, temperature inversion, and calm winds, which hinder the particulate dispersion. Drought conditions worsen the situation by causing wildfires. Sources vary by regions; in Bangkok, high PM 2.5 due to traffic, industry and open burning, while PM 2.5 in North and Northeast came from wildfires, agricultural burning of rice, corn, and sugarcane, cross-border haze and traffic-related emissions. In the South, peak season due to peatland fires and transboundary haze. (PCD, 2022a)

Recognizing the detrimental effects of air pollution, the Thai government has integrated measures to control and reduce emissions into national agendas and action plans. These efforts align with sustainable development goals, aiming to promote sustainable consumption and production while minimising the negative impacts on health and the environment. Numerous laws are in place to regulate open burning and mitigate its consequences (TEI, 2022).

Under the Thailand Taxonomy waste sector, the focus is to facilitate waste management from the collection at source to the place where waste is properly treated. In terms of the agricultural residuals value chain, treatment in a form of bioenergy will be under Technical Screening Criteria of bioenergy can be found in Thailand Taxonomy Phase 1, while collection and transport of agriculture residues to bioenergy power plants will be fall under waste management, Technical Screening Criteria of which will promote practices to prevent PM 2.5. situations, include:

- Minimizing air pollution from waste transportation by promoting waste transportation emissions standards that are internationally recognized.
- Controlling particulate matter from waste management activities, ensuring compliance with best practices and relevant national regulation.

1.3 Environmental Contamination

Thailand has faced significant challenges in managing waste, particularly in the handling of hazardous waste like Cadmium and the proliferation of illegal landfills. These issues are exacerbated by weak regulatory frameworks and enforcement.

In 2023, out of 2,079 waste processing facilities, only 114 of these facilities, or 5%, were complying to relevant national regulations (82 state-owned and 32 privately owned). 1,965 facilities, or 95%, did not manage waste properly. Illegal waste management/storage facilities consist of more than 1,700 open dump or landfill sites, 62 open burning sites, 77 incineration plants without emissions control, and others (PCD, 2024b). In Bangkok alone, as of February 2023 the authorities have identified more than 23 illegal landfill sites located across various districts (Khaosod, 2022).

Figure 4 Waste Disposal Operation in Thailand (PCD, 2024b)

Illegal dumping involves the unauthorized disposal of waste, particularly hazardous industrial types, affecting the circular economy by losing recyclable materials and contaminating land and water. This contamination impairs crucial environmental processes and poses health risks, making recovery slow and impacting resource reuse in the economy. The research by Otwong, Jongmeewasin & Phenrat in 2021 found that the five main reasons for the illegal dumping of recyclable hazardous industrial waste in Thailand include:

- Insufficient market and financial feasibility analysis for reuse and recycling activities, leading to potential illegal dumping;
- A lack of monitoring the balance of materials used and waste produced. The recycling facilities need to report waste received and generated, but not recycled products or buyers. This loophole enables illegal dumping by recycling companies, either on-site or through fake transactions;
- Weak regulations on soil and groundwater contamination;
- A lack of transparency in the regulatory oversight process; and
- Inadequate penalties and minimal engagement from the private sector (Otwong, Jongmeewasin, & Phenrat, 2021)

Mitigation measures against illegal dumping include:

- Remediation of contaminated sites;
- Capacity building for local administrative organizations or relevant agencies to close illegal landfill waste disposal sites, and to strictly monitor potential environmental negative impact resulted from those sites; and
- Issuing regulations for the registration of waste disposal service providers to enable them to access low-interest loans (PCD, 2023b).

2. Current State and Outlook of Waste Management in Thailand (by source)

2.1 Municipal Solid Waste (MSW)

In 2023, Thailand generated approximately 26.95 million tonnes of municipal solid waste (MSW), which increase from 2022 at 25.70 million tonnes. Approximately 2.0 million tonnes (8%) of waste are managed at the source at the household level. Additionally, 4.8 million tonnes (18%) are sorted for reuse from households and various sources. The remaining 20.15 million tonnes (74%) are collected by local administrative organizations and transported to waste disposal sites. Some of this waste, around 4.51 million tonnes (16%), is further sorted for reuse. This results in 34% of waste being recovered, and leaves 15.64 million tonnes (58%) of waste for disposal, of which 10.17 million tonnes (38%) are properly disposed of, while 5.47 million tonnes (20%) are improperly disposed of. (PCD, 2024b)

Figure 5 Overview of 2023 Thailand MSW Management including hazardous waste (PCD, 2024b)

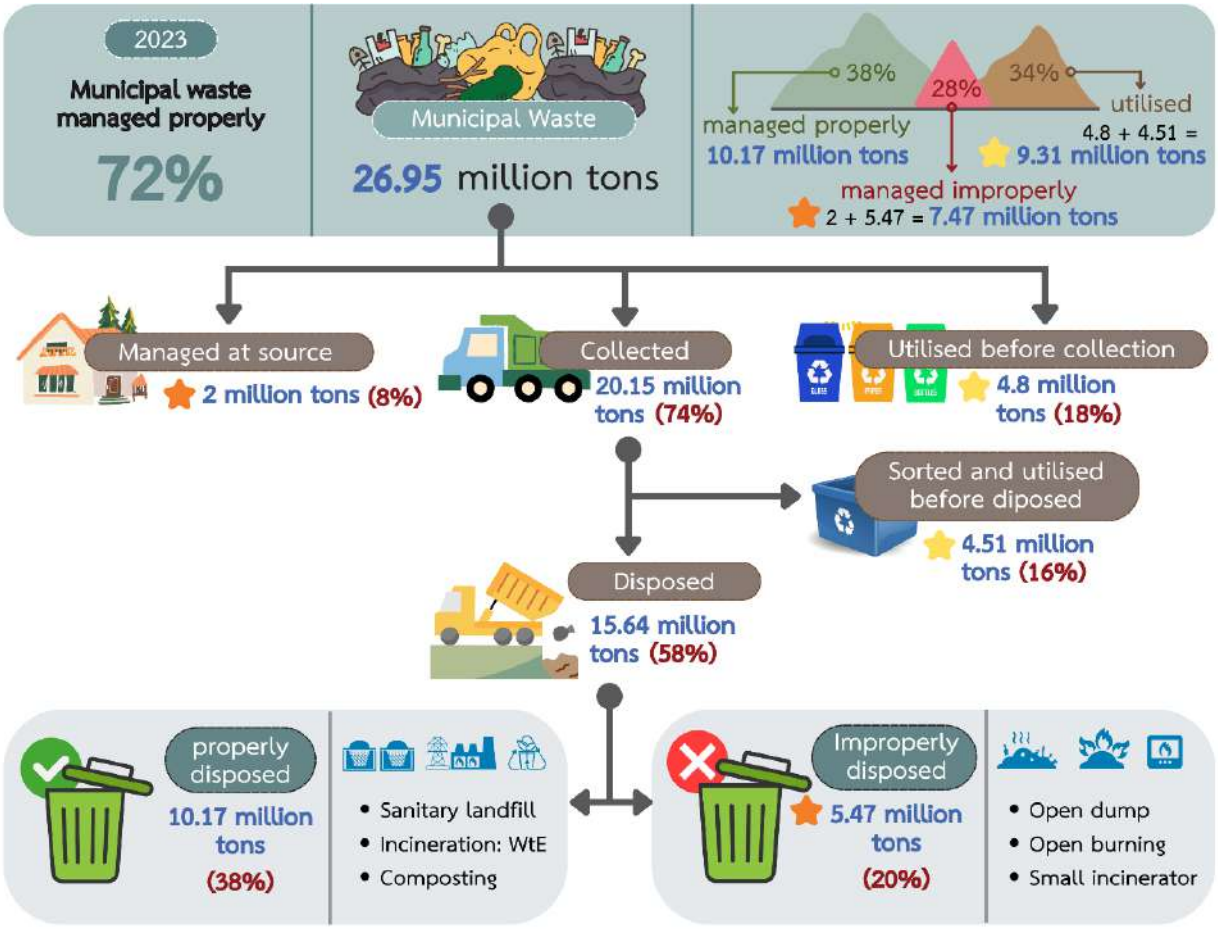
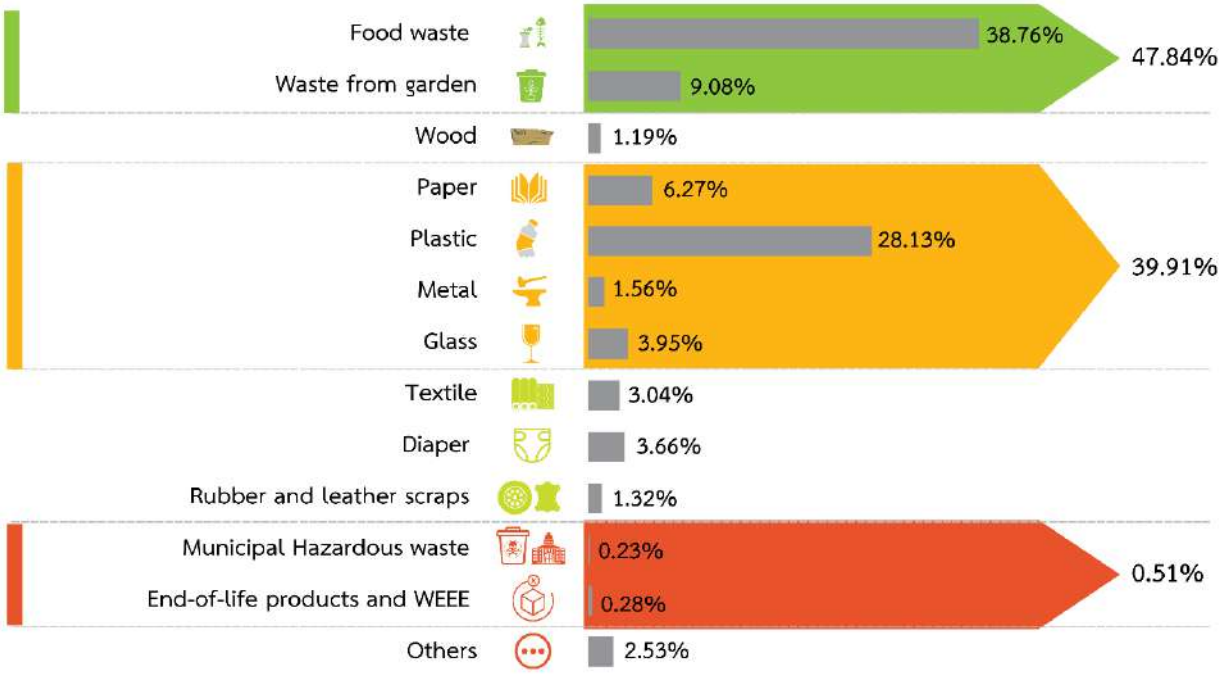


Figure 6 Thailand 2021 MSW Composition (PCD, 2024a)



MSW comprises 47.84% organic waste from food and garden, 28.13% plastic waste, 6.27% paper waste, and others (PCD, 2024a).

Waste segregation regulations in Thailand involve comprehensive laws that aim to manage and reduce environmental impacts from industrial and municipal waste. Key legislations include:

- The Ministry of Interior Announcement on Waste Management, B.E. 2567 (2024), focuses on segregation of waste at public collection facilities into 5 different categories which are general waste, organic waste, recyclable waste, hazardous waste, and infectious waste.
- The Public Health Act B.E. 2535 (1992), and subsequent amendments, mention segregation of infectious and hazardous waste from communities. Infectious waste and hazardous waste must be segregated at source into the following categories: light bulbs, batteries, chemical containers, medicinal products, WEEEs, and other hazardous waste.

PCD has set the goal to increase the proportion of plastic, glass, paper, and aluminum waste segregated for recycle or reuse purposes to 8 million tonnes or 30% of MSW by 2027 (PCD, 2023b).

A crucial strategy for managing and diminishing solid waste involves converting it into energy through a process known as Waste-to-Energy (WtE), which is projected to handle 26% of total municipal waste by 2027 (PCD, 2023b). However, WtE poses challenges in developing countries, including Thailand, due to high initial costs and the need for advanced technology.

The Thai government is prioritising WtE projects to tackle the country's waste management issues as part of its national agenda and waste disposal policy. Various initiatives, including feed-in tariff rates and subsidies, have been introduced to encourage investment in WtE projects. Despite interest from stakeholders and plans to increase the number of WtE projects, challenges such as funding issues, environmental concerns, and inefficient waste sorting persist. To address these challenges, future regulations emphasise environmentally sound operations and community acceptance, along with subsidies and tax incentives. The government has aimed to achieve a target of 500 MW for WtE in the most recent Power Development Plan by 2037 (EPPO, 2016). Nevertheless, the policy also has detractors. Environmental experts and academics have urged the government to reconsider its WtE strategy due to the emission of

hazardous pollutants and greenhouse gases from such projects (Rujivanarom, 2023) (Wachpanich & Coca, 2022).

It should be noted that WtE is yet not included in the EU Taxonomy (EU, 2024), although it is allowed in other taxonomies, such as Singapore Taxonomy (MAS, 2023) and the Climate Bonds Initiative Taxonomy (CBI, 2022). The reasons why EU Taxonomy does not regard WtE as green are:

- WtE incineration is seen as contradictory to circular economy principles because it destroys materials that could otherwise be recycled;
- WtE is considered less favourable compared to other renewable energy sources due to its carbon footprint;
- WtE could cause significant harm because it leads to increased waste generation and incineration, impacting pollution prevention and control (Makavou, 2021)

WtE is included in the Thailand Taxonomy due to its importance in waste reduction in the context of Thailand. According to Thailand's Power Development Plan (PDP) 2018-2037 (Rev. 1) and the National Waste Management Action Plan (2022-2027), the implementation of Waste-to-Energy (WtE) technology is being promoted to enhance the efficiency of waste management. Both strategic documents emphasize the critical necessity of initiating WtE projects within Thailand. The National Waste Management Action Plan projects that by 2027, up to 30% of solid waste management will incorporate WtE. Furthermore, the PDP sets a target of 400 MW for WtE power plant capacity.

Effective waste management has become crucial as many cities face a shortage of landfill space. With limited land availability and growing urban populations, governments must adopt sustainable waste management strategies, including WtE technologies. The process starts with policies aimed at minimizing waste, followed by recycling and WtE incineration, and disposing of the remaining ash in landfills. In addition, WtE systems are valued for their ability to generate renewable energy and, importantly, for their capacity to reduce waste volume, significantly decreasing the amount of waste sent to landfills, which in turn reduces methane gas production. These challenges are particularly pressing in Thailand, where the urban population continues to increase and urbanization is concentrated in large cities, necessitating substantial investments to manage the growing waste.

WtE technology is identified as a pivotal solution for addressing solid waste management challenges, offering numerous environmental benefits. These include reducing landfill usage, mitigating environmental risks associated with leachate contamination, lowering methane emissions from landfills, decreasing fossil fuel consumption for electricity generation, and reducing air pollution from uncontrolled incineration or open burning. The integration of WtE in the Thailand Taxonomy is expected to act as a catalyst in achieving these environmental and economic objectives.

In developing the Taxonomoy for WtE activity, international standards and other taxonomies have been taken into account. The green and amber criteria for the WtE activity in the Thailand Taxonomy are designed to align with Singapore Taxonomy criteria. To address concerns about potential negative environmental impacts, including air and odour pollution, preventive and mitigation measures have been incorporated into the Technical Screening Criteria (TSC). Pre-operational WtE plants must share baseline environmental assesment results with stakeholders upon request. Operational WtE plants must share the results of annual or bi-annual audit reports, conducted by the Energy Regulatory Committee, with stakeholders for transparency. Furthermore, to address concerns about lack of monitoring capacity from the regulatory authorities, a valid third-party certified environmental management must be put in place.

2.1.1 Food Waste

In 2023, the total amount of consumer level food waste generated across Thailand was approximately 10.24 million tonnes, or 155 kilograms per person per year. 40% of food waste components were edible, and 60% were inedible (PCD, 2024b)

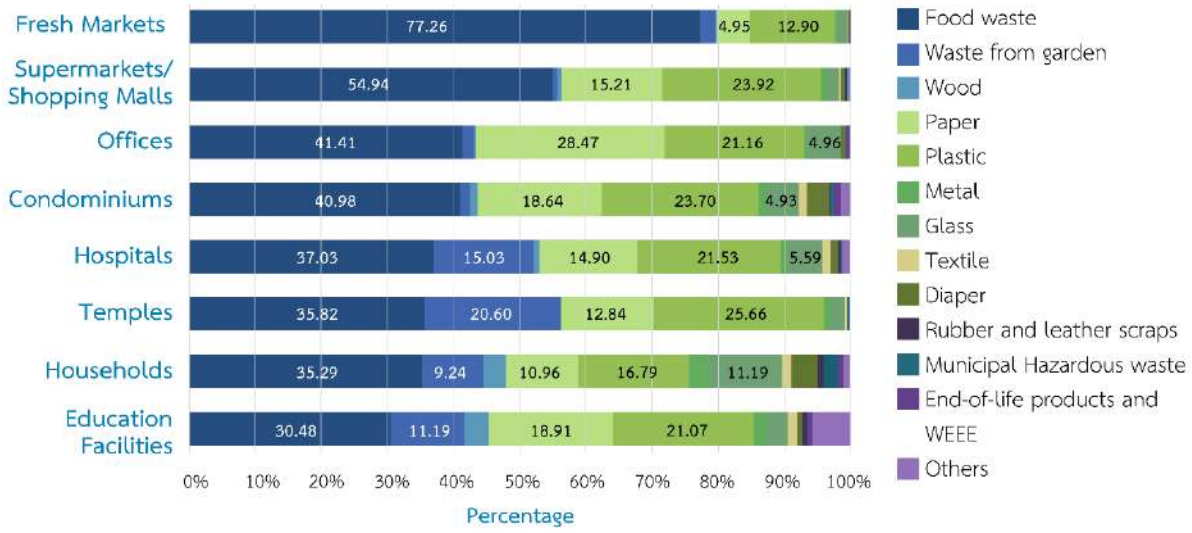
Improperly managed food waste produces methane and causes significant losses, including misused resources, higher costs, and environmental damage. These effects emphasize the urgent need for effective waste management strategies to mitigate environmental and socio-economic impacts.

Food waste is generated from various sources. Household food waste primarily consists of inedible post-consumption items such as eggshells and fish bones. In contrast, food waste from hotels and restaurants arises through different stages of food preparation, including leftovers from restaurant buffets. Currently, many department stores and supermarkets have implemented measures to mitigate food waste. These measures include aligning their orders

with customer demand, discounting food near closing time, and donating surplus food to various foundations. However, the number of organizations that accept surplus food remains limited. Additionally, households lack motivation to separate waste, with approximately 35% of households still disposing of food waste along with general waste (PCD, 2024a).

To effectively address Thailand's food waste problem, a Food Waste Management Roadmap (2023-2027) and a Phase 1 Food Waste Management Action Plan (2023-2027) were developed. These plans aim to reduce the proportion of food waste from 39% to no more than 28% by 2027 with measures ranging from segregating food waste at source, for example, as animal feed or for producing biogas, thereby reducing waste residues that can spread diseases, reduce pollution from waste, and minimize the waste sent for landfill or incineration (PCD, 2024a)

Figure 7 Food Waste Composition by Source Type



2.1.2 Plastic Waste

Thailand's petrochemical sector is the largest in Southeast Asia and ranks as the 16th largest globally (World Bank Group, 2021). In 2023, 3.03 million tonnes of waste were single-use plastics (SUPs), constituting approximately 11.25% of the total municipal solid waste (MSW) generated, with only about 0.75 million tonnes or 25% of SUP waste being sorted and recycled (PCD, 2024b). This marks an increase from 0.71 million tonnes in 2022, driven by various policy initiatives, including the implementation of Phase 2 (2023–2027) of the Plastic Waste Management Action Plan which aims to enhance sustainable plastic waste management, with a strong emphasis on waste management at the source, ultimately leading to more effective and long-term plastic waste solutions (PCD, 2024b).

Marine debris entering the upper Gulf of Thailand was 882 tonnes in 2023, a notable reduction from 1,636 tonnes in 2022. Single-use plastics remained the dominant pollutant, encompassing items like food bags, handle bags, and thin plastic film (PCD, 2024b). Efforts to address marine debris include waste collection, advocacy for waste segregation, and campaigns involving public and private sectors, as well as local organisations, resulting in the collection of significant amounts of garbage from coastal habitats in 2021 (PCD, 2023a). The Department of Marine and Coastal Resources, along with relevant agencies, successfully removed 220,854.80 kilograms (221 tonnes) of waste from coastal ecosystems, totalling 3,688,082 pieces of litter in 2023 (PCD, 2024b).

Factors such as population density, education, and household size influence plastic consumption behaviour. On average, the disposal of end-of-life plastics releases 0.15 kg CO2eq per household per day, contributing to climate change, with improper waste management being common in many households. Proper waste management is essential for Thailand to achieve carbon neutrality in the future (Kittithammavong, Khanitchaidecha, & Thongsanit, 2023).

The Thai government has recognised plastic waste as a significant environmental challenge. Therefore, Action Plans on Plastic Waste Management was established in 2020, with the current phase 2 implementation (2023-2027), to provide clear definition and guidelines for plastic waste management and to improve efficiency across all sectors. The plan emphasises principles such as Bio-Circular-Green Economy (BCG Model), the 3R principle (Reduce, Reuse, Recycle), public-private partnerships, extended producer responsibility (EPR), and extended consumer responsibility (ECR). To reiterate Thailand's commitment, it has set a goal to have 100% of its plastic waste recycled and reused by 2027 (PCD, 2023a) .

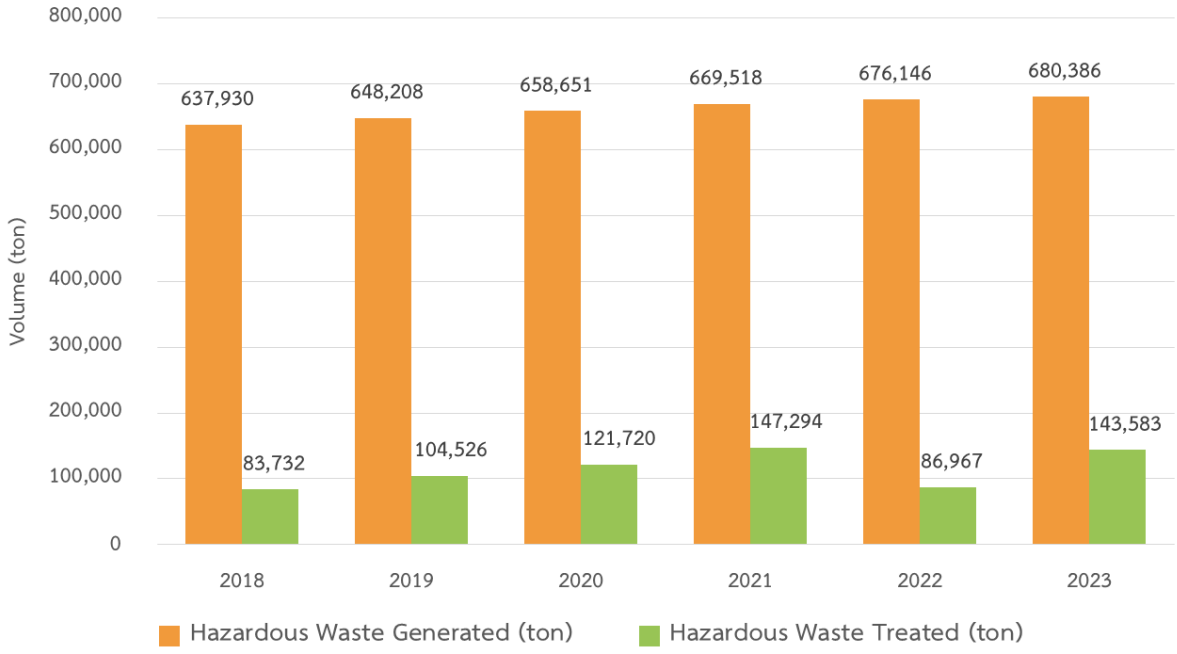
2.1.3 Municipal Hazardous Waste including WEEE and end-of-life products

The "Ministerial Regulation of Public Health regarding Management of Municipal Toxic and Hazardous Waste B.E. 2563 (2020)" defines hazardous waste from communities as 'Hazardous waste generated from community activities, consisting of substances or objects contaminated with toxic, flammable, oxidizing, peroxide, corrosive, reactive, explosive, or genetically mutagenic substances, or any other substances or objects that may cause or have the potential to cause harm to humans, animals, plants, property, or the environment.' This regulation excludes general solid waste, infectious waste, radioactive waste, and hazardous

waste as defined by factory related laws. These substances may pose a risk to human health, animals, plants, property, or the environment.

In 2023, hazardous waste from communities reached 680,386 tonnes, an increase of 0.627% from 2022. This increase is largely due to waste from electrical and electronic products (WEEE), which accounted for 65% of the total, while other hazardous wastes—such as batteries, flashlights, chemical containers, and spray cans—comprised approximately 238,135 tonnes (35%). In 2023, a total of 143,583.24 tonnes of hazardous waste was properly managed, accounting for 94.36% of the total. This was divided into 101,852.52 tonnes for resource recovery, 41,730.72 tonnes for disposal, and 46,977 tonnes for safe landfill. However, when compared to the total amount generated, only 21.10% was properly disposed of, which is below the target of 30% set in the country's second waste management plan (2022-2027). Effective hazardous waste management, particularly for electronic and electrical waste, is hampered by several critical issues. First, collection systems are not adequately integrated into standard waste management practices. Second, the availability of consistent and geographically diverse treatment and disposal facilities is insufficient. Finally, regulatory ambiguities surrounding e-waste management create confusion and hinder clear delegation of responsibilities to relevant agencies. These shortcomings contribute to improper handling of hazardous materials, posing potential environmental and public health risks (PCD, 2024b)

Figure 8 Municipal Hazardous Waste Generated and Treated from 2018 – 2023



The "Ministerial Regulation of Public Health regarding Management of Municipal Toxic and Hazardous Waste B.E. 2563 (2020)" mandates that local administrative organizations take charge of the collection and disposal of hazardous waste from households including items like batteries, light bulbs, and containers contaminated with chemicals. Local administrative organisations are also required to provide appropriate containers, designated collection points, or central storage facilities for hazardous waste. The transportation of municipal hazardous waste from these central storage facilities to treatment facilities is governed not only by the Ministerial Regulation of Public Health regarding Management of Municipal Toxic and Hazardous Waste, but also by the "Ministry of Industry Announcement on the Management of Refuse or Unused Materials B.E. 2566 (2023)." Due to this regulatory separation, the criteria of municipal hazardous waste transportation and collection to collection points falls under a framework that allows for material recovery during transport. Non-recyclable hazardous waste transported to central storage is then subsequently sent to treatment facilities, contributing to pollution prevention and control efforts.

As of March 2025, a draft version of WEEE Integrated Action Plan B.E. 2565 - 2569 (2022 - 2026) has been published on the website of PCD. The objectives of the Action Plan are to develop an efficient system for the segregation and collection of WEEE, to have WEEE properly dismantled, recycled, and disposed of, and to establish at least one waste product Environmentally Sound Management (ESM) plants by 2026 (PCD, 2021).

Thailand's urban expansion and rising vehicle ownership, coupled with its role as a major auto manufacturer hub, have led to a surge in end-of-life vehicles (ELVs). Addressing the environmental impacts of ELVs disposal is crucial as urbanization and economic growth accelerate, highlighting the need for sustainable vehicle disposal practices.

Statistics from the Department of Land Transport show an upward trend in the number of privately owned cars from 38.87 million in 2019 to 42.57 million in 2023 (DLT, 2024). It is estimated that by 2045, Thailand will have 16 million end-of-life vehicles with an accumulated battery weight of almost 0.5 million tonnes to deal with. As of 2023, there are only 4 fully integrated automobile dismantling factories currently in operation with the total capacity of 23,500 tonnes of end-of-life-vehicles per year (PCD, 2023b).

The operational objectives outlined in the second national waste management action plan (2022-2027) for hazardous waste management aim to achieve progressively increasing

percentages of proper management for hazardous waste generated by households. Targets are set to increase by 5% annually, starting from 25% in 2022 and reaching 50% by 2027. Three measures have been defined for hazardous waste management as follows:

1. **Management at Source**: Sorting and collecting hazardous waste to increase recovery rate, and/or to be treated by competent waste processors.
2. **Improvement of Disposal Systems**: Enhancing the efficiency of waste disposal systems, such as supporting investments in the establishment of dismantling and WEEE and ELVs disposal facilities.
3. **Development of Waste Management Tools**: Creating management tools, including the enactment of WEEE and ELVs legislation (PCD, 2023d).

2.2 Industrial Waste

In 2023, Thailand recorded a total of 19.82 million tonnes of industrial waste notified for transportation and integrated into the Department of Industrial Works' management system. This comprised 18.69 million tonnes of non-hazardous waste and 1.13 million tonnes of hazardous waste, based on data collected from January 1 to October 31, 2023. The Eastern region had the highest potential for treating and disposing of industrial waste, with a ratio of waste generators to waste processors at 12:1. Following this were the Central, Northeastern, Western, Northern, and Southern regions, respectively. The Southern region had the highest ratio of waste generators to processors at 108:1. However, medium and small-sized enterprises still lacked understanding and compliance with waste management regulations, and they often lacked personnel dedicated to handling industrial waste. Additionally, these businesses faced high costs associated with exporting hazardous waste for treatment (PCD, 2024b).

In addition to domestic hazardous industrial waste, Thailand was also one of the countries that has been importing such waste from developed countries prior to the ratification of Ban Amendment in 2023. Thailand ratified the Basel Convention on the Control of Transboundary Movement of Hazardous Waste and their Disposal in 1997 but has just officially ratified the Ban Amendment in 2023. This amendment prohibits the export or movement of hazardous wastes across borders between countries (PCD, 2023b).

Ministry of Industry Announcement on the Disposal of Refuse or Unused Materials (Issue 3), B.E. 2566 introduced extended responsibility to waste generators. Waste generators are now

responsible for their waste from generation through to its complete disposal, including overseeing the waste processor's activities and taking necessary actions if waste processors fail or if accidents occur.

Challenges in hazardous industrial waste treatment include:

- **Insufficient Hazardous Waste Treatment Facilities**: The hazardous waste treatment facilities are concentrated only in the central and eastern regions, which does not cover all areas. This inadequacy leads to illegal dumping and improper disposal of hazardous industrial waste.
- **Inadequate Monitoring and Supervision**: There is a lack of comprehensive monitoring and supervision of factories generating hazardous industrial waste and those treating/disposing of it. This includes the entire system of collection, transportation, and treatment/disposal.
- **Legal Gaps**: The current laws do not cover hazardous waste management from small enterprises that do not qualify as factories under the Factory Act (No. 2) B.E. 2562.
- **Lack of Knowledge among SMEs**: Small and medium-sized enterprises lack understanding of hazardous waste management laws. They either lack personnel or frequently change the personnel responsible for waste management. Additionally, the cost burden of disposing/treating hazardous waste is high, particularly for hazardous waste. (PCD, 2023b).

2.3 Wastewater

As the Thailand economy continues to grow, the increase in industrial activities, urbanisation and population growth has led to significant pressure on water and wastewater management systems resulting in environmental and social negative impacts such as public health risks, water pollution, and also economic impacts on tourism, fishing and agriculture.

In 2019, Thailand produced around 9.99 million cubic meters of community wastewater daily, with an average individual contribution of 150 litres (PCD, 2023). Thailand National Strategic Plan 2018-2037, Issue 18 sets a goal to ensure that 90% of the surface water, groundwater, and sea water are of a quality suitable for use by 2037. However, in 2019 only 5% of the water sources met the quality standards for their respective uses. A significant cause of this is the discharge of

wastewater and sewage from communities, agriculture, and industry, with most of the pollution originating from communities, especially in densely populated areas (PCD, 2023).

Community wastewater management from households and buildings primarily involves reducing contamination through the installation of grease traps and/or onsite wastewater treatment systems, mostly anaerobic systems such as sedimentation ponds, and anaerobic filter tanks. Mostly, only sewage is treated, allowing wastewater from other activities like kitchen water, bathing water, and laundry water to be discharged directly into the environment. For large buildings, aerated treatment systems are often used to treat wastewater to meet specified discharge standards (PCD, 2017). Of treated water, 27% takes place at central wastewater treatment plants while onsite wastewater treatment plants manage the remaining 73% (MONRE, 2022).

Similarly, wastewater management in the industrial and agricultural sectors remains ineffective. Challenges to improvement include the complexity of wastewater treatment technologies, a shortage of skilled personnel in wastewater management, and the need for large areas to deploy simple wastewater treatment solutions. This is further complicated by the reliance on traditional community practices and seasonal variations in production. The underutilized wastewater treatment system, designed for future demands, is experiencing reduced efficiency due to prolonged retention times (PCD, 2023).

Thailand's 20-Year Master Plan on Water Resources Management (2023–2040), updated by the Office of National Water Resources (ONWR) focuses on five key areas:

- Consumption Management – Expand and upgrade water systems for 7.2 million households;
- Water security for Production – Supply water to 915,200 hectares of rain-fed agriculture;
- Flood and Inundation Management – Improve waterways, dams and manage flood-prone zones
- Ecosystem Conservation and Restoration – Restore 220,000 hectares of watershed forests and build 759 wastewater treatment facilities;
- Management and Organizational Development – strengthen policies, data integration, and community participation (MONRE, 2024).

The management of industrial wastewater involves measures aligned with NDC goals to reduce GHG emissions. These measures include increasing biogas production from industrial wastewater by reusing methane gas, in accordance with the Alternative Energy Development Plan 2015 – 2036. The AEDP2015 aims to utilise biogas from various sources, including industrial wastewater, agricultural waste, and community waste, for electricity and heat generation (EPPO, 2016).

The impacts of waste, along with the current state and outlook of waste management in Thailand, underscore the critical need for robust waste management systems that fit to local context. This necessitates engagement with both private and public sectors, as well as the public. The Thailand Taxonomy for waste management aims to encourage and incentivize greener waste management practices and infrastructure, with the goal of supporting Thailand in achieving its national targets related to waste management.

Interoperability with international taxonomies

In response to the environmental demands of waste management in Thailand, a range of economic activities have been considered for including in the Thailand Taxonomy. These economic activities were considered with due consideration to interoperability with international activities. Most specifically, the water supply, sewerage, waste management and remediation sector of the EU Taxonomy and Singapore (SG) Taxonomy. As of April 2024, ASEAN Taxonomy had not yet developed criteria for Waste Management Activities.

The master list of activities is derived from EU Taxonomy and Singapore Taxonomy. Activities are then selected based on the following rationale:

1. Substantial contribution to environmental objectives;
2. Materiality of activity to Thailand's economy;
3. Existence in other taxonomies.

While some activities can be adopted to allow interoperability, other activities need adaptation to meet the local context of Thailand. Irrelevant activities are excluded from the list. The activities

which require a broader outreach to stakeholder outside the Waste Management Working Group is set aside for the next phase.

The summary of comparison of EU and Singapore Taxonomy economic activities is in Annex II.

Proposed Thailand Taxonomy waste management activities

Thirteen activities have been proposed for Thailand Taxonomy Waste Management Sector, with the majority of these activities referring to the EU Taxonomy to ensure interoperability.

Table 3 lists the 13 proposed economic activities for the Waste Management Sector in the Thailand Taxonomy, where they correspond to each of these Environmental Objectives (EOs):

- EO1 – Climate Change Mitigation
- EO2 – Climate Change Adaptation
- EO3 – Sustainable Use and Protection of Marine and Water Resources
- EO4 – Resource Resilience and Transition to a Circular Economy
- EO5 – Pollution Prevention and Control
- EO6 – Protection and Restoration of Biodiversity and Ecosystems

Table 2: Proposed Taxonomy Waste Management Activities

Ref	Proposed Activity (ENG)	EO1	EO2	EO3	EO4	EO5	EO6
1	Anaerobic digestion of bio-waste or wastewater **(ISIC 3821, 3700)**	✓	X	X	✓	X	X
2	Composting of bio-waste **(ISIC3821)**	X	X	X	✓	X	X
3	Collection and transport of waste **(ISIC 381)**	X	X	X	✓	✓	X
4	Depollution and dismantling of end-of-life products **(ISIC 383)**	X	X	X	✓	X	X
5	Waste to Energy (WtE) **(ISIC 3821, 3822)**	✓	X	X	X	X	X
6	Landfill gas capture and utilisation **(ISIC 3821)**	✓	X	X	X	X	X
7	Remediation of contaminated sites and areas **(ISIC 390, 3320, 431, 711)**	X	X	X	X	✓	X
8	Remediation of legally non-conforming landfills and abandoned or illegal waste dumps **(ISIC 390, 382, 383)**	X	X	X	X	✓	X

Ref	Proposed Activity (ENG)	EO1	EO2	EO3	EO4	EO5	EO6
9	Sorting and material recovery from non-hazardous waste **(ISIC 3830)**	X	X	X	✓	X	X
10	Treatment of hazardous waste **(ISIC 3822)**	X	X	X	✓	✓	X
11	Construction, extension, upgrade, operation and renewal of decentralised wastewater collection and treatment **(ISIC 3700)**	X	✓	✓	✓	X	X
12	Construction, extension, upgrade and operation of centralised wastewater collection and treatment **(ISIC 3700)**	✓	✓	X	X	X	X
13	Renewal of centralised wastewater collection and treatment **(ISIC 3700)**	✓	✓	X	X	X	X

The majority of waste management activities can contribute to EO4 - Resource Resilience and Transition to Circular Economy and EO5 - Pollution Prevention and Control.

Some activities can contribute to EO1 Climate Change Mitigation by reducing GHG emissions through waste prevention, waste separation, reuse and recycling. However, the TSC for EO1 of Waste Management activities do not take the form of emissions thresholds as the Waste Management sector mainly enables other sectors of the economy to reduce GHG emissions through waste prevention, waste separation, reuse and recycling.

Also, some activities can contribute to EO2 – Climate Change Adaptation as these relate specifically to wastewater management, an activity which may be particularly stressed by the effects of climate change.

One activity in this sector can contribute to EO3 - Sustainable Use and Protection of Marine and Water Resource, specifically in relation to the construction, extension, upgrade, operation and renewal of urban wastewater collection and treatment. It will be noted that no TSC have been set in this sector for EO6 – Protection and Restoration of Biodiversity and Ecosystems. It is generally assumed that activities in this sector are not directly related to this EO, although indirect benefits to biodiversity will result from promotion of other EOs (e.g. EO3 and EO5).

The scope of waste and wastewater encompasses discharge points after waste has been produced such as farm gates, house gates, and factory gates. Consequently, residues that can be reused or recycled on-site, such as small-scale fertilisation production from agricultural

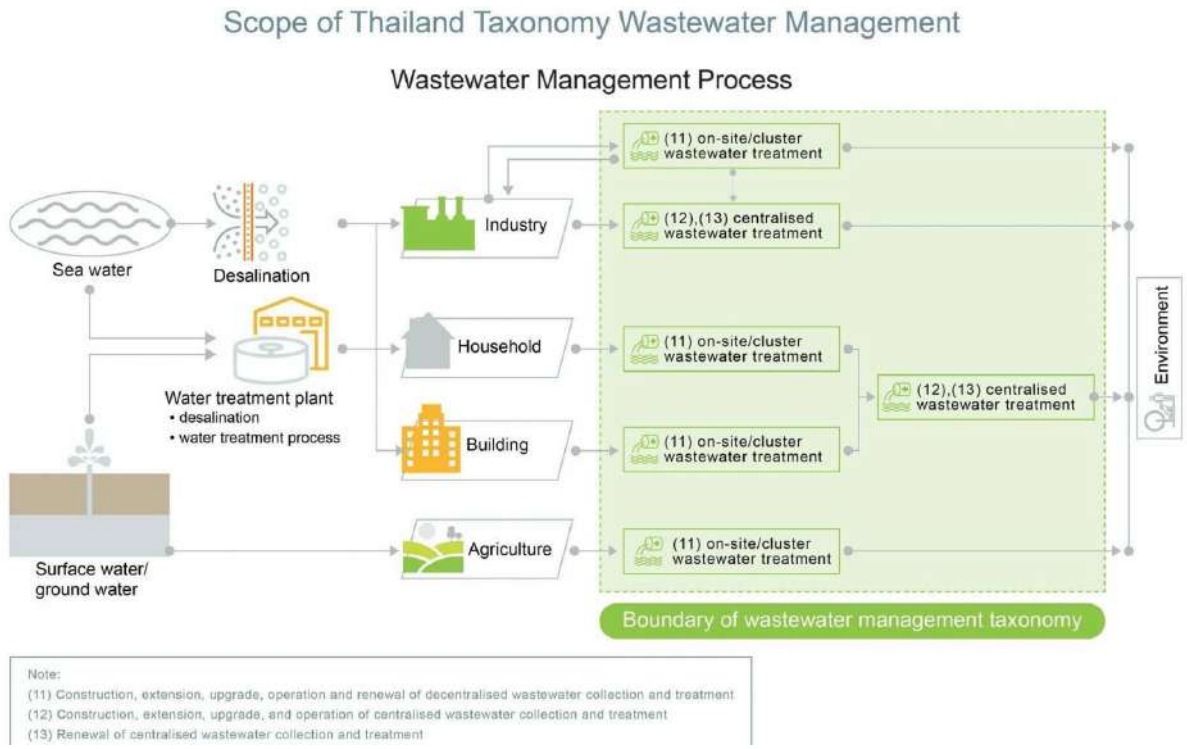
residue compost, are not considered waste but contribute to the Circular Economy Environmental Objective of the specific activity.

In Thailand, valuable waste such as plastic, WEEEs, glass and paper are collected at many different levels due to their economic value. Informal collectors include scavengers, motorbikes or vehicles that are not authorized by local administrative authorizations to conduct the activity of waste collection or transport. In addition to the informal garbage collectors, the formal garbage collectors also collect valuable waste. The valuable waste is then sold to the waste shops. When the TSC refers to "intermediate sorting facilities", this may include informal and/or formal garbage collectors.

Apart from this, the scope of Thailand Taxonomy Waste Management covers also Wastewater Management including decentralised wastewater (on-site treatment and cluster treatment), and centralised wastewater treatment.

Figure 9 Solid Waste Management Activities proposed for Thailand Taxonomy Waste Management

Figure 10 Wastewater Management Activities proposed for Thailand Taxonomy Waste Management



Guiding principles for setting technical screening criteria (TSC)

This section explains the considerations which guided the setting of Green TSC at each Environmental Objective.

1. Guiding Principles for TSC setting in EO1: Climate Change Mitigation

An activity shall be considered as fulfilling the objective of Climate Change Mitigation (EO1) if it contributes to one or more the following:

1. Avoids GHG emissions
2. Reduces GHG emissions; or
3. Enables others to avoid or reduce GHG emissions

EO1 TSC for Waste Management does not take the form of emissions thresholds as Waste Management is the sector that enables other sectors of the economy to reduce GHG emissions through waste prevention, waste separation, reuse and recycling. The climate

mitigation impact of waste management is inherently linked to the nature of its business models. As a result, the climate mitigation criteria are primarily focused on qualitative metrics that ensure the effective implementation of strategies aimed at maximizing operational efficiency and minimizing life cycle emissions.

The criteria for the Waste Sector focus on the procedural steps, refers to the waste management hierarchy which prioritises Prevention over Reuse, followed by Recycling, Recovery and Disposal. In the areas where legal enforcement needs to be strengthened, compliance with law is set as Green TSC to increase recycling rate, and to mitigate potential negative environmental or social effects.

Material recovery is prioritised over energy recovery. As an example, digestate or compost is used as fertiliser or soil improver or secondary raw material for construction as permitted by the applicable regulations. If material recovery is not permitted or not feasible, then incineration of digestate or compost for energy recovery is permitted. Material recovery contributes to EO4 due to replacement of virgin materials. Energy recovery contributes to EO1 due to methane avoided from landfill diversion.

Figure 11 Waste Management Hierarchy (PCD, 2023b)

2. Guiding Principles for TSC setting in EO2: Climate Change Adaptation

An activity shall be considered as fulfilling the objective of Climate Change Adaptation (EO2) if it contributes in one or more of the following:

1. Activity shall positively contribute to a reduction in material physical climate risk and/or shall reasonably reduce material physical risk from current and future climate change. This can include obvious physical risks, such as flooding, but also less immediately visible effects, such as impact on health from higher temperatures.
2. Impact assessments under a broad range of climate scenarios shall be conducted to provide better understanding and insights on the effectiveness and benefits of the Activity.
3. Activity that enables adaptation of other Activities should reduce the impact of material physical risk from other Activities and/or reduce barriers to adaptation through technology, services or products.
4. Activity must not adversely affect the adaptation efforts, or increase the physical risk, of other stakeholders.
5. Adaptation solutions should be location-specific and context-specific and shall be assessed and ranked in order of priority using the best available climate projections in order to prevent and/or reduce the adverse impact on people, nature or assets.

3. Guiding Principles for TSC setting in EO3: Sustainable use of Marine and Water Resources

An activity shall be considered as fulfilling the objective of Sustainable use of Marine and Water resources (EO3) if it contributes to achieving good environmental status of bodies of water, through protection, preservation, or restoration mechanisms, including improving water management and efficiency activities, as well as promoting the sustainable use of water through the long-term protection of available water resources.

4. Guiding Principles for TSC setting in EO4: Resource Resilience and Transition to a Circular Economy

An activity intended to promote EO4 shall fulfil some or all the principles:

Strategy & Operations, Adjusting Business Models:

1. Uses renewable energy, bio-based resources, or other recovered materials to reduce rate of resource extraction.

2. Uses future-proof, sustainable considerations and specifications to design and produce products, assets or process technologies that enable circular economy strategies through:
    a. Designing for longevity, resource efficiency, durability, functionality, modularity, upgradability, easy disassembly, and repair;
    b. Using recyclable or biodegradable materials;
    c. Replacing substances in materials and products throughout their lifecycle with safer alternatives, where applicable, and promoting traceability.
3. Optimises waste management, including the management and reduction of waste from (i) the extraction of minerals, and (ii) the construction and demolition of buildings.
4. Optimises resource use and/or extends product use, including through:
    a. Replacement of virgin materials with secondary raw materials or by-products, either fully or partially;
    b. Repair, reuse, donation, resale, upcycling activities or on-site composting;
    c. Repurposing, refurbishing, remanufacturing, disassembling, upgrading and repairing, and sharing of products.
5. Offers product as a service based on, inter alia, leasing, pay-per-use, subscription, or deposit return schemes to reduce the demand for new products and their embedded raw materials.
6. Provides for cleaner and more efficient options for waste disposal, including minimising disposal to landfills.

Enablers: Facilitating the Transition

1. Develops and/or improves resource optimisation / waste management infrastructure needed for re-use and recycling to increase resource efficiency and ensure recovered materials are recycled as high-quality secondary raw material.
2. Invests in the creation of a research and development (R&D) and knowledge sharing platform to increase expertise in circular economy and/or execute circular economy related pilot projects.

5. Guiding Principles for TSC setting in EO5: Pollution Prevention and Control

An activity shall be considered as fulfilling the objective of Pollution prevention and control (EO5) if it contributes to environmental protection from pollution by improving levels of air, water, and/or land quality, including the cleaning up of litter and other pollution.

6. Guiding Principles for TSC setting in EO6: Protection and Restoration of Biodiversity and Ecosystem

An activity intended to promote EO6 shall conform with the following principles while simultaneously minimising or eliminating any direct or indirect adverse effects on the natural ecosystem and biodiversity:

1. Enable ecosystem restoration and/or facilitate the protection of ecosystems.
2. Implement necessary measures to protect ecosystems and biodiversity, including but not limited to, actions such as the adoption of sustainable logging practices and ensuring timber products are sourced from sustainably managed forests.
3. Enforce and empower existing policies related to the protection of natural areas.
4. Take into consideration the sustainable and equitable use of biodiversity and ecosystem services.

TSC for waste management activities

With respect to comparisons of the Thailand Taxonomy criteria and international best practice/reference taxonomies, note the following general points[2]:

1. The codes EO1 – EO6 have the meanings defined in the Thailand Taxonomy. Where comparisons are made, the code may refer to a comparable EO in another taxonomy, regardless of the coding system used in that other taxonomy.
2. Comparisons are not made in the following cases:
    a. **Amber – EU Taxonomy**: The EU Taxonomy does not set amber criteria for any EO.

[2] Points refer to the situation as of March 2025.

b. **EOs other than EO1 – Singapore (SG) Taxonomy**: The SG Taxonomy does not set criteria for any EO other than 'climate mitigation' (equivalent to EO1).

3. The EU Taxonomy establishes green criteria for certain activities that, "contribute to overall local, national or regional resilience" (equivalent to EO2). In contrast, the Thailand Taxonomy sets TSC for EO2 only for activities primarily aimed at providing climate change adaptation services to broader society or the economy, such as flood management. To avoid misclassification under green or amber based solely on an activity's climate resilience, only these specific activities can be classified under EO2. It is important to note that any activity assessed as green or amber under any other EO must demonstrate DNSH to EO2, making climate resilience a minimum requirement.

4. Whilst the EU Taxonomy refers to EU Directives and Regulations, the Thailand Taxonomy refers to national laws, international standards or best practice.

1. Anaerobic digestion of bio-waste or wastewater

Sector	Waste Management
Activity	Anaerobic digestion of bio-waste or wastewater
ISIC Code	3821, 3700
Description	Construction and operation of facilities for the treatment of separately collected bio-waste including sewage sludge and wastewater by anaerobic digestion with the resulting production and utilisation of biogas, digestate or chemicals.
Objective	- EO1: Climate Change Mitigation - EO4: Resource Resilience and Transition to a Circular Economy

Tiers	**EO1: Climate Change Mitigation**	**Reference with international best practice/reference taxonomies**
Green	1. The bio-waste that is used for anaerobic digestion is segregated at source (i.e., before formal collection) and collected separately; AND 2. A monitoring and contingency plan is in place in order to minimise methane leakage at the facility; AND	Aligned to EU and SG Taxonomy criteria. However, note that segregation of woody waste is covered in the

	3. The produced biogas is used directly for the generation of electricity or heat, or upgraded to bio-methane for injection in the natural gas grid, or used as vehicle fuel, or as feedstock in the chemical industry; AND 4. The produced digestate: a. from biowaste (excluding sewage sludge) from single digestion facilities is used as fertiliser or soil improver, either directly or after composting, or any other treatment as permitted by the applicable regulations; AND/OR b. from anaerobic digestion of sewage sludge or co-digestion facilities will be further processed as permitted by the applicable regulations, prioritising material recovery over energy recovery.	Thailand Taxonomy at EO4.
Amber	1. The bio-waste is segregated at source (i.e., before formal collection), or at an intermediate sorting facility, or at anaerobic digestion facility; AND 2. The rejects from segregation are disposed of at Taxonomy-eligible facilities (Green or Amber); AND 3. A monitoring and contingency plan is in place in order to minimise methane leakage at the facility; AND 4. Produced biogas is flared directly without utilization of energy, whilst avoiding the release of incomplete combustion products, such as carbon monoxide (CO) or particulate matter (PM), into the atmosphere; AND 5. The produced digestate: a. from biowaste (excluding sewage sludge) from single digestion facilities is used as fertiliser or soil improver, either directly or after composting, or any other treatment as permitted by the applicable regulations; AND/OR	Aligned to SG Taxonomy criteria

	b. from anaerobic digestion of sewage sludge or co-digestion facilities will be further processed as permitted by the applicable regulations, prioritising material recovery over energy recovery; AND 6. The sunset date for activities classified under these Amber criteria is 31 December 2029	
Red	Does not meet Green or Amber criteria	
Applicable standards/ Best Practice Examples	1. Regulations for the detection and elimination of gas leaks should demonstrate due consideration of the Methane Guiding Principles (Link) 2. GHG Reduction Enhancement Project from Wastewater and Sludge from Community Integrated Wastewater Treatment System PCD 02-321 Book 1/3 (Link) 3. Guidelines and Measures to promote the use of effluent and sludge from PCD 02-321 Book 2/3 (Link) 4. Environmentally friendly low-carbon community wastewater management technologies and good practices (Link)	

Tiers	**EO2: Climate Change Adaptation**	**Reference with international best practice/reference taxonomies**
Green	No TSC available	See notes at the start of this section (TSC for waste management activities)

Tiers	**EO3: Sustainable Use and Protection of Marine and Water Resources**	**Reference with international best practice/reference taxonomies**
Green	No TSC available	Not applicable

Tiers	EO4: Resource Resilience and Transition to a Circular Economy	Reference with international best practice/reference taxonomies
Green	1. The bio-waste that is used for anaerobic digestion is segregated at source (i.e., before formal collection) and collected separately; AND 2. A monitoring and contingency plan is in place in order to minimise methane leakage at the facility; AND 3. The produced biogas is used directly for the generation of electricity or heat, or upgraded to bio-methane for injection in the natural gas grid, or used as vehicle fuel, or as feedstock in the chemical industry; AND 4. The activity produces at least one of the following: a. Digestate from biowaste (excluding sewage sludge) from single digestion facilities is used as fertiliser or soil improver, either directly or after composting, or any other treatment as permitted by the applicable regulations. Burning is not allowed; AND/OR b. Digestate from sewage sludge or co-digestion facilities which will be further processed for material recovery as permitted by the applicable regulations. Burning is not allowed; AND/OR c. Chemicals through the conversion of organic waste to carboxylates, carboxylic acids or polymers by fermentation with mixed cultures; AND 5. Woody waste is segregated before or after processing and sent to an eligible treatment plant (such as composting or biomass-based energy plants).	Aligned to EU Taxonomy criteria. Aligned to SG Taxonomy criteria (EO1 equivalent).

Amber	1. The bio-waste is segregated at source (i.e., before formal collection) or, at an intermediate sorting facility, or at anaerobic digestion facility; AND 2. The rejects from the intermediate sorting facility or facility are disposed of at Taxonomy-eligible facilities (Green or Amber); AND 3. A monitoring and contingency plan is in place in order to minimise methane leakage at the facility; AND 4. Produced biogas is flared directly without utilization of energy. Avoid the release of incomplete combustion products such as carbon monoxide (CO) and particulate matter (PM) into the atmosphere; AND 5. The produced digestate: a. from biowaste (excluding sewage sludge) from single digestion facilities is used as fertiliser or soil improver, either directly or after composting, or any other treatment as permitted by the applicable regulations;, AND/OR b. from sewage sludge or co-digestion facilities will be further processed as permitted by the applicable regulations, prioritising material recovery over energy recovery; AND 6. The sunset date for activities classified under these Amber criteria is 31 December 2029.	Aligned to SG Taxonomy criteria (EO1 equivalent)
Red	Does not meet Green or Amber criteria	
Applicable Standards/ Best Practice Examples	1. Regulations for the detection and elimination of gas leaks should demonstrate due consideration of the Methane Guiding Principles (Link) 2. Refer to Department of Primary Industries and Mine's Sludge Input Criteria 3. ISO 19698:2020 Sludge recovery, recycling, treatment and disposal – beneficial use of biosolids – land application	

Tiers	EO5: Pollution Prevention and Control	Reference with international best practice/reference taxonomies
Green	No TSC available	Not applicable

Tiers	EO6: Protection and Restoration of Biodiversity and Ecosystem	Reference with international best practice/reference taxonomies
Green	No TSC available	Not applicable

2. Composting of bio-waste

Sector	Waste Management
Activity	Composting of bio-waste
ISIC Code	3821
Description	Construction and operation of dedicated facilities for the treatment of separately collected bio-waste through aerobic digestion with the resulting production and utilisation of compost.
Objective	EO4: Resource Resilience and Transition to a Circular Economy

Tiers	EO1: Climate Change Mitigation	Reference with international best practice/reference taxonomies
Green	No TSC available	Thailand Taxonomy sets criteria at EO4 for this activity.

Tiers	EO2: Climate Change Adaptation	Reference with international best practice/reference taxonomies
Green	No TSC available	See notes at the start of this section (TSC for waste

		management activities)

Tiers	EO3: Sustainable Use and Protection of Marine and Water Resources	Reference with international best practice/reference taxonomies
Green	No TSC available	Not applicable

Tiers	EO4: Resource Resilience and Transition to a Circular Economy	Reference with international best practice/reference taxonomies
Green	1. The bio-waste that is composted is segregated at source (i.e., before formal collection) and collected separately; AND 2. The produced compost is used as fertiliser or soil improver as permitted by the applicable regulations; AND 3. Efficient operations ensure avoidance of methane leakage; AND 4. Measures to prevent and mitigate odour and water pollution from leachate are in place	Aligned to EU Taxonomy criteria. Aligned to SG Taxonomy criteria (EO1 equivalent).
Amber	1. The bio-waste is segregated at an intermediate sorting facility, or at composting facility; AND 2. The rejects from segregation are disposed of at Taxonomy-eligible facilities (Green or Amber); AND 3. The produced compost is used as fertiliser or soil improver as permitted by the applicable regulations; AND 4. Efficient operations ensure avoidance of methane leakage; AND 5. Measures to prevent and mitigate odour and water pollution from leachate are in place	Aligned to SG Taxonomy criteria (EO1 equivalent)
Red	Does not meet Green or Amber criteria	

Applicable standards/ Best Practice Examples	1. Fertiliser production from bio-waste compost handbook PCD 04-117 (Link) 2. Announcement from Pollution Control Department regarding the criteria for construction and management of municipal solid waste composting facilities (Link)	

Tiers	EO5: Pollution Prevention and Control	Reference with international best practice/reference taxonomies
Green	No TSC available	Not applicable

Tiers	EO6: Protection and Restoration of Biodiversity and Ecosystem	Reference with international best practice/reference taxonomies
Green	No TSC available	Not applicable

3. Collection and transport of waste

Sector	Waste Management
Activity	Collection and Transport of Waste
ISIC Code	381
Description	Separate collection and transport of hazardous and non-hazardous waste aimed at preparing for re-use or recycling, including the construction, operation and upgrade of facilities involved in the collection and transport of such waste, as a means for material recovery or appropriate treatment. The activity includes operation of waste collection containers, transfer stations, all types of transportation vehicles, ICT solutions, and other related infrastructure. Note: 1. Municipal Solid Waste consists of general waste[3], municipal hazardous waste[4], infectious waste[5], recyclable waste[6], and bio-waste.

[3] Ministerial Regulation on General Waste Management B.E. 2560

[4] Ministerial Regulation on Hazardous Waste Management from Communities B.E. 2563

[5] Ministerial Regulation on Infectious Waste Management B.E. 2545

[6] Ministerial Regulation on General Waste Management B.E. 2560

	2. Industrial Waste[7] means unusable materials or all types of wastes including hazardous and non-hazardous waste generated from industrial activity. 3. Transportation of Municipal Hazardous Waste and/or Industrial Hazardous Waste to disposal may contribute to EO5 only when recovery (EO4) is not permitted by law. 4. Freight transport vehicles used for this activity are not required to meet the EO1 GHG emissions standards set in the Transport sector of the Thailand Taxonomy, as this activity is not classified under EO1. However, vehicles must comply with **Transportation Requirements** according to applicable regulations which include but not limit to: 4.1 Air pollution emissions comply with applicable regulatory thresholds; and 4.2 Leachate spills are prevented during transportation by a container (holding tank); and 4.3 Waste is securely covered to prevent spillage during transportation.
Objective	- EO4: Resource Resilience and Transition to a Circular Economy [Municipal Solid Waste] and [Industrial Waste]; - EO5: Pollution Prevention and Control [Crop residues waste], [Industrial Hazardous Waste], and [Municipal Hazardous Waste]

Tiers	**EO1: Climate Change Mitigation**	**Reference with international best practice/reference taxonomies**
Green	No TSC available	Thailand and EU Taxonomies set criteria at EO4, and not EO1 for this activity. SG Taxonomy sets criteria at EO1. See EO4 for comparison.

[7] Ministry of Industry Announcement on the Disposal of Refuse or Unused Materials (Issue 3), B.E. 2566

Tiers	EO2: Climate Change Adaptation	Reference with international best practice/reference taxonomies
Green	No TSC available	See notes at the start of this section (TSC for waste management activities)

Tiers	EO3: Sustainable Use and Protection of Marine and Water Resources	Reference with international best practice/reference taxonomies
Green	No TSC available	Not applicable

Tiers	EO4: Resource Resilience and Transition to a Circular Economy	Reference with international best practice/reference taxonomies
Green	**[Municipal Solid Waste:** • **Non-Hazardous Waste transportation from source to disposal point;** • **Hazardous Waste transportation from source to storage point only; transportation from storage point to disposal point is covered under EO5].** 1. Before 31 December 2029, waste is segregated at source (i.e., before formal collection), or at an intermediate sorting facility into the following waste streams: general waste, municipal hazardous waste, recyclable waste, bio-waste, and infectious waste (where applicable). Collection and transportation of specific segregated waste stream(s) is eligible; AND 2. After 31 December 2029, waste is segregated at source (i.e., before formal collection) into the following waste streams: general waste, municipal hazardous waste,	Aligned to EU Taxonomy criteria except EU Taxonomy does not allow sorting at intermediate or waste collection or transport facility. For non-hazardous waste, it is aligned to SG Taxonomy criteria (EO1 equivalent)

	recyclable waste, bio-waste, and infectious waste (where applicable). Collection and transportation of specific segregated waste stream(s) is eligible; AND 3. Waste is transported to a location with the intention of preparation for material recovery (reuse or recycling) or energy recovery (WtE), ensuring material recovery is prioritised over energy recovery. If recovery of waste is not permitted by law, it must be transported to a location with the intention of waste disposal by a competent waste treatment facility; AND 4. The transportation vehicle conforms to Transportation Requirements set out in Description Note 4 of this Activity; AND 5. For WEEE: a. collection and transport preserve the integrity of WEEE and prevent the leakage of hazardous substances such as ozone-depleting substances, fluorinated greenhouse gases or mercury contained in fluorescent lamps; AND b. A management system to manage environmental, health and safety risks is in place; AND c. WEEE is delivered to a legally approved waste management facility. **[Industrial Waste – Hazardous & Non-Hazardous from source to recovery point]** 1. Waste is segregated at source (i.e., before formal collection); AND 2. Waste is transported to a location with the intention of preparation for material recovery (reuse or recycling) or energy recovery, ensuring material recovery is prioritised over energy recovery;	

	AND 3. The transportation vehicle conforms to Transportation Requirements set out in Description Note 4 of this Activity.	
Amber	**[Municipal Solid Waste:** • **Non-Hazardous Waste transportation from source to disposal point; and** • **Hazardous Waste transportation from source to storage point]** 1. Waste is segregated at an intermediate sorting facility into the following waste streams: general waste, municipal hazardous waste, recyclable waste, bio-waste, and infectious waste (where applicable); AND 2. Waste is transported to a location with the intention of preparation for material recovery (reuse or recycling) or energy recovery (WtE), ensuring material recovery is prioritised over energy recovery. If recovery of waste is not permitted by law, it must be transported to a location with the intention of waste disposal by a competent waste treatment facility; AND 3. The transportation vehicle conforms to Transportation Requirements set out in Description Note 4 of this Activity; AND 4. For WEEE: a. collection and transport preserve the integrity of WEEE and prevent the leakage of hazardous substances such as ozone-depleting substances, fluorinated greenhouse gases or mercury contained in fluorescent lamps; AND b. A management system is set up by the collection and logistics operator to manage environmental, health and safety risks; AND c. WEEE is delivered to a legally approved waste management facility.	Aligned to SG Taxonomy criteria for (EO1 equivalent) non-hazardous waste collection and transport.

	[Industrial Waste – Hazardous & Non-Hazardous] No TSC available	
Red	1. Does not meet Green or Amber criteria; OR 2. Waste is transported to ineligible WtE, or ineligible bioenergy plant, or unapproved waste management facility, or directly disposed to landfill.	
Applicable standards/ Best Practice Examples	1. DLA's Waste Bank Project: 2. Household and Office Waste Segregation and Waste Reduction E-book (Link)	

Tiers	**EO5: Pollution Prevention and Control**	**Reference with international best practice/reference taxonomies**
Green	**[Crop Residues Waste]** 1. Collection, transport, storage, and delivery of crop residues that are segregated at source (i.e., before formal collection), or at an intermediate sorting facility, to a location with the intention of preparation for material recovery (reuse or recycling) or Taxonomy-eligible energy recovery (Green or Amber bioenergy power plants), ensuring crop residues waste is not burned in an open space; AND 2. The transportation vehicle conforms to Transportation Requirements set out in Description Note 4 of this Activity. **[Transport of:** • **Industrial Hazardous Waste from source to disposal point; and** • **Municipal Hazardous Waste from storage point to disposal point]** 1. Collection, transport, storage and delivery of hazardous waste to the permitted treatment facility is managed	**[Crop residues waste]** Thailand specific **[Industrial Hazardous Waste from source to disposal, and Municipal Hazardous Waste from storage point to disposal]**

	according to applicable national and international legislations: a. Hazardous waste is segregated at source (i.e. before formal collection) and collected separately from non-hazardous waste, is not mixed nor diluted either with other materials; AND b. Proper collection and handling prevent leakage of hazardous waste during collection, transport, storage and delivery to the permitted treatment facility; AND c. During collection and transport, hazardous waste is packaged and labelled; AND d. The operator collects record of hazardous waste including quantity, nature, origin, destination, frequency of collection, mode of transport and treatment method; AND e. Where a given waste classified as hazardous has also a transport status of dangerous goods under the Agreement concerning the International Carriage of Dangerous Goods by Road (ADR), the transport complies with the relevant requirements set by the ADR; AND f. When the waste is stored, the activity complies with the requirements set out in national law; AND g. Rehearsal of hazardous waste spill emergency response plan and inspection of necessary equipment is conducted at the frequency identified by national regulations; AND h. The transportation vehicle is installed with a GPS tracking system, vehicle logbook, and transportation	Aligned to EU Taxonomy criteria

	document for at least 1 year or as identified by national regulations; AND 2. The transportation vehicle conforms to Transportation Requirements set out in Description Note 4 of this Activity; AND 3. For WEEE: a. collection and transport preserve the integrity of WEEE and prevent the leakage of hazardous substances such as ozone-depleting substances, fluorinated greenhouse gases or mercury contained in fluorescent lamps; AND b. A management system is set up by the collection and logistics operator to manage environmental, health and safety risks; AND c. WEEE is delivered to a legally approved waste management facility for dismantling and stripping.	
Amber	No TSC available	
Red	1. Does not meet Green or Amber criteria; OR 2. Waste is transported to ineligible WtE, or ineligible bioenergy plant, or unapproved waste management facility, or directly disposed to landfill.	
Applicable standards/ Best Practice Examples	1. Best Practice for WEEE waste transportation: refer to CLC/EN 50625-1:2014 and CLC/TS 50625-4:2017 2. PCD Manual for the transportation of hazardous waste from local communities under the administration of local government organizations to disposal point (Link)	

Tiers	**EO6: Protection and Restoration of Biodiversity and Ecosystem**	**Reference with international best practice/reference taxonomies**
Green	No TSC available	Not applicable

4. Depollution and dismantling of end-of-life products

Sector	Waste Management
Activity	Depollution and dismantling of end-of-life-products
ISIC Code	383
Description	Construction, operation and upgrade of facilities dismantling and depolluting complex end-of-life products, movable assets and their components for materials recovery or preparation for re-use of components. The economic activity includes the dismantling of end-of-life products and movable assets and their components of any type, such as automobiles, ships and electrical and electronic equipment (EEE) for material recovery. The economic activity does not include the treatment of batteries stemming from separate collection or removed during dismantling and depollution activities, and the demolition and wrecking of buildings and other structures which belongs to Construction Sector.
Objective	EO4: Resource Resilience and Transition to a Circular Economy

Tiers	**EO1: Climate Change Mitigation**	**Reference with international best practice/reference taxonomies**
Green	No TSC available	Not applicable

Tiers	**EO2: Climate Change Adaptation**	**Reference with international best practice/reference taxonomies**
Green	No TSC available	See notes at the start of this section (TSC for waste management activities)

Tiers	**EO3: Sustainable Use and Protection of Marine and Water Resources**	**Reference with international best practice/reference taxonomies**
Green	No TSC available	Not applicable

Tiers	EO4: Resource Resilience and Transition to a Circular Economy	Reference with international best practice/reference taxonomies
Green	1. The economic activity dismantles and depollutes separately collected waste, complex end-of-life products, such as automobiles, ships, or WEEE, in order to: a. harvest parts and components that are suited for re-use; AND b. separate non-hazardous and hazardous waste fractions suited for material recovery including recovery of critical raw materials; AND c. remove hazardous substances, mixtures and components, so that these are contained in an identifiable stream or that are an identifiable part of a stream within the treatment process, and send them to facilities permitted for proper treatment including disposal of hazardous waste; AND d. enclose documentation of the materials that are sent for further treatment or reuse; AND 2. The economic activity dismantling and depolluting complex end-of-life products, such as automobiles, ships, or WEEE, including waste originating from collection points, complies with at least the following standards: a. ISO 9001:2015 Quality Management Systems; AND b. ISO 14001:2015 Environmental Management Systems; AND c. ISO 45001:2018 Occupational health and safety management systems – Requirements with guidance for use.	Aligned to EU Taxonomy criteria.

Amber	1. The economic activity dismantles and depollutes separately collected waste, complex end-of-life products, such as automobiles, ships, or WEEE, in order to: a. harvest parts and components that are suited for re-use; AND b. separate non-hazardous and hazardous waste fractions suited for material recovery including recovery of critical raw materials; AND c. remove hazardous substances, mixtures and components, so that these are contained in an identifiable stream or that are an identifiable part of a stream within the treatment process, and send them to facilities permitted for proper treatment including disposal of hazardous waste; AND d. enclose documentation of the materials that are sent for further treatment or reuse;	Thailand specific
Red	Does not meet Green or Amber criteria	
Applicable standards/ Best Practice Examples	1. ISO 9001:2015 Quality Management Systems 2. ISO 14001:2015 Environmental Management Systems 3. ISO 45001:2018 Occupational health and safety management systems – Requirements with guidance for use 4. ISO 22628:2002 Road vehicles – Recyclability and recoverability 5. IEC 62635: Guidelines for End-of-Life Information provided by manufacturers and recyclers and for recyclability rate calculation of electrical and electronic equipment 6. UNEP E-Waste Management Manual (Link) 7. [For ship recycling] The Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships	

Tiers	EO5: Pollution Prevention and Control	Reference with international best practice/reference taxonomies
Green	No TSC available	Not applicable

Tiers	EO6: Protection and Restoration of Biodiversity and Ecosystem	Reference with international best practice/reference taxonomies
Green	No TSC available	Not applicable

5. Waste to Energy

Sector	Waste Management
Activity	Waste to Energy
ISIC Code	3821, 3822
Description	Generation of energy in the form of electricity and/or heat from pre-sorted residual waste (non-recyclable fraction of waste) incineration, including R&D investments related to developing and testing new and emerging technologies such as pyrolysis and gasification that can produce alternate and sustainable fuels or chemicals. Note: 1) Co-processing activity does not belong to WtE activity. Please refer to cement-manufacturing activity for criteria related to co-processing. 2) Input feedstock excludes agriculture residues which is covered under Thailand Taxonomy Phase I. Refer to Thailand Taxonomy Phase I for bioenergy power plant criteria.
Objective	EO1: Climate Change Mitigation

Tiers	EO1: Climate Change Mitigation	Reference with international best practice/reference taxonomies
Green	1. High quality recyclables and hazardous waste portion has been removed before entering the incineration process. Recyclables are sent for material recovery. Hazardous waste is sent for material recovery or appropriate disposal if recovery is not possible;	Aligned to SG Taxonomy criteria. The EU Taxonomy does not set criteria

	AND 2. Plant efficiency[8] is not less than 25%; AND 3. Partial Bottom ash recovery (in as much as permitted by national law) with at least 75% recovery of metal from ash. This activity could take place in an off-site location; AND 4. The bottom ash and fly ash management system is in place, ensuring no leakage of hazardous substances; AND 5. Pre-operational Waste-to-Energy (WtE) plant conducts a baseline environmental assessment, minimally addressing air quality and odour nuisance, prior to commencement of operations. The result is provided to stakeholder upon request. Operational WtE plant, upon stakeholder request, provides Energy Regulatory Commission audited Code of Practice Monitoring reports, including Continuous Emissions Monitoring Systems (CEMS) data; AND 6. WtE possesses a certified environmental management system, verified by a qualified third-party, that ensures effective pollution control and monitoring.	for this activity under any EO.
Amber	1. High quality recyclables and hazardous waste portion has been removed before entering the incineration process. Recyclables are sent to material recovery facilities and hazardous waste is sent to material recovery or hazardous waste treatment facilities; AND 2. Plant efficiency[9] is between 10% and 25%; AND	Aligned to SG Taxonomy criteria

[8] Plant efficiency is defined as (Electrical + Thermal Energy Output)/Energy Content of Waste, where 'Energy Output' means useful energy provided by the plant.

[9] Plant efficiency is defined as (Electrical + Thermal Energy Output)/Energy Content of Waste, where 'Energy Output' means useful energy provided by the plant.

	3. Partial Bottom ash recovery (in as much as permitted by national law) with at least 50% recovery of metal from ash. This activity could take place in an off-site location; AND 4. The bottom ash and fly ash management system is in place, ensuring no leakage of hazardous substances; AND 5. Pre-operational Waste-to-Energy (WtE) plant conducts baseline environmental assessment, minimally addressing air quality and odour nuisance, prior to commencement of operations. The result is provided to stakeholder upon request. Operational WtE plant, upon stakeholder request, provides Energy Regulatory Commission audited Code of Practice Monitoring reports, including Continuous Emissions Monitoring Systems (CEMS) data; AND 6. WtE possesses a certified environmental management system, verified by a third-party, that ensures effective pollution control and monitoring.	
Red	Does not meet Green or Amber criteria	
Applicable standards/ Best Practice Examples	PCD Guidelines for municipal solid waste management with WtE (Link)	

Tiers	**EO2: Climate Change Adaptation**	**Reference with international best practice/reference taxonomies**
Green	No TSC available	See notes at the start of this section (TSC for waste management activities)

Tiers	EO3: Sustainable Use and Protection of Marine and Water Resources	Reference with international best practice/reference taxonomies
Green	No TSC available	Not applicable

Tiers	EO4: Resource Resilience and Transition to a Circular Economy	Reference with international best practice/reference taxonomies
Green	No TSC available	Not applicable

Tiers	EO5: Pollution Prevention and Control	Reference with international best practice/reference taxonomies
Green	No TSC available	Not applicable

Tiers	EO6: Protection and Restoration of Biodiversity and Ecosystem	Reference with international best practice/reference taxonomies
Green	No TSC available	Not applicable

6. Landfill gas capture and utilisation

Sector	Waste Management
Activity	Landfill gas capture and utilisation
ISIC Code	3821
Description	Installation and operation of infrastructure for landfill gas capture and utilisation in permanently closed landfills or landfill cells using new or supplementary dedicated technical facilities and equipment installed during or post landfill or landfill cell closure.
Objective	EO1: Climate Change Mitigation

Tiers	EO1: Climate Change Mitigation	Reference with international best practice/reference taxonomies
Green	1. The landfill or landfill cell where the gas capture system is implemented is permanently closed and is not taking in further waste; AND 2. A monitoring and contingency plan is in place in order to minimise methane leakage at the facility; AND 3. The produced biogas is used directly for the generation of electricity or heat, or upgraded to bio-methane for injection in the natural gas grid, or used as vehicle fuel, or as feedstock in chemical industry.	Aligned to EU and SG Taxonomies
Amber	1. The landfill or landfill cell where the gas capture system is implemented is permanently closed and is not taking in further waste; AND 2. A monitoring and contingency plan is in place in order to minimise methane leakage at the facility; AND 3. The produced biogas is flared directly without use of energy, whilst avoiding the release of incomplete combustion products, such as carbon monoxide (CO) and particulate matter (PM), into the atmosphere; AND 4. The sunset date for an activity classified under the Amber criteria is 31 December 2029.	Aligned to SG Taxonomy criteria
Red	Does not meet Green or Amber criteria	
Applicable standards/ Best Practice Examples	Regulations for the detection and elimination of gas leaks should demonstrate due consideration of the Methane Guiding Principles (Link)	

Tiers	EO2: Climate Change Adaptation	Reference with international best practice/reference taxonomies
Green	No TSC available	See notes at the start of this section (TSC for waste management activities)

Tiers	EO3: Sustainable Use and Protection of Marine and Water Resources	Reference with international best practice/reference taxonomies
Green	No TSC available	Not applicable

Tiers	EO4: Resource Resilience and Transition to a Circular Economy	Reference with international best practice/reference taxonomies
Green	No TSC available	Not applicable

Tiers	EO5: Pollution Prevention and Control	Reference with international best practice/reference taxonomies
Green	No TSC available	Not applicable

Tiers	EO6: Protection and Restoration of Biodiversity and Ecosystem	Reference with international best practice/reference taxonomies
Green	No TSC available	Not applicable

7. Remediation of contaminated sites and areas

Sector	Waste Management
Activity	Remediation of contaminated sites and areas
ISIC Code	390, 3320, 431, 711

Description	The activity includes: 1. decontamination or remediation of soils and groundwater in the polluted area, either in situ or ex situ, in particular using physical, chemical or biological methods; 2. decontamination or remediation of contaminated industrial plants or sites; 3. decontamination or remediation of surface water and its shores following accidental pollution, such as through collection of pollutants or through physical, chemical or biological methods; 4. cleaning up oil spills and other types of pollutants on or in: a) surface water including rivers, lakes, coastal waters or transitional waters; b) groundwater; c) marine water; d) sediments (for all surface water types); e) aquatic ecosystems; f) buildings; g) soil; h) terrestrial ecosystems; 5. material abatement of hazardous substances, mixtures or products, such as asbestos or lead-based paint; 6. other specialised pollution-control activities; 7. clean-up after disasters from natural hazards, such as flooding, or earthquake; 8. remediation of disused mining sites or legacies not associated with extraction revenues; 9. containment operations, hydraulic barriers, active and passive barriers intended to limit or prevent migration of pollutants. The activity also includes all activities that are required to prepare, plan, monitor and follow-up the decontamination or remediation activity itself, such as: 1. preparatory investigations, including data collection and surveying activities (in particular geological or hydrological), technical feasibility and environmental impact studies required to define the remediation project; 2. monitoring and control of the remediation measures, including: a) sampling of soil, water, sediment, biota or other materials; b) laboratory analysis of samples to identify the nature and concentration of pollutants;

	c) installation, operation and maintenance of monitoring facilities and equipment such as observation wells in and outside the perimeter of the remediation site; 3. demolition of contaminated buildings or other structures, dismantling large-scale machinery and equipment (i.e., decommissioning) and removal of surface sealing and concreting; 4. earth moving or dredging, including excavation, landfilling, levelling, construction or reinforcement of perimeter walls or fences, primary access and internal roads and any other activities necessary to operate the decontamination; 5. implementation of other environmental protection and pollution prevention and control measures to comply with the conditions imposed in the environmental permit for the remediation project, including measures for safeguarding safety of operations on-site and health of workers (such as for fire control, flood protection, hazardous waste management), protection of workers, site access control, management of invasive species before or during decontamination or remediation, reinforcement operations carried out prior to or during decontamination. This economic activity does not include: 1. pest control in agriculture; 2. purification of water for water supply purposes; 3. decontamination or remediation of nuclear plants and sites; 4. treatment and disposal of hazardous or non-hazardous waste unrelated to the site contamination problem; 5. morphological remediation; 6. remediation of legally non-conforming landfills and abandoned or illegal waste dumps unrelated to the site under remediation; 7. emergency services; 8. outdoor sweeping and watering of streets. This activity covers the case where the polluter cannot be identified or is financially incapable of undertaking the remediation, third-party remediation will be considered. This activity is eligible for green finance mechanism, aiming to incentivize and support environmental restoration efforts.
Objective	EO5: Pollution Prevention and Control

Tiers	EO1: Climate Change Mitigation	Reference with international best practice/reference taxonomies
Green	No TSC available	Not applicable

Tiers	EO2: Climate Change Adaptation	Reference with international best practice/reference taxonomies
Green	No TSC available	See notes at the start of this section (TSC for waste management activities)

Tiers	EO3: Sustainable Use and Protection of Marine and Water Resources	Reference with international best practice/reference taxonomies
Green	No TSC available	Not applicable

Tiers	EO4: Resource Resilience and Transition to a Circular Economy	Reference with international best practice/reference taxonomies
Green	No TSC available	Not applicable

Tiers	EO5: Pollution Prevention and Control	Reference with international best practice/reference taxonomies
Green	1. Remediation activities are not carried out by the operator that caused the pollution or a person acting on behalf of that operator, in order to comply with the requirements of 'polluter-pays' principle according to national law; AND	Aligned to EU Taxonomy criteria, except 5 which is Thailand specific.

	2. Contaminant removal or control meets national regulatory standards, or a site-specific risk assessment when national standards are not available, considering contaminant properties and spread, to eliminate significant health and environmental risks to ensure that the contaminated area is safe for current or future use; AND 3. The remediation activity is conducted in line with best industry practice and includes all the following elements: a. the original source of contamination has been stopped or addressed so as to prevent further contamination before any assessment or remediation activity is undertaken; AND b. preparatory investigations including site-specific surveys are carried out in line with best industry practice to establish the following elements used to define the environmental targets for the remediation and evaluate the remedial options: i. the location, characteristics and extent of the contaminated site; AND ii. the underlying geological and hydrological conditions; AND iii. the likely quantity, composition and sources of contamination; AND iv. soil and water pollution originating from it as well as the risks to human health and the environment; AND c. the remedial options are analysed in line with best industry practice and the most suitable remedial measures are defined in a remediation and monitoring plan; AND d. any hazardous or non-hazardous waste or contaminated soils extracted or otherwise produced by the remediation activity is subject to appropriate	

	collection, transport, treatment, recovery or disposal by an authorized operator, in accordance with legal requirements and care is taken to prevent any mixing of excavated contaminated soils and non-contaminated soils; AND e. remediation methods do not include reducing pollutant concentrations through dilution or watering down, unless a full justification, for reason other than cost considerations, is provided in the remediation plan; AND f. control and monitoring plan is implemented for at least 10 years, unless a different duration sufficient to guarantee long-term risk control is defined in the national law or in the remediation and monitoring plan; AND 4. The remediation project, including monitoring and control plan is approved by the competent authority in accordance with national legal requirements, ensuring that conflicts with local communities have been resolved, if any, through a structured process; AND 5. Surveillance of the control and monitoring plan takes place at least on an annual basis to ensure the plan's efficiency and relevance.	
Amber	No TSC available	
Red	Does not meet Green or Amber criteria	
Applicable standards/ Best Practice Examples	1. Guidelines for the Management of Areas Contaminated with Hazardous Substances – Pollution Control Department (pcd.go.th) (Link) 2. Guidelines for Risk Assessment of Soil or Groundwater Pollution – Pollution Control Department (pcd.go.th) (Link) 3. Guidelines for the Restoration of Environment and Natural Resources Damaged by Contamination of Soil or Groundwater Pollution PCD 08-044 (Link)	

	4. UNEP Guidance on the management of contaminated sites (Link)	

Tiers	EO6: Protection and Restoration of Biodiversity and Ecosystem	Reference with international best practice/reference taxonomies
Green	No TSC available	Not applicable

8. Remediation of legally non-conforming landfills and abandoned or illegal waste dumps

Sector	Waste Management
Activity	Remediation of legally non-conforming landfills and abandoned or illegal waste dumps
ISIC Code	390, 382, 383
Description	Remediation of legally non-conforming landfills and of abandoned or illegal waste dumps that have been closed and are not taking in further waste other than possibly inert or biostabilised waste to be used as landfill cover material (as far as allowed in the environmental permit for the remediation project). The activity may include any of the following remediation strategies and sub-activities typically implemented as part of projects aimed at removing, controlling, containing or diminishing polluting emissions from non-conforming landfills and abandoned or illegal dumpsites: 1. remediation through environmental isolation of non-conforming or illegal landfills or dumpsites at the present site, including: a. physical isolation, concentration, structural stabilisation and protection of the non-conforming or illegal landfill or dumpsite, including application of hydraulic barriers, sealing, drainage and cover layers; b. installation, operation and maintenance of drainage and separate collection and treatment systems for leachates and run-off water prior to discharge; c. installation, operation and maintenance of landfill gas collection, abatement and control systems, including wells, piping and flaring systems; d. application of topsoil and vegetation cover for renaturation purposes;

	2. remediation through excavation and removal of non-conforming or illegal landfills or dumpsites with subsequent treatment, recovery or disposal of excavated waste, including: a. selective excavation of the waste deposited on the site, loading and transport to existing permitted treatment, recovery or disposal facilities with separate management of non-hazardous and hazardous waste; b. sorting and recovery of materials and fuels from excavated non-hazardous waste, including the installation, operation and maintenance of dedicated facilities and equipment for the duration of the remediation project; 3. remediation through decontamination of soils, surface and groundwater at the place of pollution, including the following: a. selective excavation, loading, transport, temporary storage, backfilling of soil, with separate management of non-contaminated and contaminated soils; b. treatment of contaminated soil or water, either in situ or ex situ, using in particular physical, chemical or biological methods, including the installation, operation and maintenance of dedicated facilities for the duration of the remediation project; c. application of hydraulic barriers, active and passive barriers intended to limit/prevent migration of pollutants. The activity also includes all of the following sub-activities that are required to prepare, plan, monitor and follow-up on the above remediation measures 1. preparatory investigations, including data collection and surveying activities (in particular geological or hydrological), technical feasibility and environmental impact studies required to define the remediation project; 2. site preparation, including earth moving and levelling works, construction or reinforcement of perimeter walls or fences, primary access and internal roads, demolition of buildings or other structures on the landfill site; 3. monitoring and control of the remediation measures, including: a) sampling of soil, water, sediment, biota or other materials; b) laboratory analysis of samples to identify the nature and concentration of pollutants;

	c) installation, operation and maintenance of monitoring facilities and equipment such as observation wells in and outside the perimeter of the landfill site; 4. implementation of other environmental protection and pollution prevention and control measures to comply with the conditions imposed in the environmental permit for the remediation project, including measures for safeguarding safety of operations on-site and health of workers, such as for fire control, flood protection, hazardous waste management. The activity does not include: 1. the permanent closure, rehabilitation and after care of existing or new landfills that comply with the law of Thailand, 2. landfill gas transformation for utilisation as energy carrier or industry feedstock; 3. redevelopment of the remediated site for other economic use such as recreational, residential or commercial areas, installation of photovoltaic (PV) panels; 4. compensatory measures for pollution caused by the landfill or dumpsite such as the development and operation of alternative water supply systems for affected populations living in the surrounding area. This activity covers the case where the polluter cannot be identified or is financially incapable of undertaking the remediation. In this cases, third-party remediation will be considered. This activity is eligible for green finance mechanism, aiming to incentivize and support environmental restoration efforts.
Objective	EO5: Pollution Prevention and Control

Tiers	**EO1: Climate Change Mitigation**	**Reference with international best practice/reference taxonomies**
Green	No TSC available	Not applicable

Tiers	EO2: Climate Change Adaptation	Reference with international best practice/reference taxonomies
Green	No TSC available	See notes at the start of this section (TSC for waste management activities)

Tiers	EO3: Sustainable Use and Protection of Marine and Water Resources	Reference with international best practice/reference taxonomies
Green	No TSC available	Not applicable

Tiers	EO4: Resource Resilience and Transition to a Circular Economy	Reference with international best practice/reference taxonomies
Green	No TSC available	Not applicable

Tiers	EO5: Pollution Prevention and Control	Reference with international best practice/reference taxonomies
Green	1. Remediation activities are not carried out by the operator that caused the pollution or a person acting on behalf of that operator in order to comply with the requirements of 'polluter-pays' principle according to national law; AND 2. Contaminant removal or control meets national regulatory standards, or a site-specific risk assessment when national standards are not available, considering contaminant properties and spread, to eliminate significant health and environmental risks to ensure that the contaminated area is safe for current or future use; AND	Aligned to EU Taxonomy criteria except for monitoring plan duration (criterion 3h).

	3. The remediation activity is conducted in line with best industry practice and includes all of the following elements: a. the non-conforming or illegal landfill or dumpsite to be remediated has been closed and is not taking in further waste other than possibly inert or biostabilised waste to be used as landfill cover material (as far as allowed in the environmental permit for the remediation project); AND b. preparatory investigations including site-specific surveys are carried out in line with best industry practice to establish the following elements used to define the environmental targets for the remediation and evaluate the remedial options: i. the location, characteristics and extent of the landfill and the polluted area; AND ii. the underlying geological and hydrological conditions; AND iii. the likely quantity, composition and sources of landfilled waste; AND iv. soil and water pollution originating from it as well as the risks to human health and the environment; AND c. the results of such remedial investigations are inputs for a feasibility study that defines the objectives, targets and scope for the remediation and evaluates alternative remedial options; AND d. the remedial options are analysed in line with best industry practice, and/or accepted international standards, and described in a feasibility study produced for the landfill remediation project that convincingly demonstrates how the selected remedial option is the overall best solution to meet the defined remediation objectives and targets;	

	AND e. all materials and fuels recovered from landfilled waste meet relevant quality standards or user specifications for the intended recovery operations and do not represent a risk for the environment or human health; AND f. any hazardous or non-hazardous waste extracted or otherwise produced by the remediation activity is subject to appropriate collection, transport, treatment, recovery or disposal by an authorised operator, in accordance with legal requirements; AND g. remediation methods do not include reducing pollutant concentrations through dilution or watering down, unless a full justification, for reason other than cost considerations, is provided in the remediation plan; AND h. control and monitoring plan is implemented for at least 10 years unless a different duration sufficient to guarantee long-term risk control is defined in national legislation or by the competent regulatory authority for the specific remediation project; AND 4. The remediation project, including monitoring and control plan is approved by the competent authority in accordance with national legal requirements ensuring that conflicts with local communities have been resolved, if any, through a structured process; AND 5. Surveillance of the control and monitoring plan takes place at least on an annual basis to ensure the plan's efficiency and relevance.	
Amber	No TSC available	Not applicable.
Red	Does not meet Green or Amber criteria	

Applicable standards/ Best Practice Examples	1. Guidelines for the Management of Areas Contaminated with Hazardous Substances – Pollution Control Department (pcd.go.th) (Link) 2. Guidelines for Risk Assessment of Soil or Groundwater Pollution – Pollution Control Department (pcd.go.th) (Link) 3. Guidelines for the Restoration of Environment and Natural Resources Damaged by Contamination of Soil or Groundwater Pollution PCD 08-044 (Link) 4. UNEP Guidance on the management of contaminated sites (Link)	

Tiers	EO6: Protection and Restoration of Biodiversity and Ecosystem	Reference with international best practice/reference taxonomies
Green	No TSC available	Not applicable

9. Sorting and material recovery from non-hazardous waste

Sector	Waste Management
Activity	Sorting and material recovery from non-hazardous waste
ISIC Code	3830
Description	Construction, upgrade, and operation of facilities for the sorting and/or recovery of separately collected non-hazardous waste streams into usable secondary raw materials, thus displacing the use of primary raw materials in production processes. This activity includes all types of Material Recovery Facility (MRF) from manual MRF (waste buy-back centre or informal MRF), semi-automated MRF and automated MRF (formal MRF). The non-hazardous waste feedstock may originate from any MSW, from dismantling and depollution activities, from construction and demolition activity, or from sorting of mixed waste intended for recycling. All facilities and equipment such as conveyor belts, compactors, pelletisers, air classifiers, magnetic belts, and other infrastructure required for material sorting and/or recovery are eligible. This activity does not include WEEE dismantling.
Objective	EO4: Resource Resilience and Transition to a Circular Economy

Tiers	EO1: Climate Change Mitigation	Reference with international best practice/reference taxonomies
Green	No TSC available	Thailand and EU Taxonomies set criteria at EO4, and not EO1 for this activity. SG Taxonomy sets criteria at EO1. See EO4 for comparison.

Tiers	EO2: Climate Change Adaptation	Reference with international best practice/reference taxonomies
Green	No TSC available	See notes at the start of this section (TSC for waste management activities)

Tiers	EO3: Sustainable Use and Protection of Marine and Water Resources	Reference with international best practice/reference taxonomies
Green	No TSC available	Not applicable

Tiers	EO4: Resource Resilience and Transition to a Circular Economy	Reference with international best practice/reference taxonomies
Green	1. The activity converts at least 40%[10] by weight of all non-hazardous waste received by the facility into secondary raw materials (for example pet bales, paper bales and fertiliser) which are suitable for the substitution of primary raw materials; AND 2. The facility recovering non-hazardous waste has implemented best industry practice on improving overall environmental performance of the plant including: a. a waste characterisation procedure and a waste acceptance procedure regarding the quality of incoming waste; AND b. a tracking system and inventory aiming to track the location and quantity of waste in the plant; AND c. an output quality management system to ensure that the output of the waste treatment is in line with applicable quality requirements or standards; AND d. the relevant waste segregation measures or procedures to ensure that waste, after separation, is kept separated depending on its properties in order to enable easier and environmentally safer storage and treatment;	Aligned to SG and EU Taxonomy criteria except for 40% recovery rate (criterion 1). The reason is that significant volumes of high-value recyclables are collected by the waste buy-back centre before entering the formal MRF.

[10] **Rationale for threshold setting:** according to 2023 Thailand Pollution Outlook Report – Pollution Control Department (pcd.go.th) and 2022 Thailand Pollution Outlook Report - – Pollution Control Department (pcd.go.th), approximate 34% of MSW is sorted and utilised. To align with EU and Singapore Taxonomies which require a minimum 50% recycling rate, Thailand Taxonomy sets out a 40% recycling rate for Green and 30% for Amber criteria. This approach aims to improve current practices without distinguishing between waste buy-back centre and formal MRF. Although lower than international targets, these figures are considered more feasible for Thailand's context, promoting better waste management practices across the country.

	AND e. implemented measures to prevent and control potential environmental pollutions are made publicly available; AND f. [Semi-automated or Automated MRF] the facility has installed the sorting and material recovery technology and processes to meet relevant technical specifications or quality standards. The activity uses state-of-the-art technologies suited to the waste fractions processed including optical separation by near-infrared spectroscopy or X-ray systems, density separation, magnetic separation or size separation.	
Amber	**1.** The activity converts at least 30% by weight of all non-hazardous waste received by the facility into secondary raw materials (for example pet bales, paper bales, and fertiliser) which are suitable for the substitution of primary raw materials; AND **2.** Implemented measures to prevent and control potential environmental pollution are implemented and made publicly available; AND **3.** The sunset date for an activity classified under the Amber criteria is 31 December 2029 after which the facilities must meet the Green Criteria	Aligned to SG Taxonomy criteria except for 30% recovery rate (criterion 1).
Red	Does not meet Green or Amber criteria	
Applicable Standards/ Best Practice Examples	1. UNEP Topic Sheet – Extended Producer Responsibility (Link) 2. Voluntary EPR initiatives in Thailand include Thailand Institute of Packaging and Recycling Management for Sustainable Environment (TIPMSE) and Packaging Recovery Organization Thailand Network	

Tiers	EO5: Pollution Prevention and Control	Reference with international best practice/reference taxonomies
Green	No TSC available	Not applicable

Tiers	EO6: Protection and Restoration of Biodiversity and Ecosystem	Reference with international best practice/reference taxonomies
Green	No TSC available	Not applicable

10. Treatment of hazardous waste

Sector	Waste Management
Activity	Treatment of hazardous waste
ISIC Code	3822
Description	Construction, repurposing, upgrade, and operation of dedicated facilities for the treatment of hazardous waste, including the incineration of non-recyclable hazardous waste, biological treatment of hazardous waste and physico-chemical treatment. The activity does not include: 1. disposal operations of hazardous waste such as landfilling or permanent storage. 2. incineration of recyclable hazardous waste and incineration of non-hazardous waste; 3. treatment and disposal of toxic live or dead animals and other contaminated waste; 4. treatment and disposal of radioactive nuclear waste. <u>Note:</u> 1) Co-processing activity does not belong to Treatment of hazardous activity. Please refer to Cement-manufacturing Activity in Manufacturing sector. 2) Recovery of batteries does not belong to Treatment of hazardous waste activity. Please refer to Recovery of Batteries Activity in Manufacturing sector.
Objective	- EO4: Resource Resilience and Transition to a Circular Economy - EO5: Pollution Prevention and Control

Tiers	EO1: Climate Change Mitigation	Reference with international best practice/reference taxonomies
Green	No TSC available	Not applicable

Tiers	EO2: Climate Change Adaptation	Reference with international best practice/reference taxonomies
Green	No TSC available	See notes at the start of this section (TSC for waste management activities)
Tiers	EO3: Sustainable Use and Protection of Marine and Water Resources	Reference with international best practice/reference taxonomies
Green	No TSC available	Not applicable

Tiers	EO4: Resource Resilience and Transition to a Circular Economy	Reference with international best practice/reference taxonomies
Green	1. The activities consist of the material recovery of secondary raw materials (including chemical substances) from source segregated hazardous waste; AND 2. The recovered materials are substituting primary raw materials, or chemicals in production processes; AND 3. The recovered materials comply with the applicable industry specifications, harmonised standards, as well as relevant applicable national legislation.	Aligned to EU Taxonomy criteria.
Amber	No TSC available.	Not applicable
Red	Does not meet Green or Amber criteria	

Tiers	EO5: Pollution Prevention and Control	Reference with international best practice/reference taxonomies
Green	1. For all waste treatment processes, the activity complies with the national regulations, international conventions, and requirements set out either in the industry best practice for waste treatment or for waste incineration; AND a) During the pre-acceptance procedures, at least the following information is gathered: i. expected date of arrival at the waste treatment plant; AND ii. contact details of the waste producer, the sector which the waste originates from and the nature of process producing the waste, including the variability of the process; AND iii. the estimated quantity expected to be delivered to the operator per delivery and per year; AND iv. description of the waste, including composition, hazardous properties of the waste, waste code and the suitable treatment route; AND b) During the acceptance procedures, the following elements are in place: i. a reception facility equipped with a laboratory to analyse samples on site and documented analytical standard operating procedures, with the option to sub-contract analyses to accredited external contract laboratories; AND ii. documented sampling procedure consistent with and relevant standards; AND	Aligned to EU Taxonomy criteria.

	iii. documented analysis of the relevant physico-chemical parameters for the treatment; AND iv. a dedicated quarantine waste storage area, as well as written procedures to manage non-accepted waste; AND 2. Prior to final disposal, hazardous waste is treated to the level specified by national law and in alignment with international best practice; AND 3. For final disposal, hazardous waste is treated in accordance with national law and in alignment with international best practice. When secured landfill is identified as the disposal method, ensure that leachate qualifications comply with the thresholds set out in applicable regulations.	
Amber	No TSC available	Not applicable
Red	Does not meet Green or Amber criteria	

Tiers	**EO6: Protection and Restoration of Biodiversity and Ecosystem**	**Reference with international best practice/reference taxonomies**
Green	No TSC available	Not applicable

11. Construction, extension, upgrade, operation and renewal of decentralised wastewater collection and treatment

Sector	Waste Management
Activity	Construction, extension, upgrade, operation and renewal of decentralised wastewater collection and treatment
ISIC Code	3700
Description	Construction, extension, upgrade, operation and renewal of decentralised wastewater infrastructure including treatment plants, sewer networks, connections to the wastewater infrastructure, decentralised wastewater treatment facilities, including individual and other appropriate systems, and discharge structures for treated

	effluent. The activity may include innovative and advanced treatments, including the removal of micropollutants. Decentralised treatment plants consist of on-site and cluster wastewater treatment plants. Sources of wastewater include human, industrial, and agricultural wastewater. <u>Note:</u> For EO1 contribution of Anaerobic digestion of wastewater, refer to the activity 1. Anaerobic digestion of bio-waste or wastewater.
Objective	- EO2: Climate Change Adaptation - EO3: Sustainable Use and Protection of Marine and Water Resources - EO4: Resource Resilience and Transition to a Circular Economy

Tiers	**EO1: Climate Change Mitigation**	**Reference with international best practice/reference taxonomies**
Green	No TSC available	Not applicable

Tiers	**EO2: Climate Change Adaptation**	**Reference with international best practice/reference taxonomies**
Green	1. The economic activity has implemented physical and nonphysical solutions ('adaptation solutions') that substantially reduce the most important physical climate risks that are material to that activity; AND 2. The physical climate risks that are material to the activity have been identified by performing a robust climate risk and vulnerability assessment (CRVA); AND 3. The climate projections and assessment of impacts are based on best practice and available guidance and take into account the state-of-the-art science for vulnerability and risk analysis and related methodologies in line with the most recent Intergovernmental Panel on Climate	Criteria are aligned with generic EO2 criteria for ASEAN Taxonomy (AT) V3. Note that the AT does not define criteria for this specific activity.

	Change reports, scientific peer-reviewed publications and open source or paying models; AND 4. The adaptation solutions implemented: a. do not adversely affect the adaptation efforts or the level of resilience to physical climate risks of other people, of nature, of cultural heritage, of assets and of other economic activities; AND b. favour nature-based solutions or rely on blue or green infrastructure to the extent possible; AND c. are consistent with local, sectoral, regional or national adaptation plans and strategies; AND d. are monitored and measured against pre-defined indicators and remedial action is considered where those indicators are not met; AND e. where the solution implemented is physical and consists in an activity for which technical screening criteria have been specified, the solution complies with the do no significant harm technical screening criteria for that activity.	
Amber	No TSC available	Not applicable.
Red	Does not meet Green or Amber criteria	

Tiers	**EO3: Sustainable Use and Protection of Marine and Water Resources**	**Reference with international best practice/reference taxonomies**
Green	1. The wastewater treatment system fulfils the discharge requirements and size-specific requirements, contributes to the achievement of good status of the water bodies, in accordance with applicable national law or international standards which pursue objectives of good water status and good ecological potential;	Aligned to EU Taxonomy criteria.

	AND 2. The river basin or water use and protection management plan contains at least the information related to the status of water bodies, the activities potentially impacting the status, and the measures taken to avoid or minimize such impacts.; AND 3. Where the wastewater treatment plant has a capacity of 100,000 population equivalent (20,000 m^3/day[11]) or more, or of a daily inflow of a five-day biochemical oxygen demand (BOD5) load of more than 6,000 kg, it uses a sludge treatment such as anaerobic digestion or a technology with the same or a lower net energy demand (considering both energy generation and consumption), to stabilise the sludge.	
Amber	1. The wastewater treatment system fulfils the discharge requirements and size-specific requirements, contributes to the achievement of good status of the water bodies, in accordance with applicable national law or international standards which pursue objectives of good water status and good ecological potential; AND 2. The river basin or water use and protection management plan contains at least the information related to the status of water bodies, the activities potentially impacting the status, and the measures taken to avoid or minimize such impacts.; AND 3. Sludge is treated according to national requirements.	Not applicable.
Red	Does not meet Green or Amber criteria	

[11] The conversion from p.e. to m3/day was done based on the estimated average discharge of 200 litre per population per day based on the figure stated in Urban Wastewater Treatment Manual – Pollution Control Department (pcd.go.th) (link)

Tiers	EO4: Resource Resilience and Transition to a Circular Economy	Reference with international best practice/reference taxonomies
Green	For facilities for collection and treatment of wastewater for the production of water, the activity complies with the following criteria: 1. Water is for purposes other than human consumption; 2. Water is suitable for reuse after proper treatment depending on the level of contamination and subsequent reuse purposes in accordance with national regulations.	Aligned to EU Taxonomy – Production of alternative water resources but the scope is limited to wastewater treatment.
Amber	No TSC available	Not applicable
Red	Does not meet Green or Amber criteria	

Tiers	EO5: Pollution Prevention and Control	Reference with international best practice/reference taxonomies
Green	No TSC available	Not applicable

Tiers	EO6: Protection and Restoration of Biodiversity and Ecosystem	Reference with international best practice/reference taxonomies
Green	No TSC available	Not applicable

12. Construction, extension, upgrade, and operation of centralised wastewater collection and treatment

Sector	Waste Management
Activity	Construction, extension, upgrade, and operation of centralised wastewater collection and treatment
ISIC Code	3700
Description	Construction, extension, upgrade, and operation of centralised wastewater systems including collection (sewer network) and treatment
Objective	- EO1: Climate Change Mitigation

	- EO2: Climate Change Adaptation

Tiers	EO1: Climate Change Mitigation	Reference with international best practice/reference taxonomies
Green	1. The net energy consumption of the wastewater treatment plant equals to or is lower than: a. 0.48 kWh/m^3 (35 kWh per population equivalent per annum) for treatment plant capacity below 2,000 m^3/day (10,000 p.e)[11]; OR b. 0.34 kWh/m^3 (25 kWh per population equivalent per annum) for treatment plant capacity between 2,000 – 20,000 m^3/day (10,000 and 100,000 p.e.) [11]; OR c. 0.27 kWh/m^3 (20 kWh per population equivalent per annum) for treatment plant capacity above 20,000 m^3/day (100,000 p.e) [11]; AND 2. Net energy consumption of the operation of the wastewater treatment plant may take into account measures decreasing energy consumption relating to source control (reduction of storm water or pollutant load inputs), and, as appropriate, energy generation within the system (such as hydraulic, solar, thermal and wind energy); AND 3. For the construction and extension of a wastewater treatment plant or a wastewater treatment plant with a collection system, which are substituting more GHG-intensive treatment systems, an assessment of the direct GHG emissions is performed for example IPCC Guidelines. The results are disclosed to investors and clients on demand;	Aligned to EU and SG Taxonomy criteria.
Amber	1. The net energy consumption of the wastewater treatment plant equals to or is lower than 0.93 kWh/m^3 (68 kWh per population equivalent per annum)[11] and is applicable for	Aligned to SG Taxonomy criteria.

	all treatment plant capacities. Net energy consumption of the operation of the wastewater treatment plant may take into account measures decreasing energy consumption relating to source control (reduction of storm water or pollutant load inputs), and as appropriate, renewable energy generation; AND 2. The sunset is 31 December 2035, beyond which the plants must meet the Green Criteria.	
Red	Does not meet Green or Amber criteria	

Tiers	**EO2: Climate Change Adaptation**	**Reference with international best practice/reference taxonomies**
Green	1. The economic activity has implemented physical and nonphysical solutions ('adaptation solutions') that substantially reduce the most important physical climate risks that are material to that activity; AND 2. The physical climate risks that are material to the activity have been identified by performing a robust climate risk and vulnerability assessment (CRVA); AND 3. The climate projections and assessment of impacts are based on best practice and available guidance and take into account the state-of-the-art science for vulnerability and risk analysis and related methodologies in line with the most recent Intergovernmental Panel on Climate Change reports, scientific peer-reviewed publications and open source or paying models; AND 4. The adaptation solutions implemented: a) do not adversely affect the adaptation efforts or the level of resilience to physical climate risks of other people, of nature, of cultural heritage, of assets and of other economic activities;	Criteria are aligned with generic EO2 criteria for ASEAN Taxonomy (AT) V3. Note that the AT does not define criteria for this specific activity.

	AND b) favour nature-based solutions or rely on blue or green infrastructure to the extent possible; AND c) are consistent with local, sectoral, regional or national adaptation plans and strategies; AND d) are monitored and measured against pre-defined indicators and remedial action is considered where those indicators are not met; AND e) where the solution implemented is physical and consists in an activity for which technical screening criteria have been specified, the solution complies with the do no significant harm technical screening criteria for that activity.	
Amber	No TSC available	Not applicable.
Red	Does not meet Green or Amber criteria	

Tiers	**EO3: Sustainable Use and Protection of Marine and Water Resources**	**Reference with international best practice/reference taxonomies**
Green	No TSC available	Not applicable

Tiers	**EO4: Resource Resilience and Transition to a Circular Economy**	**Reference with international best practice/reference taxonomies**
Green	No TSC available	Not applicable

Tiers	**EO5: Pollution Prevention and Control**	**Reference with international best practice/reference taxonomies**
Green	No TSC available	Not applicable

Tiers	EO6: Protection and Restoration of Biodiversity and Ecosystem	Reference with international best practice/reference taxonomies
Green	No TSC available	Not applicable

13. Renewal of centralised wastewater collection and treatment

Sector	Waste Management
Activity	Renewal of centralised wastewater collection and treatment
ISIC Code	3700
Description	Renewal of centralised wastewater systems including collection (sewer network) and treatment. It implies no material change related to the load or volume of flow collected or treated in the wastewater system
Objective	- EO1: Climate Change Mitigation - EO2: Climate Change Adaptation

Tiers	EO1: Climate Change Mitigation	Reference with international best practice/reference taxonomies
Green	1. The renewal of a collection system improves energy efficiency by decreasing the average energy consumption by 20% compared to own baseline performance averaged over three years, demonstrated on an annual basis. That decrease of energy consumption can be accounted for at the level of the project (i.e., the collection system renewal) or, across the downstream wastewater agglomeration (i.e., including the downstream collection system, treatment plant or discharge of wastewater); AND/OR 2. The renewal of a wastewater treatment plant improves energy efficiency by decreasing the average energy consumption of the system by at least 20% compared to own baseline performance averaged over three years, demonstrated on an annual basis; AND	Aligned to EU Taxonomy criteria.

	3. The net energy consumption is calculated or estimated in terms of kWh/p.e. per annum of the wastewater collected or effluent treated[12]; AND 4. The operator demonstrates that there are no material changes relating to external conditions, including modifications to discharge authorisation(s) or changes in load to the agglomeration that would lead to a reduction of energy consumption, independent of efficiency measures taken.	
Amber	1. The renewal of a collection system improves energy efficiency by decreasing the average energy consumption by 10% compared to own baseline performance averaged over three years, demonstrated on an annual basis. That decrease of energy consumption can be accounted for at the level of the project (i.e., the collection system renewal) or, across the downstream wastewater agglomeration (i.e., including the downstream collection system, treatment plant or discharge of wastewater); AND/OR 2. The renewal of a wastewater treatment plant improves energy efficiency by decreasing the average energy consumption of the system by at least 10% compared to own baseline performance averaged over three years, demonstrated on an annual basis; AND 3. The net energy consumption of the system is calculated or estimated in terms of kWh/p.e. per annum; AND 4. The operator demonstrates that there are no material changes relating to external conditions, including modifications to discharge authorisation(s) or changes in load to the agglomeration that would lead to a reduction	Thailand specific

[12] Calculation of net energy consumption takes into account measures decreasing energy consumption relating to source control (reduction of storm water or pollutant load inputs) and, as appropriate, energy generation within the system (such as hydraulic, solar, thermal and wind energy)

	of energy consumption, independent of efficiency measures taken.	
Red	Does not meet Green or Amber criteria	

Tiers	EO2: Climate Change Adaptation	Reference with international best practice/reference taxonomies
Green	1. The economic activity has implemented physical and nonphysical solutions ('adaptation solutions') that substantially reduce the most important physical climate risks that are material to that activity; AND 2. The physical climate risks that are material to the activity have been identified by performing a robust climate risk and vulnerability assessment (CRVA); AND 3. The climate projections and assessment of impacts are based on best practice and available guidance and take into account the state-of-the-art science for vulnerability and risk analysis and related methodologies in line with the most recent Intergovernmental Panel on Climate Change reports, scientific peer-reviewed publications and open source or paying models; AND 4. The adaptation solutions implemented: a) do not adversely affect the adaptation efforts or the level of resilience to physical climate risks of other people, of nature, of cultural heritage, of assets and of other economic activities; AND b) favour nature-based solutions or rely on blue or green infrastructure to the extent possible; AND c) are consistent with local, sectoral, regional or national adaptation plans and strategies; AND	Criteria are aligned with generic EO2 criteria for ASEAN Taxonomy (AT) V3. Note that the AT does not define criteria for this specific activity.

	d) are monitored and measured against pre-defined indicators and remedial action is considered where those indicators are not met; AND e) where the solution implemented is physical and consists in an activity for which technical screening criteria have been specified, the solution complies with the do no significant harm technical screening criteria for that activity.	
Amber	No TSC available	Thailand specific
Red	Does not meet Green or Amber criteria	

Tiers	**EO3: Sustainable Use and Protection of Marine and Water Resources**	**Reference with international best practice/reference taxonomies**
Green	No TSC available	Not applicable

Tiers	**EO4: Resource Resilience and Transition to a Circular Economy**	**Reference with international best practice/reference taxonomies**
Green	No TSC available	Not applicable

Tiers	**EO5: Pollution Prevention and Control**	**Reference with international best practice/reference taxonomies**
Green	No TSC available	Not applicable

Tiers	**EO6: Protection and Restoration of Biodiversity and Ecosystem**	**Reference with international best practice/reference taxonomies**
Green	No TSC available	Not applicable

Annex I Example of Compliance Record

The following documents may be requested as evidence of compliance.

1. Environmental Permits and Licenses

Copies of all relevant environmental permits and licenses including (but not limited to):

- Factory operation permit issued by DIW for Type 3 factories
- Fertiliser or Soil improver registration certificate from Department of Agriculture if the fertiliser or soil improver is for commercialization purpose
- Proof of annual vehicle inspection as evidence on compliance of national emission regulations
- Valid operating permits for waste collection and transport.

2. Standard Operating Procedures (SOPs)

Documentation of all relevant SOPs for all aspects of the activity including (but not limited to):

- Waste acceptance, segregation, tracking procedure
- Rejects handling procedure
- Leachate leakage prevention and control procedure
- Biogas utilization procedure
- Digestate or Compost utilization procedure ensuring material recovery is prioritised
- Methane leakage prevention procedure
- Safe handling, transport, and storage of WEEE procedure

3. Records or Documentation

Records or documentation to evidence the performance of SOPs implemented including (but not limited to):

- Records of employee training on relevant environmental regulations, safety procedures, and best practices.

- Records of quantity of waste collected, destinations of waste according to waste stream
- Updated photos of waste transport, storage and collection facilities
- [for WtE or waste treatment facilities] Report on the type and quantity of pollutants discharged from industrial factories (Ror Wor1-3)
- [for EO2 Climate Change Adaptation] Climate Risk and Vulnerability Assessment (CRVA)
- [for wastewater treatment activities] Water or River basin management plan for wastewater related activities
- [for wastewater treatment activities] Operational logs showing daily or hourly wastewater flow rates, records of influent and effluent water quality parameters
- [for wastewater treatment activities] Detailed energy consumption breakdown showing the consumption of individual units within the wastewater treatment plant. Documentation of energy generation within the system. GHG Emissions Assessment Report.

4. Audits and Inspections

Records of internal and/or external audits and inspections conducted at the facility including (but not limited to):

- ISO 14001:2015 – Environmental management systems
- [for wastewater treatment activities] Third-party Inspection result of discharge water quality

Annex II Applicable laws

This table provides a list of regulations that may not directly contribute to the achievement of green TSC but are fundamental to the implementation of the activity.

Activity	Applicable Laws
1. Anaerobic digestion of bio-waste or wastewater	1. The Enhancement and Conservation of National Environment Quality Act, B.E.2535 (1992) and (No. 2) B.E. 2561 (2018) 1.1. Notification of the Ministry of Natural Resources and Environment on Establishment of controlling standards for wastewater from industrial factories, industrial estates and industrial zones, B.E. 2559 (2016). 1.2. Notification of the Ministry of Natural Resources and Environment Prescribing Standards for Controlling Air Emissions from factory 1.3. Notification of the Ministry of Natural Resources and Environment on Prescribing of Factory Types and Sizes, Procedure for the Control of Discharges of Waste Water that Cause Adverse Effects on the Public Water Bodies and Environment 1.4. Notification of the Ministry of Natural Resources and Environment on Prescribing Standards for Controlling Odor Intensity Emission from Pollution Sources 1.5. Notification of Pollution Control Department on Guidelines for Considering the Suitability of Areas for Designing, Constructing, and Managing Sanitary Landfill Facility B.E. 2560 (2017) 2. Public Health Act, B.E. 2535 (1992) 2.1. Ministerial Regulation of Public Health on the Management of Toxic or Hazardous Waste from Communities, B.E. 2563 (2020) 2.2. Ministerial Regulation of Public Health on the Joint management of Infectious Waste between Local

Activity	Applicable Laws
	Government Authorities and other Local Government Agencies or State Agencies, B.E. 2564 (2021) 2.3. Ministerial Regulation of Public Health on the Disposal of Infectious Waste (No. 2), B.E. 2564 (2021) 2.4. Ministerial Regulation of Public Health on Sanitary Standards for General Waste Management, B.E. 2560 (2017) 2.5. Notification of the Ministry of Public Health on Control Measures for the Transport of Infectious Waste to Prevent Illegal Dumping, B.E. 2565 (2022) 2.6. Notification of the Ministry of Public Health on Criteria for Selecting Sanitary Landfill Facilities, B.E. 2560 (2017) 2.7. Notification of the Ministry of Public Health on Characteristics and Conditions for Preventing Groundwater Contamination from Leachate, B.E. 2560 (2017) 2.8. Notification of the Ministry of Public Health on Businesses Hazardous to Health, B.E. 2558 (A.D. 2015) 3. Fertiliser Act, B.E. 2518 (1975) and its Amendments 3.1. Ministerial Regulation on Fees for Fertiliser-related Business Operations, B.E. 2554 (2011) 3.2. Notification of Ministry of Agriculture and Cooperatives on Standardised Chemical Fertilisers, B.E. 2559 (2016) 3.3. Notification of Ministry of Agriculture and Cooperatives on the Required Organic Matter Content in Organic Chemical Fertilisers under the Fertiliser Act, B.E. 2518 (1975), as amended by the Fertiliser Act (No. 2), B.E. 2550 (2007), B.E. 2554 (2011) 3.4. Notification of Department of Agriculture on Criteria and Methods for Sampling Fertilisers or Suspected Fertilisers in Reasonable Quantities for Inspection or Analysis (No. 2), B.E. 2557 (2014)

Activity	Applicable Laws
	3.5. Notification of Department of Agriculture on Organic Fertiliser Standards, B.E. 2557 (2014) 4. Act on the Maintenance of the Cleanliness and Orderliness of the Country, B.E. 2535 (1992) and amendments no.2 B.E. 2560 (2017) 5. Town Planning Act, B.E. 2562 (2019) 5.1. Notification of Ministry of Interior on Waste Management, B.E. 2567 (2024)
2. Composting of bio-waste	1. The Enhancement and Conservation of National Environment Quality Act, B.E.2535 (1992) and (No. 2) B.E. 2561 (2018) 1.1. Notification of the Ministry of Natural Resources and Environment on Establishment of controlling standards for wastewater from industrial factories, industrial estates and industrial zones, B.E. 2559 (2016). 1.2. Notification of the Ministry of Natural Resources and Environment Prescribing Standards for Controlling Air Emissions from factory 1.3. Notification of the Ministry of Natural Resources and Environment on Prescribing of Factory Types and Sizes, Procedure for the Control of Discharges of Waste Water that Cause Adverse Effects on the Public Water Bodies and Environment 1.4. Notification of the Ministry of Natural Resources and Environment on Prescribing Standards for Controlling Odor Intensity Emission from Pollution Sources 1.5. Notification of Pollution Control Department on Guidelines for Considering the Suitability of Areas for Designing, Constructing, and Managing Sanitary Landfill Facility B.E. 2560 (2017) 2. Public Health Act, B.E. 2535 (1992)

Activity	Applicable Laws
	2.1. Ministerial Regulation of Public Health on the Management of Toxic or Hazardous Waste from Communities, B.E. 2563 (2020) 2.2. Ministerial Regulation of Public Health on the Joint management of Infectious Waste between Local Government Authorities and other Local Government Agencies or State Agencies, B.E. 2564 (2021) 2.3. Ministerial Regulation of Public Health on the Disposal of Infectious Waste (No. 2), B.E. 2564 (2021) 2.4. Ministerial Regulation of Public Health on Sanitary Standards for General Waste Management, B.E. 2560 (2017) 2.5. Notification of the Ministry of Public Health on Control Measures for the Transport of Infectious Waste to Prevent Illegal Dumping, B.E. 2565 (2022) 2.6. Notification of the Ministry of Public Health on Criteria for Selecting Sanitary Landfill Facilities, B.E. 2560 (2017) 2.7. Notification of the Ministry of Public Health on Characteristics and Conditions for Preventing Groundwater Contamination from Leachate, B.E. 2560 (2017) 2.8. Notification of the Ministry of Public Health on Businesses Hazardous to Health, B.E. 2558 (2015) 3. Fertiliser Act, B.E. 2518 (1975) and its Amendments 3.1. Ministerial Regulation on Fees for Fertiliser-related Business Operations, B.E. 2554 (2011) 3.2. Notification of Ministry of Agriculture and Cooperatives on Standardised Chemical Fertilisers, B.E. 2559 (2016) 3.3. Notification of Ministry of Agriculture and Cooperatives on the Required Organic Matter Content in Organic Chemical Fertilisers under the Fertiliser Act, B.E. 2518 (1975), as amended by the Fertiliser Act (No. 2), B.E. 2550 (2007), B.E. 2554 (2011)

Activity	Applicable Laws
	3.4. Notification of Department of Agriculture on Criteria and Methods for Sampling Fertilisers or Suspected Fertilisers in Reasonable Quantities for Inspection or Analysis (No. 2), B.E. 2557 (2014) 3.5. Notification of Department of Agriculture on Organic Fertiliser Standards, B.E. 2557 (2014) 4. Act on the Maintenance of the Cleanliness and Orderliness of the Country, B.E. 2535 (1992) and amendments no. 2 B.E. 2560 (2017) 5. Notification of Ministry of Interior on Waste management, B.E. 2567 (2024) 6. Town Planning Act, B.E. 2562 (2019) 7. Hazardous Substances Act, B.E. 2535 (1992) and its Amendments
3. Collection and Transport of Waste	1. The Enhancement and Conservation of National Environment Quality Act, B.E.2535 (1992) and (No. 2) B.E. 2561 (2018) 1.1. Notification of Ministry of Natural Resources and Environment on Noise standards for Three-Wheeled Vehicles 1.2. Notification of the Ministry of Natural Resources and Environment on Descriptions of Factory Types and Sizes, Procedure for the Control of Discharges of Waste Water that cause Adverse Effects on the Public Water Bodies and Environment 1.3. Notification of the Ministry of Natural Resources and Environment on Prescribing Standards for Controlling Odour Intensity Emission from Pollution Sources 2. Public Health Act, B.E. 2535 (1992) 2.1. Ministerial Regulation of Public Health on the Management of Toxic or Hazardous Waste from Communities, B.E. 2563 (2020) 2.2. Ministerial Regulation of Public Health on the Joint management of Infectious Waste between Local

Activity	Applicable Laws
	Government Authorities and other Local Government Agencies or State Agencies, B.E. 2564 (2021) 2.3. Ministerial Regulation of Public Health on the Disposal of Infectious Waste (No. 2), B.E. 2564 (2021) 2.4. Ministerial Regulation of Public Health on Sanitary Standards for General Waste Management, B.E. 2560 (2017) 2.5. Notification of the Ministry of Public Health on Control Measures for the Transport of Infectious Waste to Prevent Illegal Dumping, B.E. 2565 (2022) 2.6. Notification of the Ministry of Public Health on Criteria for Selecting Sanitary Landfill Facilities, B.E. 2560 (2017) 2.7. Notification of the Ministry of Public Health on Characteristics and Conditions for Preventing Groundwater Contamination from Leachate, B.E. 2560 (2017) 3. Act on the Maintenance of the Cleanliness and Orderliness of the Country, B.E. 2535 (1992) and amendments no. 2 B.E. 2560 (2017) 4. Notification of Ministry of Interior on Waste Management, B.E. 2567 (2024) 5. Town Planning Act, B.E. 2562 (2019) 6. Factory Act, B.E. 2535 (1992) 6.1. Notification of Ministry of Industry on Prescribing Limits of Air Pollutants Emitted from Chimneys in Relation to Hazardous Waste from Industries, B.E. 2545 (2002), dated October 2, 2002 6.2. Notification of Ministry of Industry on Prescribing Limits of Air Pollutants Emitted from Factories in Relation to Hazardous Waste, B.E. 2549 (2006), dated October 31, 2006 6.3. Notification of Ministry of Industry on Standards for Controlling Wastewater Discharge from Factories, B.E. 2560 (2017), dated June 7, 2017

Activity	Applicable Laws
	6.4. Ministerial Regulation No. 2 (B.E. 2535) Issued under the Factory Act, B.E. 2535 (1992) 7. Machinery Registration Act, B.E. 2514 (1971) 7.1. Ministerial Regulation No. 1 and No. 2 (B.E. 2514) Issued under the Machinery Registration Act, B.E. 2514 (1971) 7.2. Ministerial Regulation on Criteria, Methods, and Conditions for Machinery Trial Operation, B.E. 2553 (2010) 7.3. Ministerial Regulation on Fees for Machinery Registration, B.E. 2560 (2017) 8. Hazardous Substances Act, B.E. 2535 (1992) and its Amendments 8.1. Notification of Ministry of Industry on the Transport of Hazardous Substances under the Responsibility of the Department of Industrial Works, B.E. 2558 (2015) 8.2. Notification of Department of Industrial Works on the Application form for Initial Compensation for Government or Private Entities assigned by Government Agencies, B.E. 2567 (2024) 8.3. Notification of Ministry of Industry on the Registration of Containers Used for Transporting Hazardous Substances under the Responsibility of the Department of Industrial Works, B.E. 2558 (2015) 8.4. Notification of Ministry of Industry on Liability Insurance for the Transport of Hazardous Substances, B.E. 2559 (2016)
4. Depollution and dismantling of end-of-life products	1. The Enhancement and Conservation of National Environment Quality Act, B.E.2535 (1992) and (No. 2) B.E. 2561 (2018) 1.1. Notification of the Ministry of Natural Resources and Environment, Establishment of controlling standards for wastewater from industrial factories, industrial estates and industrial zones, B.E. 2559 (2016).

Activity	Applicable Laws
	1.2. Notification of the Ministry of Natural Resources and Environment Prescribing Standards for Controlling Air Emissions from factory 1.3. Notification of the Ministry of Natural Resources and Environment on Descriptions of Factory Types and Sizes of Industrial Factories as Pollution Sources Subject to Odor Intensity Control for Air Emissions 1.4. Notification of the Ministry of Natural Resources and Environment Prescribing Standards for Controlling Odor Intensity Emission from Pollution Sources 1.5. Notification of the Ministry of Natural Resources and Environment Descriptions of Factory Types and Sizes, Procedure for the Control of Discharges of Waste Water that Cause Adverse Effects on the Public Water Bodies and Environment 2. Public Health Act, B.E. 2535 (1992) 2.1. Ministerial Regulation of Public Health on the Management of Toxic or Hazardous Waste from Communities, B.E. 2563 (2020) 2.2. Ministerial Regulation of Public Health on the Joint Management of Infectious Waste Between Local Government Authorities and Other Local Government Agencies or State Agencies, B.E. 2564 (2021) 2.3. Ministerial Regulation of Public Health on the Disposal of Infectious Waste (No. 2), B.E. 2564 (2021) 2.4. Ministerial Regulation of Public Health on Sanitary Standards for General Waste Management, B.E. 2560 (2017) 2.5. Notification of the Ministry of Public Health on Control Measures for the Transport of Infectious Waste to Prevent Illegal Dumping, B.E. 2565 (2022)

Activity	Applicable Laws
	2.6. Notification of the Ministry of Public Health on Criteria for Selecting Sanitary Landfill Facilities, B.E. 2560 (2017) 2.7. Notification of the Ministry of Public Health on Characteristics and Conditions for Preventing Groundwater Contamination from Leachate, B.E. 2560 (2017) 3. Act on the Maintenance of the Cleanliness and Orderliness of the Country, B.E. 2535 (1992) and amendments No.2 B.E. 2560 (2017) 3.1. Notification of Ministry of Interior on Waste Management, B.E. 2567 (2024 4. Town Planning Act, B.E. 2562 (2019) 5. Factory Act B.E. 2535 (1992) 5.1. Notification of the Ministry of Industry on Requiring factories to install special equipment or devices to report air pollution from factory chimneys, B.E. 2565 (2022), dated April 1, 2022 5.2. Notification of the Ministry of Industry on Specifying the types and sizes of factories, methods for controlling the release of waste, pollution, or any substances affecting the environment, qualifications of supervisors and operators, and criteria for registering supervisors for environmental protection systems, B.E. 2545 (2002), dated April 5, 2002 5.3. Notification of the Ministry of Industry on Setting air pollutant concentration limits for emissions from chimneys containing hazardous industrial waste, B.E. 2545 (2002), dated October 2, 2002.2545 5.4. Notification of the Ministry of Industry on Setting air pollutant concentration limits for emissions from factories, B.E. 2549 (2006), dated October 31, 2006 5.5. Notification of the Ministry of Industry on (Supplement No. 2) on specifying factory types and sizes, controlling the release of waste, pollution, or substances affecting the environment, qualifications of supervisors and operators, and

Activity	Applicable Laws
	criteria for registering supervisors for environmental protection systems, B.E. 2554 (2011), dated January 31, 2012 5.6. Notification of the Ministry of Industry on Prescribing wastewater discharge standards for factories, B.E. 2560 (2017), dated June 7, 2017 5.7. Ministerial Regulation of the Ministry of Industry on controlling soil and groundwater contamination within factory premises, B.E. 2559 (2016) 5.8. Notification of the Ministry of Industry on the responsibilities of lead smelting factory operators regarding waste, refuse, and unused materials disposal, dated April 27, 2001 5.9. Notification of the Ministry of Industry on safety measures for lead smelting factories processing used batteries, dated April 27, 2001 5.10. Notification of the Ministry of Industry on reporting requirements for lead smelting factories processing used batteries, dated April 27, 2001 5.11. Notification of the Ministry of Industry on the Management of Waste and Unused Materials, B.E. 2566 (2023). 5.12. Notification of the Ministry of Industry on (Supplement No. 2) on the Management of Waste and Unused Materials, B.E. 2566 (2023), dated August 15, 2023. 5.13. Notification of the Ministry of Science, Technology, and Environment on Prescribing criteria, procedures, regulations, and guidelines for preparing Environmental Impact Assessment (EIA) reports, issued under the National Environmental Quality Promotion and Conservation Act, B.E. 2535 (1992) 5.14. Ministerial Regulation No. 2 (B.E. 2535/1992) Issued under the Factory Act, B.E. 2535 (1992)

Activity	Applicable Laws
	5.15. Notification of the Ministry of Industry on Prescribing types or Categories of Factories Engaged in Service Industries or Industries Providing Services to Communities, B.E. 2545 (2002) 5.16. Notification of the Ministry of Industry on Prescribing Factory Types and Sizes, Methods for Controlling the Release of Waste, Pollution, or Substances Affecting the Environment, Qualifications of Supervisors and Operators, and Criteria for Registering Supervisors for Environmental Protection Systems, B.E. 2545 (2002) and amendments No.2 B.E. 2554 (2011) 5.17. Notification of the Department of Industrial Works on the Qualifications, Training, and Examination Standards for Environmental Personnel in Factories, B.E. 2554 (2011) 5.18. Notification of the Department of Industrial Works on Registration Requirements for Pollution Control System Operators in Wastewater Treatment, Air Pollution Control, and Industrial Waste Management, B.E. 2556 (2013). 5.19. Notification of the Department of Industrial Works on the Notification and Registration of Environmental Personnel in Factories, B.E. 2556 (2013) 6. Hazardous Substances Act, B.E. 2535 (1992) and its Amendments 7. The Machinery Registration Act, B.E. 2514 (1971) 7.1. Ministerial Regulations No. 1 and No. 2 (B.E. 2514) Issued under the Machinery Registration Act, B.E. 2514 (1971) 7.2. Ministerial Regulation on the Criteria, Procedures, and Conditions for Testing Machinery, B.E. 2553 (2010) 7.3. Ministerial Regulation on Registration Fees for Machinery, B.E. 2560 (2017)
5. Waste-to-Energy (WtE)	1. The Enhancement and Conservation of National Environment Quality Act, B.E.2535 (1992) and (No. 2) B.E. 2561 (2018)

Activity	Applicable Laws
	1.1. Notification of the Ministry of Natural Resources and Environment on Establishment of controlling standards for wastewater from industrial factories, industrial estates and industrial zones, B.E. 2559 (2016). 1.2. Notification of the Ministry of Natural Resources and Environment Prescribing Standards for Controlling Air Emissions from factory 1.3. Notification of the Ministry of Natural Resources and Environment on Designating New Power Plants as Sources of Pollution Subject to Control over the Release of Air Pollutants into the Atmosphere 1.4. Notification of the Ministry of Natural Resources and Environment on Establishing Standards for Controlling the Release of Air Pollutants from New Power Plants 1.5. Notification of the Ministry of Natural Resources and Environment on Designating Certain Types and Sizes of Industrial Factories as Sources of Pollution Subject to Control over Odor Intensity of Air Emissions Released into the Atmosphere 1.6. Notification of the Ministry of Natural Resources and Environment Prescribing Standards for Controlling Odor Intensity Emission from Pollution Sources 1.7. Notification of the Ministry of Natural Resources and Environment on Establishing Standards for Controlling the Release of Air Pollutants from Incinerators for Infectious Waste 1.8. Notification of the Ministry of Natural Resources and Environment on Establishing Standards for Controlling the Release of Air Pollutants from Waste Incinerators 1.9. Notification of the Pollution Control Department on the Criteria for Assessing the Suitability of Sites for the Design,

Activity	Applicable Laws
	Construction, and Management of Waste Disposal Facilities Using Incinerators, B.E. 2560 (2017) 1.10. Notification of the Pollution Control Department on the Preliminary Suitable Characteristics of Waste-derived Fuel from Municipal Solid Waste, B.E. 2561 (2018) 1.11. Notification of the Pollution Control Department on Guidelines for Efficient Waste Management Using Incinerators, B.E. 2561 (2018) 2. Public Health Act, B.E. 2535 (1992) 2.1. Ministerial Regulation of the Ministry of Public Health on the Management of Hazardous or Toxic Waste from Communities, B.E. 2563 (2020) 2.2. Ministerial Regulation of the Ministry of Public Health on the Joint Management of Infectious Waste Between Local Government Authorities and Other Local Government Authorities or State Agencies, B.E. 2564 (2021) 2.3. Ministerial Regulation of the Ministry of Public Health on the Disposal of Infectious Waste (No. 2), B.E. 2564 (2021) 2.4. Ministerial Regulation of the Ministry of Public Health on Sanitary Management of General Waste, B.E. 2560 (2017) 2.5. Notification of the Ministry of Public Health on Control Measures for the Supervision of Infectious Waste Transportation to Prevent Illegal Dumping, B.E. 2565 (2022) 2.6. Notification of the Ministry of Public Health on Criteria for Selecting Suitable Locations for Sanitary Landfills, B.E. 2560 (2017) 2.7. Notification of the Ministry of Public Health on Characteristics and Conditions for Preventing Groundwater Contamination from Leachate, B.E. 2560 (2017) 3. Act on the Maintenance of the Cleanliness and Orderliness of the Country, B.E. 2535 (1992) and amendments No.2 B.E. 2560 (2017)

Activity	Applicable Laws
	4. Notification of Ministry of Interior on Waste management, B.E. 2567 (2024) 5. Town Planning Act, B.E. 2562 (2019) 6. Factory Act B.E. 2535 (1992) 6.1. Notification of the Ministry of Industry on Requiring factories to install special equipment or devices to report air pollution from factory chimneys, B.E. 2565 (2022), dated April 1, 2022 6.2. Notification of the Ministry of Industry on Specifying the types and sizes of factories, methods for controlling the release of waste, pollution, or any substances affecting the environment, qualifications of supervisors and operators, and criteria for registering supervisors for environmental protection systems, B.E. 2545 (2002), dated April 5, 2002 6.3. Notification of the Ministry of Industry on Setting air pollutant concentration limits for emissions from chimneys containing hazardous industrial waste, B.E. 2545 (2002), dated October 2, 2002 6.4. Notification of the Ministry of Industry on Setting air pollutant concentration limits for emissions from factories, B.E. 2549 (2006), dated October 31, 2006 6.5. Notification of the Department of Industrial Works Regarding The Submission of Data to the Continuous Emission Monitoring Systems (CEMS) for Air Quality from Stacks B.E. 2550, dated October 10, 2007 6.6. Notification of the Ministry of Industry on Prescribing Factory Types and Sizes, Methods for Controlling the Release of Waste, Pollution, or Substances Affecting the Environment, Qualifications of Supervisors and Operators, and Criteria for Registering Supervisors for Environmental Protection Systems (No. 2), B.E. 2554 (2011), dated 31 January 2012

Activity	Applicable Laws
	6.7. Notification of the Ministry of Industry on Prescribing wastewater discharge standards for factories, B.E. 2560 (2017), dated June 7, 2017 6.8. Ministerial Regulation of the Ministry of Industry on controlling soil and groundwater contamination within factory premises, B.E. 2559 (2016) 6.9. Notification of the Ministry of Industry on Prescribing the Permissible Amounts of Airborne Contaminants Emitted from Incinerators for Hazardous Waste or Discarded Materials from Industries, B.E. 2545 (2002), dated 30 October 2002. 6.10. Notification of the Ministry of Industry on the Management of Waste or Discarded Materials, B.E. 2566 (2023). 6.11. Notification of the Ministry of Industry on (Supplement No. 2) on the Management of Waste and Unused Materials, B.E. 2566 (2023), dated August 15, 2023 6.12. Notification of the Department of Industrial Works on Prescribing Types or Categories of Factories Required to Prepare Reports on the Types and Quantities of Pollutants Emitted from Factories, B.E. 2553 (2010). 6.13. Notification of the Ministry of Science, Technology, and Environment on Prescribing Criteria, Methods, Procedures, and Guidelines for the Preparation of Environmental Impact Assessment Reports under the Enhancement and Conservation of National Environmental Quality Act, B.E. 2535 (1992). 6.14. Ministerial Regulation No. 2 (B.E. 2535) Issued under the Factory Act, B.E. 2535 (1992) 6.15. Notification of the Ministry of Industry on the Specification of Types or Categories of Factories Engaging in Service Industries or Industries Providing Services to Communities B.E. 2545

Activity	Applicable Laws
	6.16. Notification of the Ministry of Industry on the Specification of Types and Sizes of Factories, the Specification of Methods for Controlling the Discharge of Waste, Pollutants, or Any Substances Affecting the Environment, the Specification of Qualifications for Supervisors and Regular Operators, and the Criteria for the Registration of Supervisors for Environmental Protection Systems B.E. 2545 and its Amendments No. 2 B.E. 2554 6.17. Notification of the Department of Industrial Works on the Qualifications, Training, and Examination Standards for Factory Environmental Personnel B.E. 2554 6.18. Notification of the Department of Industrial Works on the Registration as a Supervisor of Wastewater Treatment Systems, Air Pollution Control Systems, or Industrial Waste Management Systems B.E. 2556 6.19. Notification of the Department of Industrial Works on the Reporting and Notification of the Presence of Factory Environmental Personnel B.E. 2556 7. Hazardous Substances Act B.E. 2535 and its Amendments 8. Machinery Registration Act B.E. 2514 8.1. Ministerial Regulations No. 1 and No. 2 (B.E. 2514) Issued under the Machinery Registration Act B.E. 2514 8.2. Ministerial Regulation on Criteria, Procedures, and Conditions for Machinery Trial Operations B.E. 2553 8.3. Ministerial Regulation on Registration Fees for Machinery B.E. 2560 9. Energy Industry Act B.E. 2550 10. Royal Decree Prescribing Types, Sizes, and Characteristics of Energy Businesses Exempted from Licensing under the Energy Industry Act B.E. 2552

Activity	Applicable Laws
	10.1. Notification of the Energy Regulatory Commission on Criteria, Procedures, and Conditions for License Renewal B.E. 2551 10.2. Notification of the Energy Regulatory Commission Prescribing that Energy Businesses Exempted from Licensing Must Provide Notification B.E. 2551 10.3. Notification of the Energy Regulatory Commission on Classification and Validity of Energy Industry Licenses B.E. 2551 10.4. Notification of the Energy Regulatory Commission on Criteria, Procedures, and Conditions for the Transfer of Rights under an Energy Industry License B.E. 2552 10.5. Notification of the Energy Regulatory Commission on Criteria, Procedures, and Conditions for the Commencement of Electricity Business Operations B.E. 2552 10.6. Notification of the Energy Regulatory Commission on Criteria, Procedures, and Conditions for the Suspension and Revocation of Energy Industry Licenses B.E. 2555 10.7. Notification of the Energy Regulatory Commission on Criteria, Procedures, and Conditions for the Suspension or Cessation of Energy Supply Services B.E. 2559 10.8. Notification of the Energy Regulatory Commission on Measures for Prevention, Mitigation, and Environmental Impact Monitoring for Power Producers Using Municipal Solid Waste as Fuel with an Installed Capacity of Less Than 10 Megawatts B.E. 2559 and its Second Amendment B.E. 2561 10.9. Notification of the Energy Regulatory Commission on Measures for Prevention, Mitigation, and Environmental Impact Monitoring for Power Producers Using Municipal

Activity	Applicable Laws
	Solid Waste as Fuel with an Installed Capacity of 10 Megawatts or More B.E. 2559 and its Second Amendment B.E. 2561 10.10. Notification of the Energy Regulatory Commission on Criteria, Procedures, and Conditions for the Preparation and Submission of Energy Business-Related Information B.E. 2561 10.11. Notification of the Energy Regulatory Commission on the Termination of Energy Business Operations B.E. 2561 10.12. Notification of the Energy Regulatory Commission on the Calculation Formula for Feed-in Tariff Variable Component (FiTV) for Electricity Generation from Renewable Energy and the FiTV Rate for the Year B.E. 2563 10.13. Regulations on Power Purchase from Small Power Producers Specifically for Renewable Energy-Based Power Generation B.E. 2550 (Revised B.E. 2552 and B.E. 2553) 10.14. Regulations of the Energy Regulatory Commission Prescribing License Fees and Energy Business Operation Fees B.E. 2551 10.15. Regulations of the Energy Regulatory Commission on Licensing and Energy Business Operation B.E. 2551, as Amended (Second Amendment B.E. 2557 and Third Amendment B.E. 2560) 10.16. Regulations of the Energy Regulatory Commission on Engineering Standards for Energy Business Operations B.E. 2553 10.17. Regulations of the Energy Regulatory Commission on Standards, Inspection Procedures, and Certification of Grid-Connected Equipment for Electricity Distribution Systems B.E. 2559

Activity	Applicable Laws
	10.18. Regulations of the Energy Regulatory Commission on Standards, Inspection Procedures, and Certification of Low-Voltage Grid-Connected Inverter Equipment B.E. 2559 10.19. Regulations of the Energy Regulatory Commission on Public Hearings and Stakeholder Engagement in the Consideration of Electricity Generation Licenses B.E. 2559 10.20. Regulations of the Energy Regulatory Commission on Procedures for Applying for Electricity Business Licenses under Section 47 and Permissions under Section 48 of the Energy Industry Act B.E. 2550 10.21. Regulations of the Energy Regulatory Commission on Standards, Inspection Procedures, and Certification of Grid-Connected Equipment for Electricity Transmission Systems B.E. 2560 10.22. Regulations of the Energy Regulatory Commission on Public Consultation Processes for Projects or Operations That May Have Significant Environmental, Health, or Social Impacts B.E. 2562 10.23. Regulations on Power Purchase from Very Small Power Producers (for Renewable Energy-Based Power Generation) 10.24. Order of the Energy Regulatory Commission No. 61/2555 on Guidelines for Regulating Power Purchase from Renewable Energy Producers 10.25. Order of the Head of the National Council for Peace and Order No. 4/2559 on Exemption from Enforcement of Ministerial Regulations on Comprehensive City Planning for Certain Businesses
6. **Landfill gas capture and utilisation**	1. The Enhancement and Conservation of National Environment Quality Act, B.E.2535 (1992) and (No. 2) B.E. 2561 (2018) 1.1. Notification of the Ministry of Natural Resources and Environment, Establishment of controlling standards for

Activity	Applicable Laws
	wastewater from industrial factories, industrial estates and industrial zones, B.E. 2559 (2016). 1.2. Notification of the Ministry of Natural Resources and Environment Prescribing Standards for Controlling Air Emissions from factory 1.3. Notification of the Ministry of Natural Resources and Environment on Descriptions of Factory Types and Sizes of Industrial Factories as Pollution Sources Subject to Odor Intensity Control for Air Emissions 1.4. Notification of the Ministry of Natural Resources and Environment Prescribing Standards for Controlling Odor Intensity Emission from Pollution Sources 1.5. Notification of the Ministry of Natural Resources and Environment Descriptions of Factory Types and Sizes, Procedure for the Control of Discharges of Waste Water that Cause Adverse Effects on the Public Water Bodies and Environment 1.6. Notification of Pollution Control Department on Guidelines for Considering the Suitability of Areas for Designing, Constructing, and Managing Sanitary Landfill Facility B.E. 2560 (2017) 2. Public Health Act, B.E. 2535 (1992) 2.1. Ministerial Regulation of the Ministry of Public Health on the Management of Hazardous or Toxic Waste from Communities, B.E. 2563 (2020) 2.2. Ministerial Regulation of the Ministry of Public Health on the Joint Management of Infectious Waste Between Local Government Authorities and Other Local Government Authorities or State Agencies, B.E. 2564 (2021) 2.3. Ministerial Regulation of the Ministry of Public Health on the Disposal of Infectious Waste (No. 2), B.E. 2564 (2021)

Activity	Applicable Laws
	2.4. Ministerial Regulation of the Ministry of Public Health on Sanitary Management of General Waste, B.E. 2560 (2017) 2.5. Notification of the Ministry of Public Health on Control Measures for the Supervision of Infectious Waste Transportation to Prevent Illegal Dumping, B.E. 2565 (2022) 2.6. Notification of the Ministry of Public Health on Criteria for Selecting Suitable Locations for Sanitary Landfills, B.E. 2560 (2017) 2.7. Notification of the Ministry of Public Health on Characteristics and Conditions for Preventing Groundwater Contamination from Leachate, B.E. 2560 (2017) 3. Act on the Maintenance of the Cleanliness and Orderliness of the Country, B.E. 2535 (1992) and amendments No.2 B.E. 2560 (2017) 3.1. Notification of the Ministry of Interior on Waste Management B.E. 2567 4. Town Planning Act, B.E. 2562 (2019) 5. Factory Act B.E. 2535 (1992) 5.1. Notification of the Ministry of Industry on Requiring factories to install special equipment or devices to report air pollution from factory chimneys, B.E. 2565 (2022), dated April 1, 2022 5.2. Notification of the Ministry of Industry on Specifying the types and sizes of factories, methods for controlling the release of waste, pollution, or any substances affecting the environment, qualifications of supervisors and operators, and criteria for registering supervisors for environmental protection systems, B.E. 2545 (2002), dated April 5, 2002 5.3. Notification of the Ministry of Industry on Setting air pollutant concentration limits for emissions from chimneys containing hazardous industrial waste, B.E. 2545 (2002), dated October 2, 2002

Activity	Applicable Laws
	5.4. Notification of the Ministry of Industry on Setting air pollutant concentration limits for emissions from factories, B.E. 2549 (2006), dated October 31, 2006 5.5. Notification of the Ministry of Industry on (Supplement No. 2) on specifying factory types and sizes, controlling the release of waste, pollution, or substances affecting the environment, qualifications of supervisors and operators, and criteria for registering supervisors for environmental protection systems, B.E. 2554 (2011), dated January 31, 2012 5.6. Notification of the Ministry of Industry on Prescribing wastewater discharge standards for factories, B.E. 2560 (2017), dated June 7, 2017 5.7. Ministerial Regulation of the Ministry of Industry on controlling soil and groundwater contamination within factory premises, B.E. 2559 (2016) 5.8. Notification of the Ministry of Industry Regarding The Duties of Operators of Lead Smelting Factories from Used Batteries Concerning the Disposal of Waste, Refuse, and Unused Materials, dated April 27, 2001 5.9. Notification of the Ministry of Industry Regarding Safety Protection Measures in the Operation of Lead Smelting Factories from Used Batteries Dated April 27, 2001 5.10. Notification of the Ministry of Industry on the Management of Waste or Discarded Materials, B.E. 2566 (2023). 5.11. Notification of the Ministry of Industry on (Supplement No. 2) on the Management of Waste and Unused Materials, B.E. 2566 (2023), dated August 15, 2023 5.12. Notification of the Department of Industrial Works on Prescribing Types or Categories of Factories Required to Prepare Reports on the Types and Quantities of Pollutants Emitted from Factories, B.E. 2553 (2010).

Activity	Applicable Laws
	5.13. Notification of the Ministry of Science, Technology, and Environment on Prescribing Criteria, Methods, Procedures, and Guidelines for the Preparation of Environmental Impact Assessment Reports under the Enhancement and Conservation of National Environmental Quality Act, B.E. 2535 (1992). 5.14. Ministerial Regulation No. 2 (B.E. 2535) Issued under the Factory Act, B.E. 2535 (1992) 5.15. Notification of the Ministry of Industry on the Specification of Types or Categories of Factories Engaging in Service Industries or Industries Providing Services to Communities B.E. 2545 5.16. Notification of the Ministry of Industry on the Specification of Types and Sizes of Factories, the Specification of Methods for Controlling the Discharge of Waste, Pollutants, or Any Substances Affecting the Environment, the Specification of Qualifications for Supervisors and Regular Operators, and the Criteria for the Registration of Supervisors for Environmental Protection Systems B.E. 2545 and its Amendments No. 2 B.E. 2554 5.17. Notification of the Department of Industrial Works on the Qualifications, Training, and Examination Standards for Factory Environmental Personnel B.E. 2554 5.18. Notification of the Department of Industrial Works on the Registration as a Supervisor of Wastewater Treatment Systems, Air Pollution Control Systems, or Industrial Waste Management Systems B.E. 2556 5.19. Notification of the Department of Industrial Works on the Reporting and Notification of the Presence of Factory Environmental Personnel B.E. 2556 6. Fertiliser Act, B.E. 2518 (1975) and its Amendments

Activity	Applicable Laws
	6.1. Ministerial Regulation on Fees for Fertiliser-related Business Operations, B.E. 2554 (2011) 6.2. Notification of Ministry of Agriculture and Cooperatives on Standardised Chemical Fertilisers, B.E. 2559 (2016) 6.3. Notification of Ministry of Agriculture and Cooperatives on the Required Organic Matter Content in Organic Chemical Fertilisers under the Fertiliser Act, B.E. 2518 (1975), as amended by the Fertiliser Act (No. 2), B.E. 2550 (2007), B.E. 2554 (2011) 6.4. Notification of Department of Agriculture on Criteria and Methods for Sampling Fertilisers or Suspected Fertilisers in Reasonable Quantities for Inspection or Analysis (No. 2), B.E. 2557 (2014) 6.5. Notification of Department of Agriculture on Organic Fertiliser Standards, B.E. 2557 (2014) 7. Hazardous Substances Act B.E. 2535 and its Amendments 8. Machine Registration Act B.E. 2514 8.1. Ministerial Regulation No. 1 and No. 2 (B.E. 2514) Issued under the Machine Registration Act B.E. 2514 8.2. Ministerial Regulation on the Guidelines, Procedures, and Conditions for Machine Trial Runs B.E. 2553 8.3. Ministerial Regulation on Fees Related to Machine Registration B.E. 2560
7. **Remediation of contaminated sites and areas**	1. The Enhancement and Conservation of National Environment Quality Act, B.E.2535 (1992) and (No. 2) B.E. 2561 (2018) 1.1. Notification of Ministry of Natural Resources and Environment on Noise standards for Three-Wheeled Vehicles 1.2. Notification of the Pollution Control Department on the Guidelines for Hazardous Waste Management from Communities for Local Administrative Organizations, B.E. 2560 (2017)

Activity	Applicable Laws
	1.3. Notification of the Pollution Control Department on the Criteria for Considering the Suitability of Locations for the Design and Construction of Waste Transfer Stations, B.E. 2560 (2017) 1.4. Notification of the Pollution Control Department on the Criteria for the Design and Construction of Facilities for Sorting and Processing Community Waste to Produce Waste-derived Fuel, B.E. 2561 (2018) 2. Public Health Act, B.E. 2535 (1992) 2.1. Ministerial Regulation of Public Health on the Management of Toxic or Hazardous Waste from Communities, B.E. 2563 (2020) 2.2. Ministerial Regulation of Public Health on the Joint Management of Infectious Waste Between Local Government Authorities and Other Local Government Agencies or State Agencies, B.E. 2564 (2021) 2.3. Ministerial Regulation of Public Health on the Disposal of Infectious Waste (No. 2), B.E. 2564 (2021) 2.4. Ministerial Regulation of Public Health on Sanitary Standards for General Waste Management, B.E. 2560 (2017) 2.5. Notification of the Ministry of Public Health on Control Measures for the Transport of Infectious Waste to Prevent Illegal Dumping, B.E. 2565 (2022) 2.6. Notification of the Ministry of Public Health on Criteria for Selecting Sanitary Landfill Facilities, B.E. 2560 (2017) 2.7. Notification of the Ministry of Public Health on Characteristics and Conditions for Preventing Groundwater Contamination from Leachate, B.E. 2560 (2017) 3. Act on the Maintenance of the Cleanliness and Orderliness of the Country, B.E. 2535 (1992), and Amendment (No. 2), B.E. 2560 (2017)

Activity	Applicable Laws
	4. Fertiliser Act, B.E. 2518 (1975) and its Amendments 4.1. Ministerial Regulation on Fees for Fertiliser-related Business Operations, B.E. 2554 (2011) 4.2. Notification of Ministry of Agriculture and Cooperatives on Standardised Chemical Fertilisers, B.E. 2559 (2016) 4.3. Notification of Ministry of Agriculture and Cooperatives on the Required Organic Matter Content in Organic Chemical Fertilisers under the Fertiliser Act, B.E. 2518 (1975), as amended by the Fertiliser Act (No. 2), B.E. 2550 (2007), B.E. 2554 (2011) 4.4. Notification of Department of Agriculture on Criteria and Methods for Sampling Fertilisers or Suspected Fertilisers in Reasonable Quantities for Inspection or Analysis (No. 2), B.E. 2557 (2014) 4.5. Notification of Department of Agriculture on Organic Fertiliser Standards, B.E. 2557 (2014) 5. Town Planning Act, B.E. 2562 (2019 6. Notification of the Ministry of Interior on Waste Management B.E. 2567 7. Control of Sale by Auction and Trade of Antiques Act, B.E. 2474 (1931) and Amendments (Nos. 1-5) 7.1. Ministry of Interior's Regulation on the Control of Sale by Auction and Trade of Antiques, B.E. 2533 (1990) 7.2. Ministerial Regulation No. 9 (B.E. 2548 / 2005) Issued under the Control of Sale by Auction and Trade of Antiques Act, B.E. 2474 (1931)
8. **Remediation of legally non-conforming landfills and abandoned or illegal waste dumps**	1. The Enhancement and Conservation of National Environment Quality Act, B.E.2535 (1992) and (No. 2) B.E. 2561 (2018) 2. Public Health Act, B.E. 2535 (1992)

Activity	Applicable Laws
	2.1. Ministerial Regulation of Public Health on the Management of Toxic or Hazardous Waste from Communities, B.E. 2563 (2020) 2.2. Ministerial Regulation of Public Health on the Joint Management of Infectious Waste Between Local Government Authorities and Other Local Government Agencies or State Agencies, B.E. 2564 (2021) 2.3. Ministerial Regulation of Public Health on the Disposal of Infectious Waste (No. 2), B.E. 2564 (2021) 2.4. Ministerial Regulation of Public Health on Sanitary Standards for General Waste Management, B.E. 2560 (2017) 2.5. Notification of the Ministry of Public Health on Control Measures for the Transport of Infectious Waste to Prevent Illegal Dumping, B.E. 2565 (2022) 2.6. Notification of the Ministry of Public Health on Criteria for Selecting Sanitary Landfill Facilities, B.E. 2560 (2017) 2.7. Notification of the Ministry of Public Health on Characteristics and Conditions for Preventing Groundwater Contamination from Leachate, B.E. 2560 (2017) 3. Act on the Maintenance of the Cleanliness and Orderliness of the Country, B.E. 2535 (1992), and Amendment (No. 2), B.E. 2560 (2017) 4. Town Planning Act, B.E. 2562 (2019) 5. Factory Act B.E. 2535 (1992) 5.1. Ministerial Notification on the Requirement for Factories to Install Instruments or Special Equipment to Report Air Pollution from Factory Stacks, B.E. 2565 (2022), dated April 1, 2022 5.2. Ministerial Notification on the Types and Sizes of Factories, Methods for Controlling the Release of Waste, Pollution, or Anything That May Impact the Environment, the

Activity	Applicable Laws
	Qualifications of Supervisors and Permanent Workers, and the Criteria for Registering Supervisors for Environmental Protection Systems, B.E. 2545 (2002), dated April 5, 2002 5.3. Ministerial Notification on the Defined Amount of Pollutants in the Air Emitted from Stacks Containing Waste or Hazardous Materials from Industrial Operations, B.E. 2545 (2002), dated October 2, 2002 5.4. Ministerial Notification on the Defined Amount of Pollutants in the Air Emitted from Factory Stacks, B.E. 2549 (2006), dated October 31, 2006 5.5. Industrial Factory Department Notification on the Submission of Data to the Continuous Emission Monitoring System (CEMS), B.E. 2550 (2007), dated October 10, 2007 5.6. Ministerial Notification on the Types and Sizes of Factories, Methods for Controlling the Release of Waste, Pollution, or Anything That May Impact the Environment, the Qualifications of Supervisors and Permanent Workers, and the Criteria for Registering Supervisors for Environmental Protection Systems (No. 2), B.E. 2554 (2011), dated January 31, 2012 5.7. Ministerial Notification on the Standards for Controlling Wastewater Discharges from Factories, B.E. 2560 (2017), dated June 7, 2017 5.8. Ministerial Regulation on the Control of Soil and Groundwater Contamination Within Factory Premises, B.E. 2559 (2016) 5.9. Ministerial Notification on the Responsibilities of Operators of Battery Recycling Factories Regarding Waste, Pollutants, and Unused Materials Disposal, dated April 27, 2001

Activity	Applicable Laws
	5.10. Ministerial Notification on Safety Protection Measures in the Operation of Battery Recycling Factories, dated April 27, 2001 5.11. Ministerial Notification on Reporting Requirements for Data from Battery Recycling Factories, dated April 27, 2001 5.12. Ministerial Notification on Defining the Amount of Pollutants in the Air Emitted from Stacks Containing Waste or Hazardous Materials from Industrial Operations, B.E. 2545 (2002), dated October 30, 2002 5.13. Ministerial Notification on the Criteria for Licensing Factory Types No. 105 and No. 106, dated November 28, 2002 5.14. Ministerial Notification on the Management of Waste or Unused Materials, B.E. 2566 (2023) 5.15. Ministerial Notification on the Management of Waste or Unused Materials (No. 2), B.E. 2566 (2023), dated August 15, 2023 5.16. Industrial Factory Department Notification on the Types or Categories of Factories Requiring Reports on the Type and Amount of Pollutants Emitted from Factories, B.E. 2553 (2010) 5.17. Ministerial Regulation No. 15 (B.E. 2544 / 2001) Issued Under the Factory Act, B.E. 2535 (1992), Requiring Factories Involved in the Sorting or Landfilling of Waste or Unused Materials to be Categorized as Factory Type No. 105 and as Factory Category 3, Regardless of Size 5.18. Ministerial Notification on the Criteria for Licensing Factory Types No. 105 and No. 106, dated November 6, 2002 5.19. Industrial Factory Department Regulation, dated November 25, 2002, on the Detailed Criteria for Licensing Factory Types No. 105 and No. 106, B.E. 2545 (2002)

Activity	Applicable Laws
	5.20. Ministry of Science, Technology, and Environment Notification on the Criteria, Methods, Procedures, and Guidelines for Preparing Environmental Impact Assessment Reports Under the National Environmental Quality Promotion and Conservation Act, B.E. 2535 (1992) 5.21. Ministerial Regulation No. 2 (B.E. 2535 / 1992) Issued Under the Factory Act, B.E. 2535 (1992) 5.22. Ministerial Notification on the Types or Categories of Factories Involved in Service Industries or Industries Providing Services to Communities, B.E. 2545 (2002) 5.23. Ministerial Notification on the Types and Sizes of Factories, Methods for Controlling the Release of Waste, Pollution, or Anything That May Impact the Environment, the Qualifications of Supervisors and Permanent Workers, and the Criteria for Registering Supervisors for Environmental Protection Systems, B.E. 2545 (2002) and Amendments (No. 2) B.E. 2554 (2011) 5.24. Industrial Factory Department Notification on Training and Examination Qualifications for Environmental Personnel in Factories, B.E. 2554 (2011) 5.25. Industrial Factory Department Notification on the Registration of Supervisors for Water Pollution Control Systems, Air Pollution Control Systems, or Industrial Waste Pollution Management Systems, B.E. 2556 (2013) 5.26. Industrial Factory Department Notification on Reporting and Notification of Environmental Personnel in Factories, B.E. 2556 (2013) 6. Hazardous Substances Act B.E. 2535 and its Amendments 7. Machine Registration Act B.E. 2514 7.1. Ministerial Regulation No. 1 and No. 2 (B.E. 2514) Issued under the Machine Registration Act B.E. 2514

Activity	Applicable Laws
	7.2. Ministerial Regulation on the Guidelines, Procedures, and Conditions for Machine Trial Runs B.E. 2553 7.3. Ministerial Regulation on Fees Related to Machine Registration B.E. 2560
9. **Sorting and material recovery from non-hazardous waste**	1. The Enhancement and Conservation of National Environment Quality Act, B.E.2535 (1992) and (No. 2) B.E. 2561 (2018) 1.1. Notification of the Ministry of Natural Resources and Environment, Establishment of controlling standards for wastewater from industrial factories, industrial estates and industrial zones, B.E. 2559 (2016). 1.2. Notification of the Ministry of Natural Resources and Environment Prescribing Standards for Controlling Air Emissions from factory 1.3. Notification of the Ministry of Natural Resources and Environment on Descriptions of Factory Types and Sizes of Industrial Factories as Pollution Sources Subject to Odor Intensity Control for Air Emissions 1.4. Notification of the Ministry of Natural Resources and Environment Prescribing Standards for Controlling Odor Intensity Emission from Pollution Sources 2. Public Health Act, B.E. 2535 (1992) 2.1. Ministerial Regulation of Public Health on the Management of Toxic or Hazardous Waste from Communities, B.E. 2563 (2020) 2.2. Ministerial Regulation of Public Health on the Joint Management of Infectious Waste Between Local Government Authorities and Other Local Government Agencies or State Agencies, B.E. 2564 (2021) 2.3. Ministerial Regulation of Public Health on the Disposal of Infectious Waste (No. 2), B.E. 2564 (2021)

Activity	Applicable Laws
	2.4. Ministerial Regulation of Public Health on Sanitary Standards for General Waste Management, B.E. 2560 (2017) 2.5. Notification of the Ministry of Public Health on Control Measures for the Transport of Infectious Waste to Prevent Illegal Dumping, B.E. 2565 (2022) 2.6. Notification of the Ministry of Public Health on Criteria for Selecting Sanitary Landfill Facilities, B.E. 2560 (2017) 2.7. Notification of the Ministry of Public Health on Characteristics and Conditions for Preventing Groundwater Contamination from Leachate, B.E. 2560 (2017) 3. Act on the Maintenance of the Cleanliness and Orderliness of the Country, B.E. 2535 (1992), and Amendment (No. 2), B.E. 2560 (2017) 4. Notification of the Ministry of Interior on Waste Management B.E. 2567 5. Town Planning Act, B.E. 2562 (2019) 6. Factory Act B.E. 2535 (1992) 6.1. Notification of the Ministry of Industry on the Requirement for Factories to Install Instruments or Special Equipment for Reporting Air Pollution from Factory Stacks, B.E. 2565 (2022), Dated April 1, 2022 6.2. Notification of the Ministry of Industry on the Specification of Pollutant Concentrations in Air Emissions from Stacks of Industrial Waste or Hazardous Materials, B.E. 2545 (2002), Dated October 2, 2002 and Amendments 6.3. Notification of the Ministry of Industry on the Amount of Contaminants in Air Discharged from Chimneys from Waste or Hazardous Materials from Industrial Operations, B.E. 2545 (2002), dated October 2, 2002

Activity	Applicable Laws
	6.4. Notification of the Ministry of Industry on the Specification of Pollutant Concentrations in Air Emissions from Factories, B.E. 2549 (2006), Dated October 31, 2006 6.5. Notification of the Ministry of Industry on Prescribing the Types and Sizes of Factories, Prescribing Methods for Controlling the Discharge of Waste, Pollution or Anything Affecting the Environment, Prescribing the Qualifications of Supervisors and On-site Operators, and Criteria for the Registration of Supervisors for Toxic Environmental Protection Systems (No. 2) B.E. 2554 (2011) Dated 31 January B.E. 2555 (2012) 6.6. Notification of the Ministry of Industry on the Specification of Standards for Controlling Wastewater Discharges from Factories, B.E. 2560 (2017), Dated June 7, 2017 6.7. Ministerial Regulation of the Ministry of Industry on the Control of Soil and Groundwater Contamination within Factory Premises, B.E. 2559 (2016) 6.8. Notification of the Ministry of Industry on the Responsibilities of Operators of Lead Battery Recycling Factories Regarding Waste Disposal, Sewage, and Hazardous Materials, Dated April 27, 2001 6.9. Notification of the Ministry of Industry on Safety Measures for Lead Battery Recycling Factories, Dated April 27, 2001 6.10. Notification of the Ministry of Industry on Reporting Requirements for Lead Battery Recycling Factories, Dated April 27, 2001 6.11. Notification of the Ministry of Industry on the Specification of Pollutant Concentrations in Air Emissions from Industrial Waste or Hazardous Materials, B.E. 2545 (2002), Dated October 30, 2002

Activity	Applicable Laws
	6.12. Notification of the Ministry of Industry on the Criteria for Approving the Types of Factories No. 105 and No. 106, Dated November 28, 2002 6.13. Notification of the Ministry of Industry on Waste and Hazardous Materials Management, B.E. 2566 (2023) 6.14. Notification of the Ministry of Industry on Waste and Hazardous Materials Management (No. 2), B.E. 2566 (2023), Dated August 15, 2023 6.15. Notification of the Department of Industrial Works on the Specification of Factory Types That Must Report the Types and Quantities of Pollutants Emitted from Factories, B.E. 2553 (2010) 6.16. Ministerial Regulation No. 15 (B.E. 2544, 2001) under the Factory Act, B.E. 2535 (1992), which Requires Factories Engaged in the Sorting or Landfilling of Waste or Hazardous Materials to be Classified as Factory No. 105, Category 3, Regardless of Size 6.17. Notification of the Ministry of Industry, Dated November 6, 2002, on the Criteria for Approving the Types of Factories No. 105 and No. 106 6.18. Regulation of the Department of Industrial Works, Dated November 25, 2002, on the Detailed Criteria for Approving the Types of Factories No. 105 and No. 106, B.E. 2545 (2002) 6.19. Notification of the Ministry of Science, Technology, and Environment on the Guidelines, Procedures, and Practices for Environmental Impact Reports, in Accordance with the National Environmental Quality Promotion and Preservation Act, B.E. 2535 (1992) 6.20. Ministerial Regulation No. 2 (B.E. 2535, 1992) under the Factory Act, B.E. 2535 (1992)

Activity	Applicable Laws
	6.21. Notification of the Ministry of Industry on the Specification of Factory Types Engaged in Service Industries or Providing Services to Communities, B.E. 2545 (2002) 6.22. Notification of the Ministry of Industry on the Specification of Factory Types and Sizes, the Methods for Controlling Waste Emissions, Pollution, or Any Harmful Environmental Impact, the Qualifications of Supervisors, and the Registration Criteria for Supervisors of Environmental Protection Systems, B.E. 2545 (2002) and Amendments 6.23. Notification of the Department of Industrial Works on the Training and Examination Qualifications of Environmental Personnel in Factories, B.E. 2554 (2011) 6.24. Notification of the Department of Industrial Works on the Registration of Supervisors for Water Pollution Treatment Systems, Air Pollution Treatment Systems, or Industrial Waste Management Systems, B.E. 2556 (2013) 6.25. Notification of the Department of Industrial Works on the Reporting and Registration of Environmental Personnel in Factories, B.E. 2556 (2013) 7. Hazardous Substances Act B.E. 2535 and its Amendments 8. Machine Registration Act B.E. 2514 8.1. Ministerial Regulation No. 1 and No. 2 (B.E. 2514) Issued under the Machine Registration Act B.E. 2514 8.2. Ministerial Regulation on the Guidelines, Procedures, and Conditions for Machine Trial Runs B.E. 2553 8.3. Ministerial Regulation on Fees Related to Machine Registration B.E. 2560
10. **Treatment of Hazardous Waste**	1. The Enhancement and Conservation of National Environment Quality Act, B.E.2535 (1992) and (No. 2) B.E. 2561 (2018) 1.1. Notification of the Ministry of Natural Resources and Environment, Establishment of controlling standards for

Activity	Applicable Laws
	wastewater from industrial factories, industrial estates and industrial zones, B.E. 2559 (2016). 1.2. Notification of the Ministry of Natural Resources and Environment Prescribing Standards for Controlling Air Emissions from factory 1.3. Notification of the Ministry of Natural Resources and Environment on Descriptions of Factory Types and Sizes of Industrial Factories as Pollution Sources Subject to Odor Intensity Control for Air Emissions 1.4. Notification of the Ministry of Natural Resources and Environment Prescribing Standards for Controlling Odor Intensity Emission from Pollution Sources 2. Public Health Act, B.E. 2535 (1992) 2.1. Ministerial Regulation of Public Health on the Management of Toxic or Hazardous Waste from Communities, B.E. 2563 (2020) 2.2. Ministerial Regulation of Public Health on the Joint Management of Infectious Waste Between Local Government Authorities and Other Local Government Agencies or State Agencies, B.E. 2564 (2021) 2.3. Ministerial Regulation of Public Health on the Disposal of Infectious Waste (No. 2), B.E. 2564 (2021) 2.4. Ministerial Regulation of Public Health on Sanitary Standards for General Waste Management, B.E. 2560 (2017) 2.5. Notification of the Ministry of Public Health on Control Measures for the Transport of Infectious Waste to Prevent Illegal Dumping, B.E. 2565 (2022) 2.6. Notification of the Ministry of Public Health on Criteria for Selecting Sanitary Landfill Facilities, B.E. 2560 (2017)

Activity	Applicable Laws
	2.7. Notification of the Ministry of Public Health on Characteristics and Conditions for Preventing Groundwater Contamination from Leachate, B.E. 2560 (2017) 3. Act on the Maintenance of the Cleanliness and Orderliness of the Country, B.E. 2535 (1992), and Amendment (No. 2), B.E. 2560 (2017) 4. Notification of the Ministry of Interior on Waste Management B.E. 2567 5. Fertiliser Act, B.E. 2518 (1975) and its Amendments 5.1. Ministerial Regulation on Fees for Fertiliser-related Business Operations, B.E. 2554 (2011) 5.2. Notification of Ministry of Agriculture and Cooperatives on Standardised Chemical Fertilisers, B.E. 2559 (2016) 5.3. Notification of Ministry of Agriculture and Cooperatives on the Required Organic Matter Content in Organic Chemical Fertilisers under the Fertiliser Act, B.E. 2518 (1975), as amended by the Fertiliser Act (No. 2), B.E. 2550 (2007), B.E. 2554 (2011) 5.4. Notification of Department of Agriculture on Criteria and Methods for Sampling Fertilisers or Suspected Fertilisers in Reasonable Quantities for Inspection or Analysis (No. 2), B.E. 2557 (2014) 5.5. Notification of Department of Agriculture on Organic Fertiliser Standards, B.E. 2557 (2014) 6. Town Planning Act, B.E. 2562 (2019) 7. Factory Act B.E. 2535 (1992) 7.1. Notification of the Ministry of Industry on the Requirement for Factories to Install Instruments or Special Equipment for Reporting Air Pollution from Factory Stacks, B.E. 2565 (2022), Dated April 1, 2022

Activity	Applicable Laws
	7.2. Notification of the Ministry of Industry on the Specification of Pollutant Concentrations in Air Emissions from Stacks of Industrial Waste or Hazardous Materials, B.E. 2545 (2002), Dated October 2, 2002 and Amendments 7.3. Notification of the Ministry of Industry on the Amount of Contaminants in Air Discharged from Chimneys from Waste or Hazardous Materials from Industrial Operations, B.E. 2545 (2002), dated October 2, 2002 7.4. Notification of the Ministry of Industry on the Specification of Pollutant Concentrations in Air Emissions from Factories, B.E. 2549 (2006), Dated October 31, 2006 7.5. Notification of the Ministry of Industry on the Specification of Standards for Controlling Wastewater Discharges from Factories, B.E. 2560 (2017), Dated June 7, 2017 7.6. Ministerial Regulation of the Ministry of Industry on the Control of Soil and Groundwater Contamination within Factory Premises, B.E. 2559 (2016) 7.7. Notification of the Ministry of Industry on the Responsibilities of Operators of Lead Battery Recycling Factories Regarding Waste Disposal, Sewage, and Hazardous Materials, Dated April 27, 2001 7.8. Notification of the Ministry of Industry on Safety Measures for Lead Battery Recycling Factories, Dated April 27, 2001 7.9. Notification of the Ministry of Industry on Reporting Requirements for Lead Battery Recycling Factories, Dated April 27, 2001 7.10. Notification of the Ministry of Industry on the Specification of Pollutant Concentrations in Air Emissions from Industrial Waste or Hazardous Materials, B.E. 2545 (2002), Dated October 30, 2002

Activity	Applicable Laws
	7.11. Notification of the Ministry of Industry on the Criteria for Approving the Types of Factories No. 105 and No. 106, Dated November 28, 2002 7.12. Notification of the Ministry of Industry on Waste and Hazardous Materials Management, B.E. 2566 (2023) 7.13. Notification of the Ministry of Industry on Waste and Hazardous Materials Management (No. 2), B.E. 2566 (2023), Dated August 15, 2023 7.14. Notification of the Department of Industrial Works on the Specification of Factory Types That Must Report the Types and Quantities of Pollutants Emitted from Factories, B.E. 2553 (2010) 7.15. Ministerial Regulation No. 15 (B.E. 2544, 2001) under the Factory Act, B.E. 2535 (1992), which Requires Factories Engaged in the Sorting or Landfilling of Waste or Hazardous Materials to be Classified as Factory No. 105, Category 3, Regardless of Size 7.16. Notification of the Ministry of Industry, Dated November 6, 2002, on the Criteria for Approving the Types of Factories No. 105 and No. 106 7.17. Regulation of the Department of Industrial Works, Dated November 25, 2002, on the Detailed Criteria for Approving the Types of Factories No. 105 and No. 106, B.E. 2545 (2002) 7.18. Notification of the Ministry of Science, Technology, and Environment on the Guidelines, Procedures, and Practices for Environmental Impact Reports, in Accordance with the National Environmental Quality Promotion and Preservation Act, B.E. 2535 (1992) 7.19. Ministerial Regulation No. 2 (B.E. 2535, 1992) under the Factory Act, B.E. 2535 (1992)

Activity	Applicable Laws
	7.20. Notification of the Ministry of Industry on the Specification of Factory Types Engaged in Service Industries or Providing Services to Communities, B.E. 2545 (2002) 7.21. Notification of the Ministry of Industry on the Specification of Factory Types and Sizes, the Methods for Controlling Waste Emissions, Pollution, or Any Harmful Environmental Impact, the Qualifications of Supervisors, and the Registration Criteria for Supervisors of Environmental Protection Systems, B.E. 2545 (2002) and Amendments 7.22. Notification of the Department of Industrial Works on the Training and Examination Qualifications of Environmental Personnel in Factories, B.E. 2554 (2011) 7.23. Notification of the Department of Industrial Works on the Registration of Supervisors for Water Pollution Treatment Systems, Air Pollution Treatment Systems, or Industrial Waste Management Systems, B.E. 2556 (2013) 7.24. Notification of the Department of Industrial Works on the Reporting and Registration of Environmental Personnel in Factories, B.E. 2556 (2013) 8. Hazardous Substances Act B.E. 2535 and its Amendments 9. Machine Registration Act B.E. 2514 9.1. Ministerial Regulation No. 1 and No. 2 (B.E. 2514) Issued under the Machine Registration Act B.E. 2514 9.2. Ministerial Regulation on the Guidelines, Procedures, and Conditions for Machine Trial Runs B.E. 2553 9.3. Ministerial Regulation Prescribing Fees related to Machinery Registration B.E. 2560
11. **Construction, extension, upgrade, operation and renewal of**	1. The Enhancement and Conservation of National Environment Quality Act, B.E.2535 (1992) and (No. 2) B.E. 2561 (2018) 1.1. Notification of the Ministry of Natural Resources and Environment, Establishment of controlling standards for

Activity	Applicable Laws
decentralised wastewater collection and treatment	wastewater from industrial factories, industrial estates and industrial zones, B.E. 2559 (2016). 1.2. Notification of the Ministry of Natural Resources and Environment Prescribing Standards for Controlling Air Emissions from factory 1.3. Notification of the Ministry of Natural Resources and Environment on Descriptions of Factory Types and Sizes of Industrial Factories as Pollution Sources Subject to Odor Intensity Control for Air Emissions 1.4. Notification of the Ministry of Natural Resources and Environment Prescribing Standards for Controlling Odor Intensity Emission from Pollution Sources 2. Public Health Act, B.E. 2535 (1992) 2.1. Notification of the Ministry of Public Health on Activities Hazardous to Health, B.E. 2558 (2015) 2.2. Ministerial Regulation of the Ministry of Public Health on the Joint Management of Infectious Waste Between Local Governments and Other Government Agencies, B.E. 2564 (2021) 2.3. Ministerial Regulation of the Ministry of Public Health on the Disposal of Infectious Waste (No. 2), B.E. 2564 (2021) 2.4. Ministerial Regulation of the Ministry of Public Health on Sanitation in General Waste Management, B.E. 2560 (2017) 2.5. Notification of the Ministry of Public Health on Measures to Control the Transportation of Infectious Waste to Prevent Illegal Dumping of Infectious Waste, B.E. 2565 (2022) 3. Act on the Maintenance of the Cleanliness and Orderliness of the Country, B.E. 2535 (1992), and Amendment (No. 2), B.E. 2560 (2017) 4. Fertiliser Act, B.E. 2518 (1975) and its Amendments

Activity	Applicable Laws
	4.1. Ministerial Regulation on Fees for Fertiliser-related Business Operations, B.E. 2554 (2011) 4.2. Notification of Ministry of Agriculture and Cooperatives on Standardised Chemical Fertilisers, B.E. 2559 (2016) 4.3. Notification of Ministry of Agriculture and Cooperatives on the Required Organic Matter Content in Organic Chemical Fertilisers under the Fertiliser Act, B.E. 2518 (1975), as amended by the Fertiliser Act (No. 2), B.E. 2550 (2007), B.E. 2554 (2011) 4.4. Notification of Department of Agriculture on Criteria and Methods for Sampling Fertilisers or Suspected Fertilisers in Reasonable Quantities for Inspection or Analysis (No. 2), B.E. 2557 (2014) 4.5. Notification of Department of Agriculture on Organic Fertiliser Standards, B.E. 2557 (201 5. Town Planning Act, B.E. 2562 (2019) 6. Factory Act, B.E. 2535 (1992) 6.1. Notification of the Ministry of Industry on the Requirement for Factories to Install Equipment or Special Devices to Report Air Pollution from Factory Chimneys, B.E. 2565 (2022), dated April 1, 2022 6.2. Notification of the Ministry of Industry on the Types and Sizes of Factories, Methods for Controlling Waste and Pollution Discharge, and Qualifications for Supervisors and Operators for Environmental Protection Systems, B.E. 2545 (2002), dated April 5, 2002 6.3. Notification of the Ministry of Industry on the Amount of Contaminants in Air Discharged from Chimneys from Waste or Hazardous Materials from Industrial Operations, B.E. 2545 (2002), dated October 2, 2002

Activity	Applicable Laws
	6.4. Notification of the Ministry of Industry on the Amount of Contaminants in Air Discharged from Factories, B.E. 2549 (2006), dated October 31, 2006 6.5. Notification of the Ministry of Industry on the Types and Sizes of Factories, Methods for Controlling Waste and Pollution Discharge, and Qualifications for Supervisors and Operators for Environmental Protection Systems (No. 2), B.E. 2554 (2011), dated January 31, 2012 6.6. Notification of the Ministry of Industry on Standards for Controlling the Discharge of Wastewater from Factories, B.E. 2560 (2017), dated June 7, 2017 6.7. Ministerial Regulation of the Ministry of Industry on the Control of Soil and Groundwater Contamination within Factory Areas, B.E. 2559 (2016) 6.8. Notification of the Ministry of Industry on the Management of Waste and Materials That Are No Longer Used, B.E. 2566 (2023) 6.9. Notification of the Ministry of Industry on the Management of Waste and Materials That Are No Longer Used (No. 2), B.E. 2566 (2023), dated August 15, 2023 6.10. Notification of the Department of Industrial Works on the Types and Sizes of Factories Required to Report the Types and Quantities of Pollutants Discharged from Factories, B.E. 2553 (2010) 6.11. Notification of the Ministry of Science, Technology, and Environment on the Guidelines, Procedures, Regulations, and Directions for Preparing Environmental Impact Assessment Reports According to the National Environmental Quality Promotion and Conservation Act, B.E. 2535 (1992)

Activity	Applicable Laws
	6.12. Ministerial Regulation No. 2, B.E. 2535 (1992), issued under the Factory Act, B.E. 2535 (1992) 6.13. Notification of the Ministry of Industry on the Types and Sizes of Factories Engaged in Service Industries or Providing Services to the Community, B.E. 2545 (2002) 6.14. Notification of the Ministry of Industry on the Types and Sizes of Factories, Methods for Controlling Waste and Pollution Discharge, and Qualifications for Supervisors and Operators for Environmental Protection Systems, B.E. 2545 (2002) and Amendment No. 2, B.E. 2554 (2011) 6.15. Notification of the Department of Industrial Works on the Qualifications for Training and Examination of Environmental Personnel in Factories, B.E. 2554 (2011) 6.16. Notification of the Department of Industrial Works on the Registration of Personnel for Managing Water Pollution Treatment Systems, Air Pollution Treatment Systems, or Industrial Waste Pollution Management Systems, B.E. 2556 (2013) 6.17. Notification of the Department of Industrial Works on Reporting and Acknowledgment of Environmental Personnel in Factories, B.E. 2556 (2013) 7. Hazardous Substances Act B.E. 2535 and its Amendments 8. Machine Registration Act B.E. 2514 8.1. Ministerial Regulation No. 1 and No. 2 (B.E. 2514) Issued under the Machine Registration Act B.E. 2514 8.2. Ministerial Regulation on the Guidelines, Procedures, and Conditions for Machine Trial Runs B.E. 2553 8.3. Ministerial Regulation on Fees Related to Machine Registration B.E. 2560
12. **Construction, extension, upgrade,**	1. The Enhancement and Conservation of National Environment Quality Act, B.E.2535 (1992) and (No. 2) B.E. 2561 (2018)

Activity	Applicable Laws
and operation of centralised wastewater collection and treatment	1.1. Notification of the Ministry of Natural Resources and Environment, Establishment of controlling standards for wastewater from industrial factories, industrial estates and industrial zones, B.E. 2559 (2016). 1.2. Notification of the Ministry of Natural Resources and Environment Prescribing Standards for Controlling Air Emissions from factory 1.3. Notification of the Ministry of Natural Resources and Environment on Descriptions of Factory Types and Sizes of Industrial Factories as Pollution Sources Subject to Odor Intensity Control for Air Emissions 1.4. Notification of the Ministry of Natural Resources and Environment Prescribing Standards for Controlling Odor Intensity Emission from Pollution Sources 2. Public Health Act, B.E. 2535 (1992) 2.1. Notification of the Ministry of Public Health on Activities Hazardous to Health, B.E. 2558 (2015) 2.2. Ministerial Regulation of the Ministry of Public Health on the Joint Management of Infectious Waste Between Local Governments and Other Government Agencies, B.E. 2564 (2021) 2.3. Ministerial Regulation of the Ministry of Public Health on the Disposal of Infectious Waste (No. 2), B.E. 2564 (2021) 2.4. Ministerial Regulation of the Ministry of Public Health on Sanitation in General Waste Management, B.E. 2560 (2017) 2.5. Notification of the Ministry of Public Health on Measures to Control the Transportation of Infectious Waste to Prevent Illegal Dumping of Infectious Waste, B.E. 2565 (2022) 3. Act on the Maintenance of the Cleanliness and Orderliness of the Country, B.E. 2535 (1992), and Amendment (No. 2), B.E. 2560 (2017)

Activity	Applicable Laws
	4. Fertiliser Act, B.E. 2518 (1975) and its Amendments 4.1. Ministerial Regulation on Fees for Fertiliser-related Business Operations, B.E. 2554 (2011) 4.2. Notification of Ministry of Agriculture and Cooperatives on Standardised Chemical Fertilisers, B.E. 2559 (2016) 4.3. Notification of Ministry of Agriculture and Cooperatives on the Required Organic Matter Content in Organic Chemical Fertilisers under the Fertiliser Act, B.E. 2518 (1975), as amended by the Fertiliser Act (No. 2), B.E. 2550 (2007), B.E. 2554 (2011) 4.4. Notification of Department of Agriculture on Criteria and Methods for Sampling Fertilisers or Suspected Fertilisers in Reasonable Quantities for Inspection or Analysis (No. 2), B.E. 2557 (2014) 4.5. Notification of Department of Agriculture on Organic Fertiliser Standards, B.E. 2557 (2014) 5. Town Planning Act, B.E. 2562 (2019) 6. Factory Act, B.E. 2535 (1992) 6.1. Notification of the Ministry of Industry on the Requirement for Factories to Install Equipment or Special Devices to Report Air Pollution from Factory Chimneys, B.E. 2565 (2022), dated April 1, 2022 6.2. Notification of the Ministry of Industry on the Types and Sizes of Factories, Methods for Controlling Waste, Pollution, or Any Environmental Impact, and the Qualifications of Supervisors and Operators, as well as the Registration Criteria for Supervisors of Environmental Protection Systems, B.E. 2545 (2002), dated April 5, 2002 6.3. Notification of the Ministry of Industry on the Amount of Contaminants in Air Discharged from Chimneys from Waste

Activity	Applicable Laws
	or Hazardous Materials in Industrial Operations, B.E. 2545(2002), dated October 2, 2002 6.4. Notification of the Ministry of Industry on the Amount of Contaminants in Air Discharged from Factories, B.E. 2549 (2006), dated October 31, 2006 6.5. Notification of the Ministry of Industry on the Types and Sizes of Factories, Methods for Controlling Waste, Pollution, or Any Environmental Impact, and the Qualifications of Supervisors and Operators, as well as the Registration Criteria for Supervisors of Environmental Protection Systems (No. 2), B.E. 2554 (2011), dated January 31, 2012 6.6. Notification of the Ministry of Industry on the Standards for Controlling the Discharge of Wastewater from Factories, B.E. 2560 (2017), dated June 7, 2017 6.7. Ministerial Regulation of the Ministry of Industry on the Control of Soil and Groundwater Contamination within Factory Areas, B.E. 2559 (2016) 6.8. Notification of the Ministry of Industry on the Management of Waste and Materials That Are No Longer Used, B.E. 2566 (2023) 6.9. Notification of the Ministry of Industry on the Management of Waste and Materials That Are No Longer Used (No. 2), B.E. 2566 (2023), dated August 15, 2023 6.10. Notification of the Department of Industrial Works on the Types and Sizes of Factories Required to Report the Types and Quantities of Pollutants Discharged from Factories, B.E. 2553 (2010) 6.11. Notification of the Ministry of Science, Technology, and Environment on the Guidelines, Procedures, Regulations, and Directions for Preparing Environmental Impact Assessment Reports According to the National

Activity	Applicable Laws
	Environmental Quality Promotion and Conservation Act, B.E. 2535 (1992) 6.12. Ministerial Regulation No. 2, B.E. 2535 (1992), issued under the Factory Act, B.E. 2535 (1992) 6.13. Notification of the Ministry of Industry on the Types and Sizes of Factories Engaged in Service Industries or Providing Services to the Community, B.E. 2545 (2002) 6.14. Notification of the Ministry of Industry on the Types and Sizes of Factories, Methods for Controlling Waste, Pollution, or Any Environmental Impact, and the Qualifications of Supervisors and Operators, as well as the Registration Criteria for Supervisors of Environmental Protection Systems, B.E. 2545 (2002) and Amendment No. 2, B.E. 2554 (2011) 6.15. Notification of the Department of Industrial Works on the Qualifications for Training and Examination of Environmental Personnel in Factories, B.E. 2554 (2011) 6.16. Notification of the Department of Industrial Works on the Registration of Personnel for Managing Water Pollution Treatment Systems, Air Pollution Treatment Systems, or Industrial Waste Pollution Management Systems, B.E. 2556 (2013) 6.17. Notification of the Department of Industrial Works on Reporting and Acknowledgment of Environmental Personnel in Factories, B.E. 2556 (2013) 7. Hazardous Substances Act B.E. 2535 and its Amendments 8. Machine Registration Act B.E. 2514 8.1. Ministerial Regulation No. 1 and No. 2 (B.E. 2514) Issued under the Machine Registration Act B.E. 2514 8.2. Ministerial Regulation on the Guidelines, Procedures, and Conditions for Machine Trial Runs B.E. 2553

Activity	Applicable Laws
	8.3. Ministerial Regulation on Fees Related to Machine Registration B.E. 2560
13. **Renewal of centralised wastewater collection and treatment**	Similar to the activity above

Annex III Thailand Taxonomy Waste Management Activities – interoperability with other Taxonomies

A summary of the list of EU Taxonomy economic activities, which have been adjusted to Thai context, is provided below.

Comparison of EUT and SGT Activities with proposed Thailand Taxonomy Activities[13]

ISIC	European Union (EU) Taxonomy	Singapore Taxonomy (SGT)[14]	Thailand Taxonomy
3821	*Anaerobic digestion of bio-waste* https://ec.europa.eu/sustainable-finance-taxonomy/activities/activity/324/view *(EO1, EO2)*	8.3 Biowaste treatment: anaerobic digestion (EO1)	Adopted as '1. Anaerobic digestion of bio-waste or wastewater' (EO1). Energy recovery contributes to EO1 due to methane avoided from landfill diversion.
370	*Anaerobic digestion of sewage sludge* https://ec.europa.eu/sustainable-finance-taxonomy/activities/activity/323/view *(EO1, EO2)*		Merged into to '1. Anaerobic digestion of bio-waste or wastewater' (EO1). Energy recovery contributes to EO1 due to methane avoided from landfill diversion.
3821	*Composting of bio-waste* https://ec.europa.eu/sustainable-finance-taxonomy/activities/activity/325/view *(EO1, EO2)*	8.2 Biowaste treatment: composting of biowaste (EO1)	Adopted as 2. Composting of bio-waste (EO4)
3821	*Recovery of bio-waste by anaerobic digestion or composting* https://ec.europa.eu/sustainable-finance-taxonomy/activities/activity/393/view *(EO4)*	n/a	Split into '1 Anaerobic digestion of bio-waste or wastewater' (EO4) and '2 Composting of bio-waste' (EO4) for consistency in activity categorization.

[13] Environmental Objectives (EO) codes have the meaning defined in the Thailand Taxonomy.

[14] As of the date of this document, SGT only includes EO1 activities.

ISIC	European Union (EU) Taxonomy	Singapore Taxonomy (SGT)[14]	Thailand Taxonomy
3812	*Collection and transport of hazardous waste* *https://ec.europa.eu/sustainable-finance-taxonomy/activities/activity/408/view (EO5)*	n/a	Merged to '3 Collection and transport of waste' (EO4, EO5) due to similarity of activities
3811, 3812	*Collection and transport of non-hazardous and hazardous waste* *https://ec.europa.eu/sustainable-finance-taxonomy/activities/activity/391/view (EO4)*	n/a	
3811, 3812	*(Demolition Waste Collection and Transport included within EUT Construction & Real Estate Sector)* *https://ec.europa.eu/sustainable-finance-taxonomy/activities/activity/396/view (EO4)*	n/a	
3811	*Collection and transport of non-hazardous waste in source segregated fractions* *https://ec.europa.eu/sustainable-finance-taxonomy/activities/activity/322/view (EO1, EO2)*	8.1 Collection and transport of non-hazardous waste (EO1)	
383	*Depollution and dismantling of end-of-life products* *https://ec.europa.eu/sustainable-finance-taxonomy/activities/activity/394/view (EO4)*	n/a	Adopted as '4. Depollution and dismantling of end-of-life products' (EO4)

ISIC	European Union (EU) Taxonomy	Singapore Taxonomy (SGT)[14]	Thailand Taxonomy
3821, 3822	*(Not recognised by EUT)*	8.4. Waste to Energy (Incineration) (EO1)	(NEW) '5. Waste to Energy' (EO1) added due to economic and environmental importance
3821	*Landfill gas capture and utilisation https://ec.europa.eu/sustainable-finance-taxonomy/activities/activity/327/view (EO1, EO2)*	8.5. Landfill gas capture and utilisation (EO1)	Adopted as '6. Landfill gas capture and utilisation' (EO1)
390, 3320, 431, 711	*Remediation of contaminated sites and areas https://ec.europa.eu/sustainable-finance-taxonomy/activities/activity/410/view (EO5)*	n/a	Adopted as '7. Remediation of contaminated sites and areas' (EO5)
390, 382, 3830	*Remediation of legally non-conforming landfills and abandoned or illegal waste dumps https://ec.europa.eu/sustainable-finance-taxonomy/activities/activity/409/view (EO5)*	n/a	Adopted as '8. Remediation of legally non-conforming landfills and abandoned or illegal waste dumps' (EO5)
3830	*Material recovery from non-hazardous waste https://ec.europa.eu/sustainable-finance-taxonomy/activities/activity/326/view (EO1, EO2)*	8.6 Material recovery facilities	Merged to '9. Sorting and material recovery from non-hazardous waste' (EO4) due to similarity of activities

ISIC	European Union (EU) Taxonomy	Singapore Taxonomy (SGT)[14]	Thailand Taxonomy
3830	*Sorting and material recovery of non-hazardous waste* *https://ec.europa.eu/sustainable-finance-taxonomy/activities/activity/395/view (EO4)*	n/a	
3822	*Treatment of hazardous waste* *https://ec.europa.eu/sustainable-finance-taxonomy/activities/activity/392/view (EO4, EO5)*	n/a	Adopted as '10. Treatment of hazardous waste' (EO4, EO5)
3700	*Urban Wastewater Treatment* *https://ec.europa.eu/sustainable-finance-taxonomy/activities/activity/383/view (EO3)*	n/a	Adapted to '11. Construction, extension, upgrade, operation and renewal of decentralised wastewater collection and treatment' (EO2, EO3) to meet the local context of wastewater infrastructure
3700	*Production of alternative water resources for purposes other than human consumption* *https://ec.europa.eu/sustainable-finance-taxonomy/activities/activity/390/view (EO4)*	n/a	Production of alternative water from wastewater was adapted to '11. Construction, extension, upgrade, operation and renewal of decentralised wastewater collection and treatment' (EO4). The rest of the scope (rain and storm water harvest) is set aside for 'Water' Working Group

ISIC	European Union (EU) Taxonomy	Singapore Taxonomy (SGT)[14]	Thailand Taxonomy
3700	*Construction, extension and operation of wastewater collection and treatment* https://ec.europa.eu/sustainable-finance-taxonomy/activities/activity/320/view *(EO1, EO2)*	9.6. Construction, extension and operation of wastewater collection and treatment (EO1)	Adapted to '12. Construction, extension, upgrade, and operation of centralised wastewater collection and treatment' (EO1, EO2) to meet the local context of wastewater infrastructure
3700	*Renewal of wastewater collection and treatment* https://ec.europa.eu/sustainable-finance-taxonomy/activities/activity/321/view *(EO1, EO2)*	9.7. Renewal of wastewater collection and treatment (EO1)	Adapted to '13. Renewal of centralised wastewater collection and treatment' (EO1, EO2) to meet the local context of wastewater infrastructure
3600	*Water supply* https://ec.europa.eu/sustainable-finance-taxonomy/activities/activity/382/view *(EO3)*	n/a	Set aside for 'Water' Working Group
3600	*Construction, extension and operation of water collection, treatment and supply systems.* https://ec.europa.eu/sustainable-finance-taxonomy/activities/activity/318/view *(EO1, EO2)*	9.1. Construction, extension and operation of new water collection and treatment systems (abstraction and treatment systems) (EO1)	Set aside for 'Water' Working Group
3600	*Desalination* https://ec.europa.eu/sustainable-finance-taxonomy/activities/activity/363/view *(EO2)*	9.5. Desalination Systems (EO1)	Excluded due to irrelevance to the context of Thailand
3600	*Renewal of water collection, treatment and supply systems* https://ec.europa.eu/sustain	9.3 Renewal of water collection, treatment and supply systems (abstraction and treatment systems) (EO1)	Set aside for 'Water' Working Group

ISIC	European Union (EU) Taxonomy	Singapore Taxonomy (SGT)[14]	Thailand Taxonomy
	able-finance-taxonomy/activities/activity/319/view (EO1, EO2)	9.4 Renewal of water collection, treatment and supply systems (distribution networks) (EO1)	
3600, 3700	*Sustainable urban drainage systems https://ec.europa.eu/sustainable-finance-taxonomy/activities/activity/384/view (EO3)*	n/a	Set aside for 'Water' Working Group
3830, 3700	*Phosphorus recovery from wastewater https://ec.europa.eu/sustainable-finance-taxonomy/activities/activity/389/view (EO4)*	n/a	Excluded due to irrelevance to the context of Thailand
390	*Underground permanent geological storage of CO2 https://ec.europa.eu/sustainable-finance-taxonomy/activities/activity/329/view (EO1, EO2)*	n/a	Excluded due to irrelevance to the context of Thailand
422	*Transport of CO2 https://ec.europa.eu/sustainable-finance-taxonomy/activities/activity/328/view (EO1, EO2)*	n/a	Excluded due to irrelevance to the context of Thailand

References

Ashijya Otwong, S. J. (2021). Legal obstacles for the circular economy in Thailand: Illegal dumping of recyclable hazardous industrial waste. *Journal of Clearner Production, 302*. Retrieved from https://www.sciencedirect.com/science/article/abs/pii/S0959652621011884

CBI. (2022, August). *Waste Management Criteria.* Retrieved from Climate Bonds Initiative: https://www.climatebonds.net/standard/waste

DLT. (2024). *Land Transportation Statistics 2019-2023.* Retrieved from Department of Land Transport: https://web.dlt.go.th/statistics/

EPPO. (2016, March 28). *Thailand Power Development Plan.* Retrieved from Energy Policy and Planning Office, Ministry of Energy: https://www.eppo.go.th/index.php/en/policy-and-plan/en-tieb/tieb-pdp

EU. (2024, March 14). *Supply, sewerage, waste management and remediation*. Retrieved from EU Taxonomy Navigator: https://ec.europa.eu/sustainable-finance-taxonomy/sectors/sector/5/view

IPCC. (2021, August). *AR6 WG1 Report - List of corrigenda to be implemented.* Retrieved April 20, 2024, from IPCC: https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Chapter_07_Supplementary_Material.pdf

IQAir. (2020, July 10). *The real cost of air pollution*. Retrieved from IQAir: https://www.iqair.com/th-en/newsroom/cost-of-air-pollution

IQAir. (2024, April 30). *Air quality in Thailand*. Retrieved from IQAir: https://www.iqair.com/thailand

Khaosod. (2022, February 5). *ปทส.เปิดปฏิบัติการ "SHUT DOWN! บ่อขยะเถื่อนทั่วกรุง" ผงะเจอทำมา 7 ปี... อ่านข่าวต้นฉบับได้ที่ : https://www.khaosod.co.th/crime/news_6873279*. Retrieved from Khaosod: https://www.khaosod.co.th/crime/news_6873279

Kittithammavong, V., Khanitchaidecha, W., & Thongsanit, P. (2023). CO2 Emissions from Plastic Consumption Behaviors in Thailand. *Sustainability 15(16):12135*, 15. Retrieved from https://www.researchgate.net/publication/373002072_CO2_Emissions_from_Plastic_Consumption_Behaviors_in_Thailand

Makavou, K. (2021, May 26). *The EU is clear: Waste-to-Energy incineration has no place in the sustainability agenda.* Retrieved from Zero Waste Europe: https://zerowasteeurope.eu/2021/05/wte-incineration-no-place-sustainability-agenda/

MAS. (2023, December 03). *MAS Launches World's First Multi-Sector Transition Taxonomy*. Retrieved from Monetary Authority of Singapore: https://www.mas.gov.sg/news/media-releases/2023/mas-launches-worlds-first-multi-sector-transition-taxonomy

MONRE. (2022, November). *Long-Term Low GHG Development Strategy (Revised).* Retrieved from UNFCCC: https://unfccc.int/documents/622276

MONRE. (2024, December 26). *Thailand. 2024 Biennial Transparency Report (BTR). BTR1.* Retrieved from UNFCCC: https://unfccc.int/documents/645098

Otwong, A., Jongmeewasin, S., & Phenrat, T. (2021). Legal obstacles for the circular economy in Thailand: Illegal dumping of recyclable hazardous industrial waste. *Journal of Cleaner Production, 302*. Retrieved from https://www.sciencedirect.com/science/article/abs/pii/S0959652621011884

PCD. (2017). *Domestic Wastewater Guidance.* Retrieved from https://www.pcd.go.th/publication/4241/

PCD. (2021, July 19). *WEE Integrated Action Plan 2022-2026 Draft.* Retrieved from PCD: https://www.pcd.go.th/wp-content/uploads/2021/07/pcdnew-2021-07-19_06-41-36_736367.pdf

PCD. (2022a, n/a n/a). *คู่มือปฏิบัติการในการป้องกันและแก้ไขปัญหาฝุ่นละออง PM 2.5 ระดับจังหวัด.* Retrieved from PCD: http://air4thai.com/tagoV2/tago_file/books/book_file/a2af0da186e2165546c0d9a845a19d5c.pdf

PCD. (2022b, August 06). *PRESS: Ministry of Natural Resources and Environment, Pollution Control Department.* Retrieved from PCD: https://www.pcd.go.th/wp-content/uploads/2022/08/pcdnew-2022-08-29_03-50-13_431030.pdf

PCD. (2023, December). *Waste Water Treatment Target Manual 2018 - 2037.* Retrieved from PCD: https://www.pcd.go.th/waters/%e0%b8%84%e0%b8%b9%e0%b9%88%e0%b8%a1%e0%b8%b7%e0%b8%ad%e0%b8%9e%e0%b8%b7%e0%b9%89%e0%b8%99%e0%b8%97%e0%b8%b5%e0%b9%88%e0%b9%80%e0%b8%9b%e0%b9%89%e0%b8%b2%e0%b8%ab%e0%b8%a1%e0%b8%b2%e0%b8%a2%e0%b9%83%e0%b8%99%e0%b8%81%e0%b8%b2%

PCD. (2023a, January 27). *Action Plan on Plastic Waste Management Phase II (2023-2027).* Retrieved from Pollution Control Department: https://www.pcd.go.th/publication/28484

PCD. (2023b, February 16). *National Waste Management Master Plan 2022 - 2027.* Retrieved from Pollution Control Department: https://www.pcd.go.th/publication/28745

PCD. (2023c, February 17). *The national GHG Reduction Action Plan 2021-2030 for the Waste Management Sector.* Retrieved from MONRE: https://hub.mnre.go.th/th/knowledge/detail/63133

PCD. (2023d, May 12). *2022 Municipal Hazardous Waste Situation Report.* Retrieved from PCD: https://www.pcd.go.th/publication/29745

PCD. (2024a, January). *2023 - 2030 Food Waste Management Roadmap and Phase 1 Food Waste Management Implementation Plan.* Retrieved from MNRE: https://hub.mnre.go.th/th/knowledge/detail/65633

PCD. (2024b, June). *Thailand State of Pollution Report 2023.* Retrieved from PCD: https://www.pcd.go.th/publication/32171/

PCD. (2025, March 12). *DSPOT.* Retrieved from PCD 02-231 Book2/3 Community Wastewater and Sludge Utilization Measures and Strategies: https://dspot.pcd.go.th/statistics/publish_document

Rujivanarom, P. (2023, April 2). *Waste plants cause stink*. Retrieved from Bangkok Post: https://www.bangkokpost.com/thailand/general/2541294/waste-plants-cause-stink

TEI. (2022, January). *Management and Reduction of Burning Practice in Agricultural Areas and Policy Recommendations to tackle PM 2.5 in Thailand.* Retrieved from TEI: https://www.tei.or.th/file/library/2022-ABM-ENG_76.pdf

Wachpanich, N., & Coca, N. (2022, December 8). *As waste-to-energy incinerators spread in Southeast Asia, so do concerns*. Retrieved from Mongabay: https://news.mongabay.com/2022/12/as-waste-to-energy-incinerators-spread-in-southeast-asia-so-do-concerns/

World Bank Group. (2021, February 10). *Market Study for Thailand: Plastics Circularity Opportunities and Barriers.* Retrieved from World Bank Group: https://www.worldbank.org/en/country/thailand/publication/market-study-for-thailand-plastics-circularity-opportunities-and-barriers

THAILAND TAXONOMY

Annex

May 2025

THAILAND TAXONOMY BOARD

Contents

Annex I: General guidance on taxonomy application

This section contains general descriptions of Taxonomy's operating principles and key concepts found throughout the text that are relevant to financial flows. This section does not in any way constitute an instruction for the use of the Taxonomy in Thailand as the actual procedure of its implementation should be determined by relevant regulators.

Please remember that taxonomies of this type as a tool were created for use in the financial market, so many verification processes are tied to financial instruments and their operating principles. For the application of the Taxonomy in other areas, additional clarifications are required and should be provided by the relevant regulator.

Key taxonomy definitions

1. What is revenue?

Revenue or net turnover means the amounts derived from the sale of products and the provision of services after deducting sales rebates and value added tax and other taxes directly linked to turnover. Overall turnover is equivalent to a firm's total revenues over a defined period. Turnover ratios are used by financial analysts to assess a company's efficiency and profitability based on data found in financial statements.

2. What is CapEx?

Capital expenditure (CapEx) is a payment for goods or services recorded or capitalised on the balance sheet instead of expensed on the income statement. Use: Aside from helping investors analyse a company's investment in its existing and new fixed assets, capital expenditures can give an indication of a company's strategy for improving environmental performance and resilience.

3. What is OpEx?

Operating expenses (OpEx) are shorter-term expenses required to meet the ongoing operational costs of running a business. While revenue is an indicator of ongoing operations and activities and is the primary indicator for alignment, where new investment is being made in technology to better align an issuer, then CapEx would be a more appropriate indicator. The use of revenue, CapEx, or OpEx is dependent on the vehicle being financed. In particular,

where capital is being extended to fund a particular activity or project, then CapEx would be more appropriate.

4. **What is an activity?**

When a company offers goods or services, it is performing an economic activity. The universe of economic activities is described using ISIC codes, which cover 21 broad sectors and with four further levels of differentiation. At the fourth level, 615 classes of economic activity are identified. The ISIC codes map directly to the EU's NACE classification system.

5. **What is a project?**

A project is an individual or collaborative enterprise that is planned to achieve a particular aim. For the purpose of Thailand Taxonomy, a project is a timebound activity or a set of activities that is intended to achieve a desired outcome, usually transforming the activity from not aligned with the Taxonomy into aligned with the Taxonomy.

How is activities' alignment aggregated to the company/issuer level?

At the issuer level, net turnover from aligned activities needs to be aggregated to determine an entity's degree of alignment with the Taxonomy. For example, one activity representing 45% and another representing 15% of issuer/company revenue may be aligned, but an activity representing 40% of revenue may not. In this case, an issuer/company would be determined as having 60% revenue alignment. For projects following completion, the company can claim 100% of the turnover associated with the project as being aligned with the Taxonomy if it meets the technical screening criteria for Green or Amber. During the project timeframe, it is only the project itself that is considered to be aligned with the Taxonomy, so the turnover associated with the project cannot be classed as aligned until completion.

How to define if different entities and forms of action are aligned with the Taxonomy

- An **activity** (e.g., production of steel or zero-emission vehicles) may be considered aligned with the Taxonomy if
    - If it meets the Technical Screening Criteria and related thresholds defined by the Taxonomy (green or amber category. Renewable Energy Certificates may be employed when operators are unable to supply renewable energy, provided that

these align with the green categories defined by the Thailand Taxonomy. Exceptions apply to certain activities where specific using of such certificates is prohibited.

- None of the **company** operations violate DNSH and MSS requirements, or the company has stated that, at present, some of the DNSH or MSS requirements are not fulfilled, but it has published a plan to remediate these deficiencies within three years.

- A **project** (e.g., retrofitting of the steel factory or construction of the solar power plant) may be considered aligned with the Taxonomy if
  - **All** major measures of the **project** (not counting supporting activities like accounting) are aligned with either green or amber criteria of one of the activity cards. For example, a power plant that is retrofitting scrubbers or installing carbon capture and storage technology.
  - **The project** meets the DNSH and MSS requirements.
- **Non-financial companies** may disclose the proportion of their economic activities that align with the Taxonomy criteria. The translation of environmental performance into financial indicators (revenue/turnover, CapEx and OpEx) allows investors and financial institutions to have clear and comparable data to help them with their investment and financing decisions. The main reporting options for non-financial companies would be:
  - Taxonomy-aligned **revenues** represent the proportion of the net turnover derived from products or services that are from activities that are aligned with the Green or Amber technical screening criteria for at least one of the six environmental objectives of the Taxonomy.
  - Taxonomy-aligned **CapEx** represents the proportion of the capital expenditure of an activity that is Taxonomy-aligned or is part of a credible plan to extend or reach Taxonomy alignment.
  - Taxonomy-aligned **OpEx** represents the proportion of the operating expenditure associated with taxonomy-aligned activities or the CapEx plan. The operating expenditure covers direct non-capitalised costs relating to research and development, renovation measures, short-term lease, maintenance, and other direct expenditures relating to the day-to-day servicing of assets of property, plant and

equipment that are necessary to ensure the continued and effective use of such assets.

- The process below can be followed by financial institutions that wish to calculate the alignment of their **portfolio against the Taxonomy:** ,:
  - After constructing a portfolio of investments, financial institutions should check the alignment of individual companies with different categories of Taxonomy and then construct a weighted average for each category (green, amber, and red). Portfolios with a green or amber alignment greater than 75%[1] would be permitted to identify as a "green" or "transitional" product.
  - For **equity** investments, company revenue is used as the main proxy for equity exposure to Taxonomy-aligned economic activities. In order to calculate total portfolio alignment, the calculation is the weight of the asset within the portfolio multiplied by the proportion of the company revenue, which is eligible and aligned with each Taxonomy alignment classification (Green, Amber, and Red) for inclusion under the Taxonomy.
- For **corporate debt and/or bonds** which are being used to fund Taxonomy-aligned projects, then 100% of the investment can be classed as Taxonomy-aligned where it commits to meeting the technical screening criteria for the environmental objective at the maturity of the project.
- In order to check the alignment of **debt** or **equity**:
  - **Equity investments**. For equity investments, company revenue is used as the main proxy for equity exposure to Taxonomy-aligned economic activities.
  - **Debt capital**. The approach for general debt capital is broadly the same as for equity investments, with revenue being used as a proxy for portfolio exposure to Taxonomy-aligned economic activities, where appropriate. For corporate debt and/or bonds which are being used to fund Taxonomy-aligned projects, then 100% of the investment can be classed as Taxonomy-aligned, where it commits to meeting the technical screening criteria for the environmental objective at the maturity of the project.

Annex II: Activities contribution to the objectives of the Taxonomy

The main environmental objective of the Taxonomy is climate change mitigation (reducing emissions leading to global warming). This is the only task that is well developed in global climate science in terms of technologies to achieve it. However, many of the activities included in the Taxonomy also contribute to other objectives. This table will help users to better navigate this area. It is based on the work[1] of the European Union on defining the contribution of different economic activities to different environmental objectives. In case if there was no guidance on this (for example, in case of agricultural section) – the final decision was made based on the own analysis of the consultants' team.

Important note: this table is only indicative and cannot be used as a basis for financial decisions.

[1] The European Commission [EU], "Commission Delegated Regulation (EU) 2023/2486," Official Journal of the European Union, September 21, 2023, https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:L_202302486.

	Climate change mitigation	Climate change adaptation	Sustainable use and protection of marine and water resources	Resource resilience and transition to a circular economy	Pollution prevention and control	Protection and restoration of biodiversity and ecosystems
Energy sector						
Solar energy generation						
Wind energy generation						
Hydropower generation						
Geothermal power generation						
Bioenergy generation and production						
Energy production from natural gas						
Marine energy generation						
Electricity generation from renewable non-fossil gaseous and liquid fuels, including green hydrogen						
Cogeneration of heating/cooling and power using renewable sources of energy						
Production of heating and cooling using waste heat						

	Climate change mitigation	Climate change adaptation	Sustainable use and protection of marine and water resources	Resource resilience and transition to a circular economy	Pollution prevention and control	Protection and restoration of biodiversity and ecosystems
Installation and operation of electric heat pumps						
Heating and cooling distribution						
Transmission and distribution networks for renewable and low-carbon gases, including green hydrogen						
Storage of electricity, thermal energy and green hydrogen						
Transmission and distribution of electricity						
Transportation sector						
Transport via railways						
Other passenger land transport						
Urban and suburban passenger land transport						
Freight transport by road						
Enabling infrastructure for low-emission transport						

	Climate change mitigation	Climate change adaptation	Sustainable use and protection of marine and water resources	Resource resilience and transition to a circular economy	Pollution prevention and control	Protection and restoration of biodiversity and ecosystems
Sea and coastal water transport						
Inland water transport						
Passenger and freight transport by air						
Agriculture sector						
Growing of perennial and non-perennial crops, incl. cassava, corn, mango, pineapples, banana etc.[2]						
Cultivation of sugarcane						
Cultivation of rice						
Cultivation of rubber trees						
Cultivation of palm oil trees						
Livestock production						
Aquaculture production						
Sustainable forest management						

[2] For agricultural activities contribution means that at least one practice suggested for implementation under the agricultural criteria can contribute to each of the objectives in the taxonomy.

	Climate change mitigation	Climate change adaptation	Sustainable use and protection of marine and water resources	Resource resilience and transition to a circular economy	Pollution prevention and control	Protection and restoration of biodiversity and ecosystems
Forestry plantation						
Conservation, restoration, and maintenance of natural forests						
Construction and real estate sector						
Construction of new buildings						
Renovation of the existing buildings						
Acquisition or ownership of buildings						
Installation, maintenance, and repair of special-purpose building equipment						
Building demolition and site preparation						
Early Warning Systems						
Manufacturing sector						
Manufacturing of cement						
Manufacturing of aluminium						
Manufacturing of iron and steel						

	Climate change mitigation	Climate change adaptation	Sustainable use and protection of marine and water resources	Resource resilience and transition to a circular economy	Pollution prevention and control	Protection and restoration of biodiversity and ecosystems
Manufacturing of hydrogen						
Manufacturing of basic chemicals						
Manufacturing of plastics in primary form						
Manufacturing of batteries						
Manufacturing of renewable energy technologies and products						
Manufacture of low-carbon technologies for transport						
Manufacturing of energy efficiency equipment for buildings						
Manufacturing of other low-carbon technologies						
Capture of CO2						
Transportation of CO2						
Storage of CO2						

	Climate change mitigation	Climate change adaptation	Sustainable use and protection of marine and water resources	Resource resilience and transition to a circular economy	Pollution prevention and control	Protection and restoration of biodiversity and ecosystems
Utilisation of captures CO2						
Introduction of energy efficiency and decarbonisation measures in manufacturing activities not specified in the Thailand Taxonomy						
Waste management sector						
Anaerobic digestion of sewage sludge						
Anaerobic digestion or composting of bio-waste						
Collection and transport of waste						
Depollution and dismantling of end-of-life products						
Waste to Energy						

	Climate change mitigation	Climate change adaptation	Sustainable use and protection of marine and water resources	Resource resilience and transition to a circular economy	Pollution prevention and control	Protection and restoration of biodiversity and ecosystems
Landfill gas capture and utilisation						
Remediation of contaminated sites and areas						
Remediation of legally n-conforming landfills and abandoned or illegal waste dumps						
Sorting and material recovery from n-hazardous waste						
Treatment of hazardous waste						
Construction, extension, upgrade, operation and renewal of urban wastewater collection and treatment						
Construction, extension, upgrade and operation of centralised wastewater collection and treatment						

	Climate change mitigation	Climate change adaptation	Sustainable use and protection of marine and water resources	Resource resilience and transition to a circular economy	Pollution prevention and control	Protection and restoration of biodiversity and ecosystems
Renewal of centralised wastewater collection and treatment						
Phosphorus recovery from wastewater						

Annex III: Guidance on performing a Climate Risk and Vulnerability Assessment (CRVA)

This annex encompasses CRVA to be considered under the climate change adaptation, as and when activities undergo an assessment for substantial contribution to the objective or do-no-significant-harm to the objective.

The guidance is based on guidance prepared by the German Environment Agency [3]for performing a taxonomy compliant CRVA[4], based on the principles and framework of ISO 14091.

Table 1 Terminology to be used under CRVA[5]

Terminology	Context
Climate-related hazard	The potential occurrence of natural or human-induced physical events and changes which stem from changes to the climate caused by anthropogenic GHG emissions. Potential climate-related hazards are listed under Table below.
Vulnerability	Encompasses or susceptibility to harm and lack of capacity to cope and adapt.
Risk	Under this context, the potential impacts as a result of exposure to hazards and level of vulnerability to specific climate-related hazards.
Physical Climate Risk	A physical climate risk can occur to any Activity (or system), where the Activity is exposed to and sensitive to a climate-related hazard. For example, "potential flooding damage to buildings or infrastructure."

Application of a CRVA

For an activity to demonstrate that it meets the criteria for contribution to the objective or do-no-significant-harm to the objective the following must be considered:

[3] German Environment Agency. How to perform a robust CRVA for EU Taxonomy reporting? Recommendations for Companies. November 2022

[4] The EU Taxonomy refers to a CRVA as a method for identifying material impacts to the Activity, in line with both chronic and acute climate-related disasters

[5] The definitions are adapted and derived from the relevant climate adaptation sections of the IPCC AR6 and ISO 14090.

1. Physical climate risks that are material to the activity must be identified from those listed in Table 2. This includes the following steps:
    I. Screening of the Activity to identify which physical climate risks from the list in Table 1 may affect the performance of the activity during its expected lifetime;
    II. Where the activity screened is likely to be at risk from one or more of the physical climate risks in Table 2, conduct a risk assessment in line with CRVA check list (see the template after Table 2 to assess the significance of the physical climate risks on the activity; and
    III. Assess and prioritise adaptation solutions that can reduce the identified physical climate risk.
2. Risk assessment must be proportionate to the scale of the activity and its expected lifespan, such that:
    I. For activities with a lifespan of less than 10 years, the assessment is performed, at least by using climate projections at the smallest appropriate scale, which may include extrapolated past trends data;
    II. For all other activities, the assessment is performed using the highest available resolution, state-of-the art climate projections across the existing range of future scenarios[6] consistent with the expected lifetime of the activity, including at least, 10-to-30-year climate projections scenarios for major investments.

The climate projections and assessment of impacts are based on best practice and available guidance, issued by international bodies, national or regional authorities, standardisation bodies and other sources of equivalent trustworthiness and consider the state-of-the-art science for vulnerability and risk analysis and related methodologies in line with the most

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

recent Intergovernmental Panel on Climate Change reports[7], scientific peer-reviewed publications, and open source[8] or paying models.

For existing and new activities using existing physical assets, physical and non-physical solutions ('adaptation solutions') must be identified, assessed, prioritised. An adaptation plan for the implementation of those solutions is to be drawn up accordingly. This implementation plan must cover a timeframe of up to five years and reduce the most important identified physical climate risks that are material to that activity.

For new and existing activities using newly built physical assets, the Activity must integrate 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 implement them before the start of operations.

Guidance on conducting a CRVA

In general, there are four main steps that should be included as part of a CRVA:

Step 1: Identify the lifespan of the activity under assessment, and identify the specific components (i.e., factors, processes, materials, etc., of the activity) that would require an investigation under a risk assessment.

Step 2: Screening of climate-related hazards from Table 2 and identify those with most potential risks to the activity and/or objects under assessment.

Step 3: Conduct the risk assessment. For current potential risks, it is recommended to use past climate trends and climate projections based on these trends. For future potential risks, it is recommended to use a range of climate projections based on future scenarios.

- For an activity with a lifespan of less than 10 years may use extrapolated past trends data assessment;

[7] 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, https://www.ipcc.ch/reports/.

[8] 5 Including, but not necessarily limited to the Copernicus Services managed by the European Commission.

- For an activity with a lifespan of more than 10 years, an assessment of both current and future risks based on modelled data is required.

Step 4: Identify adequate and effective adaptation solutions to reduce the risks that are material to the activity, including: o Identifying a range of possible solutions/measures; and o assessing the different solutions for their costs, benefits, effectiveness for reducing or eliminating the risk, the adaptation efforts, or the level of resilience.

Adaptation solutions must:

- Not adversely affect physical climate risks of other people, of nature, of cultural heritage, of assets and of other activities;
- Not result in any form of maladaptation, including solutions which will not achieve the intended objective or may result in unintended side effects;
- Be consistent with Thailand National Adaptation Plan;
- Must consider the use of nature-based solutions to the extent possible.

Proactive consultations on the proposed activity must be conducted. This ensures that adaptation solutions do not adversely affect the adaptation efforts or the level of resilience to physical climate risks of other stakeholders (directly impacted or interested persons). The consultation process should at least:

- Identify potentially impacted and/or interested persons, assets, heritage, etc.; and
- Communicate, consult, and/or provide for the participation of these persons/institutions ensuring that their concerns, desires, expectations, needs, rights, and opportunities are considered.

In this way, the adaptation solutions will ensure that there are no negative impacts as a result of implementing the activity.

Table 2 Classification of climate-related hazards

	Temperature related	Wind related	Water related	Solid mass related
Chronic	- Changing temperature (air, freshwater, marine water) - Heat stress - Temperature variability	Changing wind patterns	- Changing precipitation patterns and type - Precipitation or hydrological variability - Ocean acidification - Saline intrusion - Sea level rise - Water stress	- Coastal erosion - Soil degradation - Soil erosion - Solifluction
Acute	- Heat wave - Wildfire	- Cyclone, hurricane, typhoons - Storms (including dust and sandstorms) - Tornadoes	- Drought - Heavy precipitation - Flood (coastal, fluvial, pluvial, ground water)	- Landslide - Subsidence

Template of CRVA checklist

An example of a climate risk and vulnerability checklist is shown in **Table 3**. This checklist can be used as a template for evidence to be provided to assessors that climate risk and vulnerability of an Activity has been considered.

Table 3 Template for CRVA checklist

Step	Item	Description	Explanation	Status
1A	Lifespan of the activity equipment and materials	Activity description	What is the proposed Activity?	
1B		Equipment and materials description	What equipment and materials will be used to perform this Activity	
1C		Activity start	When will the Activity start operations?	
1D		Activity end	When will the Activity cease operations (either through deterioration of components or reduced demand for Activity)?	
1E		Operational life >10 years?	Will the operational life of the Activity be more than 10 years?: • If no, conduct assessment using current IPCC climate scenarios and trends based on extrapolated current climate data. • If yes, conduct current and future assessment using both IPCC climate scenarios and trends.	
2A	Climate related hazards	Potential climate risks to the Activity	Identify and list potential risks to the Activity from Table 2, considering location of the Activity and applicable scenarios and trends as described in 1E	
2B		Evaluate most common potential risks	Consider the likelihood of the risk based on the location of the Activity.	

Step	Item	Description	Explanation	Status
3A	Risk assessment	Projection of climate hazards	If activity has operational life >10 years, what potential hazards may occur based on using both IPCC climate scenarios and trends?	
3B		Potential impact of climate related hazards	How could climate-related hazards could affect elements of the Activity? Direct impacts may not always occur; some may also be indirect (or impacts in succession). Where appropriate, use flowchart to map the anticipated risks and impacts from each identified climate-risk hazard.	
3C		Potential impact of climate related hazards	How could climate-related hazards could affect elements of the Activity? Direct impacts may not always occur; some may also be indirect (or impacts in succession). Where appropriate, use flowchart to map the anticipated risks and impacts from each identified climate-risk hazard.	
4A	Identify adequate and effective adaptation solutions	Adaptive solutions	List adequate and effective adaptation solutions under identified climate-related hazards	