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Sustainable finance taxonomies – Designed to support the transition to a net-zero economy?

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ABSTRACT

A growing number of sustainable finance taxonomies aim to redirect capital towards climate change mitigation. Yet achieving net zero requires not only financing green economic activities but also transitional economic activities – hence activities that currently lack viable low-carbon alternatives but are required for a low carbon economy. Using comparative policy analysis, this article seeks to understand how this is addressed across 45 taxonomies worldwide based on a systematic review across five criteria: policy embeddedness, sectoral emission coverage, screening approach, target group, as well as disclosure and reporting obligations. The results show that many taxonomies are well *embedded* in national and international environmental and sustainability policies. *Sectoral emissions coverage* varies considerably, but taxonomies are often introduced in phases, with additional sectors added later. Regarding the *screening approach*, most taxonomies define only green economic activities rather than endorsing transition activities. In some cases where transitional activities are included, technical screening criteria lack clear pathways to net zero. Taxonomies differ significantly in their *target groups* and in whether they are mandatory or voluntary. Most serve as voluntary guidance for a broad range of stakeholders. The majority of frameworks do not imply *disclosure and reporting requirements*. Though taxonomies are now a widespread policy instrument, they are not yet designed to fully support the transition to net zero. The results provide important insights for policy makers developing new taxonomies, integrating transitional aspects, or improving interoperability.

Key policy insights

- Policymakers now use sustainable finance taxonomies as a policy tool to support climate solutions and to enable the scaling of green activities.
- Transitional activities are either omitted or, if included, technical screening criteria often lack a clear pathway towards net zero.
- Best practices for integrating net-zero-aligned transitional activities require entities to use quantified interim targets, define sunset dates, or use science-based transition pathways, for example through credible transition plans.
- Harmonisation among taxonomies is happening, following the EU and ASEAN Taxonomy example.
- Policymakers should use current similarities between taxonomies as a starting point for setting minimum standards and strengthening the interoperability of taxonomies.

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1. Introduction

Achieving the goals of the Paris Agreement requires a fundamental reorientation of financial systems. Article 2.1(c) calls on governments to ‘make all finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development’, placing sustainable finance at the heart of climate policy (UNFCCC, 2015). To support this objective, governments, regulators, and international organizations have developed sustainable finance roadmaps and strategies. They combine a range of complementary policy instruments, including sustainability disclosure requirements, climate-related risk management, transition planning and green financial incentives. Within this broader policy architecture, sustainable finance taxonomies have emerged as a central governance instruments (Green & Reyes, 2023; Hale et al., 2022).

By establishing a common classification system for environmentally sustainable economic or green activities, taxonomies aim to provide transparency, consistency, and comparability and reduce greenwashing in financial markets (Ehlers et al., 2021; Spinaci, 2020). Rather than functioning as standalone classification systems, taxonomies increasingly serve as the foundation upon which disclosure frameworks, green bond standards, prudential regulation, public investment programmes, and financial incentives are built. They complement climate policy instruments such as carbon taxes, cap-and-trade, and feed-in-tariffs (Bhandary et al., 2021; Stern, 2022). Thus, a sustainable finance taxonomy (subsequently named ‘taxonomy’)¹ is one specific policy instrument within this wider architecture.

The development of taxonomies has accelerated markedly in recent years. In 2018, as one of the first movers, China released a taxonomy called the ‘Green Industry Guidance Catalogue’. It set out specific criteria for identifying industries and technologies that promote environmental sustainability (Zhang et al., 2022). Other jurisdictions and countries, like the EU and Malaysia, followed shortly thereafter. A particularly strong wave of taxonomies emerged between 2022 and 2025. By the end of September 2025, we identify about 89 countries or regions that have published, are in the process of developing, or are initiating their own country-specific taxonomy to establish clear definitions of sustainable activities or investments. This rapid proliferation has produced considerable diversity in taxonomy design and implementation, raising important questions about policy effectiveness, interoperability, and the evolution of sustainable finance governance.

Critiques argue that sustainable-finance regulation can impose welfare costs when better-targeted environmental policies exist (Fuest & Meier, 2023b) and that taxonomies as policy instruments focus on defining green activities and environmental risks with limited focus on explicit penalties for brown activities (Dziwok & Jäger, 2021). For the net zero objective specifically, a more fundamental concern is that a taxonomy promoting only already-green activities omits transition aspects. This would exclude important parts of the economy that must also be transformed to contribute to net-zero targets (Schütze & Stede, 2024). This points to the distinction between the concepts of sustainable and transition finance. Broadly speaking, in the context of mitigation, sustainable finance is concerned with channelling capital into activities that are already aligned with a low-carbon future. Complementary to this, transition finance focuses on reducing the carbon footprint of emission-intensive industries that are needed for the transition – both by funding the development and scaling of low-carbon solutions and by providing general-purpose financing conditioned on the achievement of predefined decarbonization targets or pathways (Tandon, 2021). Examples of such economic activities include the production of steel, cement, and organic chemicals, where deep decarbonization technologies have yet to reach commercial maturity. The design of the screening criteria when defining economic activities’ eligibility for inclusion in the taxonomy is decisive here. When criteria and emission-intensity thresholds to measure the taxonomy alignment are not strict enough, carbon lock-in effects could result, where fossil fuel-based infrastructure and high-emission technologies persist for several decades (Schütze & Stede, 2024; Zetzsche & Bodellini, 2023). Conversely, overly stringent criteria might only classify a few economic activities as green or sustainable, resulting in higher investment costs for the transition of emission-intensive industries. To ensure activities and companies in emission-intensive sectors are provided with capital when introducing technological changes and restructuring their business (Duteil, 2021b; Tandon, 2021), we consider it important to integrate them as ‘in transition’ or ‘transitional activities’ in a taxonomy. However, to avoid ‘transition-washing’, it is specified that these transitional activities must credibly contribute to climate change mitigation and achieve net-zero emissions in accordance with a Paris-aligned timeframe.

Despite the rapid proliferation of taxonomies, existing research remains both geographically narrow and largely silent on this design question. Studies concentrate on a small number of country cases, and, to the authors' knowledge, only Schütze and Stede (2024) systematically assess whether design elements such as technical screening criteria include transitional activities and are aligned with net zero –however, only for the EU. This article addresses both gaps by asking: to what extent are existing taxonomies designed to support the transition to a net-zero economy? Because a taxonomy can advance the transition only if several conditions hold jointly, the assessment is based on five criteria that together capture the instrument as a whole: whether it is anchored in net-zero policy objectives (policy embeddedness); covers the sectors that must decarbonize (sectoral emission coverage); defines alignment in a way that drives decarbonization rather than locking in emissions (screening approach); applies to the actors and financial products that move capital (target group); and makes alignment observable and credible (disclosure and reporting). Using comparative policy analysis, we examine 45 of the identified taxonomies against these criteria.

This article is organized as follows: Section 2 provides a background on literature related to sustainable finance taxonomies as well as key elements of transition finance and taxonomy design. Section 3 presents the methodology of this study. Section 4 presents the results and findings. Section 5 concludes and highlights policy implications.

2. Background and related literature

2.1. Academic research on taxonomies

The academic literature on taxonomies can generally be categorized into two principal strands: one strand is concerned with conceptual and methodological approaches for evaluating or implementing taxonomies, while another strand is focused on region- or country-specific assessments of taxonomies.

Within the first strand, Dziwok and Jäger (2021) provide a classification of green finance and monetary policy, stating that taxonomies are a central element for 'market-making' neoliberal green finance and green monetary policy as they rely heavily on defining green and environmental risks. This may come at the cost of overlooking explicit penalties for brown activities. Furthermore, critics argue that creating exhaustive lists of all economic activities and labelling them in a binary way – as either sustainable or not sustainable, thus eligible or ineligible for dedicated financial support – is an approach that resembles a centrally planned economy, not a market economy (Fuest & Meier, 2023a). Using an analytical model, Fuest and Meier (2023b) show that the binary approach of defining aligned activities can impose welfare costs not only when targeted environmental policies are available but also when current governments influence future climate decisions.

Complementing this with methodological considerations, Tripathy et al. (2020) emphasize that the efficient development of technical screening criteria (TSC) to define the alignment of economic activities in a taxonomy is facilitated not just by standardized templates structuring discussions around scope, objectives, and metrics, but also by the integration of established sector classification codes. Yet, using an economic theory, Chan et al. (2022) conclude that TSC may only be superior to other approaches, like using a whitelist, with regard to maximizing the green impact if the country has enough review capacity. Other studies try to provide a framework for comparing different taxonomies. Ehlers et al. (2021) propose a classification along the four categories: objective, scope, target, output. The paper argues that existing taxonomies often mix multiple sustainability goals and lack transparency. They call for measurable indicators and granular impact assessments while advocating for an alignment with one single policy objective, measurable interim targets, and transparent Key Performance Indicators (KPIs), thus enhancing clarity, comparability, and interoperability. The call for a single policy objective contrasts somewhat with the conclusions of Miglior-elli (2021), who finds that taxonomies mostly relate to climate and environment-related investment, while failing to capture other sustainability-related dimensions.

The emergence of multiple taxonomies and sustainable finance frameworks also raises concerns of alignment and harmonization. Hidalgo-Oñate et al. (2024) conduct an extensive literature review of various climate-related prudential regulation, including sustainability taxonomies, which ultimately point out the need for a guided transition through harmonized regulation. Questions of harmonization and interoperability

are addressed by the work of the International Platform on Sustainable Finance (IPSF), which published its first version of the Common Ground Taxonomy (CGT) (IPSF, 2021).

The second strand deals with region- or country-specific assessments of taxonomies. Marcos and Castrillo (2022) highlight the role of the EU taxonomy with regards to creating transparency and comparability, potentially serving as a blueprint for a standard global definition of sustainable economic activities (Schütze et al., 2020). Gortsos and Kyriazis (2024) describes the EU taxonomy's impact on other legal sources of financial regulation that apply to financial institutions and thus contribute to decarbonization mechanisms beyond the taxonomy's scope. Alessi and Battiston (2022, 2023) illustrate its usefulness to estimate the greenness of financial portfolios and propose a methodology to estimate it. First empirical evidence of the potential impact of the EU taxonomy shows that it reduces divergences in environmental ratings, thereby lowering greenwashing risks in the financial system (Dumrose et al., 2022). Using syndicated loan data, Sautner et al. (2026) show that firms with larger EU Taxonomy eligible revenue shares paid lower interest rates (in years before its formal introduction). In terms of financial performance, Cauthorn et al. (2023) find that European electric utilities more strongly aligned with EU-Taxonomy-compatible activities, especially those with higher renewable energy shares, generate superior portfolio performance relative to non-taxonomy-oriented peers. Other studies also examine the implementation of the EU Taxonomy by German firms (Arnold et al., 2023) and European firms (Hummel & Bauernhofer, 2024) alongside its usage by various actors as a toolkit for transition planning (CDP, 2023; EU Platform on Sustainable Finance, 2024). In terms of the EU taxonomy's contribution to climate neutrality – hence closely related to our own research question – the analysis by Schütze and Stede (2024) is, to the best of the authors' knowledge, the only analysis systematically assessing the EU taxonomy's contribution to climate neutrality as well as the design and stringency of technical thresholds for specific sectors. The authors conclude that, for selected sectors, thresholds are currently not aligned with climate neutrality as they rely on conventional best available technology benchmarks rather than breakthrough technologies that are otherwise not incentivized.

Schoenmaker and Volz (2022) provide a comprehensive collection of examples regarding how to scale up sustainable finance and investment in the Global South, pointing to the importance and role of sustainable finance taxonomies. Hilbrich et al. (2025), when analyzing factors influencing the adoption of the South African Taxonomy by potential users, conclude that a lack of regulatory embedding, hesitance among financial market participants to build capacity to collect the necessary data, and fossil-fuel path dependencies are important factors hindering effective implementation. Meattle et al. (2025), assessing the interoperability of the South African Taxonomy with the EU Taxonomy, find that, for the latter, usability and adoption face challenges not just because governance and disclosure frameworks lack clarity regarding roles and responsibilities, but also because compliance mechanisms are absent.

Hence, although academic research focusing on taxonomies in other countries has begun, the literature review reveals a geographical bias with the EU being the most researched and a gap in assessing specific design elements enabling the transition to net zero.

2.2. Definitions of transition finance and implications for taxonomy design

While green and sustainable finance have clear academic and policy definitions, transition finance is newer and more contested. It is used and discussed by various actors, including academia (Boissinot et al., 2016; Caldecott, 2022; Tandon, 2021), governments and executive bodies (European Commission, 2023; METI, 2022; U.S. Department of the Treasury, 2023), practitioners in sustainable finance (Duteil, 2021a, 2021b; HSBC, 2020; Jun & Terada-Hagiwara, 2022; Michaelsen & Mylläri, 2021), as well as organizations (ASEAN Capital Markets Forum, 2023; CBI, 2023; G20 SFWG, 2022; Hussain et al., 2020; ICMA, 2025; NZBA, 2025; OECD, 2022). Despite this, no commonly accepted single definition of transition finance exists. Table I in Supplementary Material I provides an overview of the most common definitions. According to the OECD's (2021) assessment of transition-finance practices, existing frameworks tend to characterize transition finance as support directed towards reducing the carbon footprint of sectors or entities that: (i) produce high levels of emissions; (ii) do not yet have affordable, credible low- or zero-emission alternatives available in all relevant settings; but (iii) play a significant role in long-term socio-economic development (Tandon, 2021). Transition finance thereby

extends to both use-of-proceeds and general corporate purpose instruments as legitimate vehicles for deploying transition capital (*ibid.*). And, rather than providing funding to activities that are already green, transition finance focusses on creating better financing conditions to transform the so-called ‘brown’ emission-intensive and hard-to-abate sectors – such as steel, cement, chemical, paper making, aviation, and construction – that are on their way to become green or, as some suggest, less brown (Duteil, 2021b). Crucially, it differs from the term ‘sustainable finance’, which refers to financial services and products that integrate environmental, social or governmental (ESG) considerations into business operations and investment decisions. Aiming to promote sustainable economic growth and development while minimizing negative impacts on the environment and society, it includes investments in renewable energy, green infrastructure, and socially responsible companies, among others (Cunha et al., 2021). In contrast, ‘green finance’ supports different environmental objectives and ‘climate finance’ focuses specifically on any finance supporting climate change mitigation and adaptation (Shishlov & Censkowsky, 2022). Overall, ‘the necessary transformation of the economy relies critically on changing key systems: energy, cities, transport, land use. These large and complex systems cannot be changed by fiddling with just one parameter, a whole set of policies will be required to foster change’ (Stern, 2022, p. 1283 f.). Thus, a whole-of-system approach is needed for transition.

Drawing on the prominent definitions and key elements of transition and transition finance, as well as the foregoing considerations and the literature review we derive five criteria for the comparative analysis of the taxonomies: policy embeddedness, sectoral emissions coverage, screening approach, target group, as well as disclosure and reporting.

3. Data and methodology

This study employs a qualitative methodology and conducts document analysis (Bowen, 2009; Flick, 2022; Merriam & Tisdell, 2015; Morgan, 2022). Only taxonomies that are published, adopted or are in the developing phase by governmental bodies or other public bodies are considered in this assessment. Overall, this article examines 45 taxonomies out of the 89 identified as of September 2025 (Table II in Supplementary Material I provides a list of all taxonomies identified, Supplementary Material II provides a list of all taxonomies in initiation phase).

The analysis is based on a systematic review and evaluation of the latest available primary sources, i.e. the legal texts, frameworks, reports, or guidance documents identified as reference documents for each respective taxonomy that were made available by governments or relevant authorities by 30 September 2025. For taxonomies published in languages other than English without an official English version, DeepL and Google Translate were used for translation. Consequently, the translation of documents may contain inaccuracies. In specific cases, other secondary sources were added, if these complement the information in the actual primary source in a necessary or relevant way.

Drawing on the literature review (Section 2.1) and common aspects in the definition of transition finance (Section 2.2. and Table I Supplementary Material I), we develop five criteria to guide the comparative analysis: (1) Policy embeddedness; (2) Sectoral emission coverage; (3) Screening approach; (4) Target group; and (5) Disclosure and reporting. For each, we identify several indicators and assign one of four possible levels of contribution with corresponding scores: *no contribution* [0]; *little contribution* [1]; *moderate contribution* [2], or *significant contribution* [3].² Table 1 gives an overview of the five criteria and the indicators for the respective contribution levels.

3.1. Policy embeddedness

Policy embeddedness refers to the extent to which a taxonomy is integrated into the broader sustainability policy framework. Well-embedded taxonomies should define clear environmental goals (Ehlers et al., 2021; Hussain et al., 2020) and refer to international frameworks such as the Paris Agreement (CBI, 2023; European Commission, 2023; G20 SFWG, 2022; ICMA, 2025; OECD, 2022), the Sustainable Development Goals (SDGs) (G20 SFWG, 2022; ICMA, 2025), national commitments such as NDCs (Manning et al., 2024), as well as broader sustainability goals, like minimum social safeguards, biodiversity or circular economy (G20 SFWG,

Table 1. Comparative policy analysis – Overview of criteria.

Criteria	Level of contribution			
	<i>No contribution [0]</i>	<i>Little contribution [1]</i>	<i>Moderate contribution [2]</i>	<i>Significant contribution [3]</i>
Policy embeddedness	No objectives or reference to national or international climate or sustainability policies.	Environmental goals are specified AND reference to international policies (e. g., SDGs, Paris Agreement, 1.5°-Goal) OR national or regional policy decarbonization strategies (e.g. NDCs, Climate Protection laws).	Environmental goals are specified AND reference to international policies and frameworks (e.g. SDGs, Paris Agreement, 1.5°-Goal) AND national or regional policy decarbonization strategies (e.g. NDCs, Climate Protection laws).	Environmental goals are specified AND reference to international policies (e. g., SDGs, Paris Agreement, 1.5°-Goal) AND national or regional policy decarbonization strategies (e.g. NDCs, Climate Protection laws) AND to broader sustainability goals (e.g. biodiversity or social goals).
Sectoral emission coverage	Very few sectors/ industries are directly covered ($\leq 10\%$ of emissions).	Only a few sectors/industries are directly covered ($>10\%$ to $\leq 50\%$ of emissions).	Over half of sectors/ industries are directly covered ($>50\%$ to $\leq 90\%$ of emissions).	Most industries/sectors are directly covered ($>90\%$ of emissions).
Screening approach ^a	The framework does not define any criteria.	The framework defines clear TSC.	The framework defines clear TSC AND addresses the measurability/alignment with quantitative thresholds or qualitative conditions.	The framework defines clear TSC AND addresses the measurability with thresholds that are science-based/of regulatory origin AND follows a dynamic approach towards net zero for transitional activities.
Target group	The taxonomy does not specify financial products or market participants to whom the framework applies.	The application of the taxonomy is voluntary and targeted market participants or use cases are specified.	The application of the taxonomy is mandatory for specific market participants and financial products.	The application of the taxonomy is mandatory for multiple market participants and financial products.
Disclosure and reporting	The taxonomy does not make any specifications on disclosure or reporting.	Disclosure and reporting on taxonomy alignment are only voluntary OR recommended OR briefly mentioned.	Data on taxonomy-alignment is mandatory and needs to be disclosed and reported.	Data on taxonomy-alignment is mandatory and needs to be disclosed and reported AND audited.

^aFor the screening approach, neither the calculation of the thresholds nor their ambition is examined; i.e. the alignment of these thresholds with specific climate targets. We only check whether the scientific or regulatory origin of the criteria and thresholds is referenced transparently.

2022; Migliorelli, 2021). However, the explicit references to these frameworks do not constitute a formal assessment of alignment with national and international policy objectives.

3.2. Sectoral emission coverage

The second criterion examines the scope of a taxonomy in terms of its sectoral emission coverage. It refers to the proportion of directly targeted emissions in a taxonomy, i.e. the sectors or technologies that are explicitly mentioned, often also referred to as ‘taxonomy eligibility’. Sectors should be selected according to their contribution to the desired environmental objective (Ehlers et al., 2021; Hussain et al., 2020). In the context of climate change mitigation, this requires including high-carbon sectors that can be decarbonized in the future (Caldecott, 2022; Duteil, 2021b; Ehlers et al., 2021; Schütze & Stede, 2024; Tandon, 2021; U.S. Department of the Treasury, 2023). We recognize that, consistent with the systems approach (OECD, 2020), which acknowledges that economic activities do not operate independently of the wider system, emission reductions may also be achieved indirectly through enabling technologies from sectors outside the taxonomy’s scope. As this is beyond the scope of this article, only sectors explicitly (directly) mentioned in the

framework are counted. If a taxonomy is sector-agnostic and neither explicitly includes nor excludes any sectors, it is considered to cover all sectors and therefore receives the highest score. To assess the country-specific GHG emissions per sector, the database of the World Emissions Clock (WEC) from the World Data Lab (see Supplementary Material III for detailed methodology).³ Although the WEC is currently the only database providing comprehensive coverage across all countries, its relatively high level of aggregation constitutes a limitation. The limited availability of sub-sectoral data necessitates analysis at a broader sectoral level, which may lead to an overestimation of coverage in cases where a taxonomy specifies only particular economic activities within a sector.

3.3. Screening approach

This criterion captures the approach to define the ‘alignment’ of economic activities with the taxonomy’s defined environmental objectives. First and foremost, this requires a framework to define clear TSC against which alignment is evaluated, e.g. activity must contribute to the objective of climate change mitigation (Chan et al., 2022; Ehlers et al., 2021; Hussain et al., 2020; Tripathy et al., 2020). To ensure clear measurability, such TSC should be complemented with quantitative thresholds like emission intensity thresholds or qualitative conditions like certain standards (CBI, 2020; European Commission, 2023; Hussain et al., 2020; NZBA, 2025; U.S. Department of the Treasury, 2023) that are science-based and/or of regulatory origin (CBI, 2020; G20 SWWG, 2022; ICMA, 2025; Tripathy et al., 2020). Crucially, for the inclusion of transition activities, in order to ensure proper alignment with net zero targets, the alignment should follow a dynamic approach towards net zero, e.g. by using sunset dates, forward-looking pathways embedded in technical criteria, the recognition of interim targets (CBI, 2020), or transition plans (OECD, 2022).

3.4. Target group

This criterion examines whether and how the taxonomy defines the market participants as well as financial products within its scope. We argue that a taxonomy can achieve its intended impact if it is applied by a broad range of market participants and financial products. Given the systemic nature of climate mitigation and adaptation, achieving the transition to a low-carbon economy requires coordinated action across governments, businesses, and financial institutions within an integrated ecosystem (Manning et al., 2024; Stern, 2022). Accordingly, a diverse range of financial products and instruments is needed to mobilize capital, provide incentives, and support the decarbonization efforts of corporations, governments, and households (Caldecott, 2022; U.S. Department of the Treasury, 2023). Furthermore, voluntary application might lead to inconsistent implementation, as uptake depends on reputational incentives rather than legal obligation. Mandatory application, by contrast, creates a level playing field by ensuring all relevant market participants apply the same definitions of green and sustainable activities, reducing greenwashing, preventing regulatory arbitrage, and strengthening the credibility of sustainability signals (Ehlers et al., 2021).

3.5. Disclosure and reporting

The fifth criterion evaluates whether the taxonomy requires disclosure and reporting of relevant data. To effectively guide financial flows towards transition activities, taxonomies should incorporate robust disclosure and reporting requirements as part of a broader sustainable finance policy framework (Ehlers et al., 2021; European Commission, 2023; Hussain et al., 2020; ICMA, 2025; NZBA, 2025). Such requirements enhance both the quality and scope of information accessible to relevant stakeholders. This is also supported by academic findings; several studies highlight the positive effect that sustainability disclosure can have on access to finance and firm valuation (García-Sánchez et al., 2019; Riordan & Nerlinger, 2022; Saka & Oshika, 2014). However, mandatory disclosure alone does not guarantee data reliability; external auditing adds an additional layer of verification, reducing greenwashing risks and increasing the credibility of reported information (Sneideriene & Legenzova, 2026).

4. Results and discussion

The comparison of the 45 taxonomies shows great diversity, reflecting the rapid progress in the global development of taxonomies. [Figure 1](#) summarizes the assessment of each taxonomy (country and jurisdiction) based on the five criteria. The detailed assessment of each taxonomy and a visualization with radar-charts are available in Supplementary Material IV. Across the five criteria, taxonomies exhibit uneven performance. They generally perform well on the formal criterion of policy embeddedness but fare progressively worse on the criteria that determine whether their design effectively channels capital towards transition activities.

On *policy embeddedness*, most taxonomies define clear environmental goals and make clear reference to national sustainability goals and policies. This is specifically the case for climate change mitigation and adaptation being the most common goals. Further goals encompass (a) sustainable use and protection of water and marine resources, (b) the transition to a circular economy, (c) pollution prevention and control and protection, and (d) restoration of biodiversity and ecosystems. This is the case for, e.g. Australia, Azerbaijan, Bangladesh, Pakistan, Paraguay, Rwanda, Senegal, South Africa, Turkey, and Uganda; however, country-specific goals are also included, like sustainable land management. Some countries follow the path of the EU in launching their taxonomies in phases, initially focusing on climate change mitigation, adaptation, and resilience before subsequently adding new environmental goals (e.g. Côte d'Ivoire, Ghana, Kenya, LAC). Interestingly, China, Uzbekistan, and Vietnam do not mention any environmental goals, nor do they link to any international policies or sustainability goals.

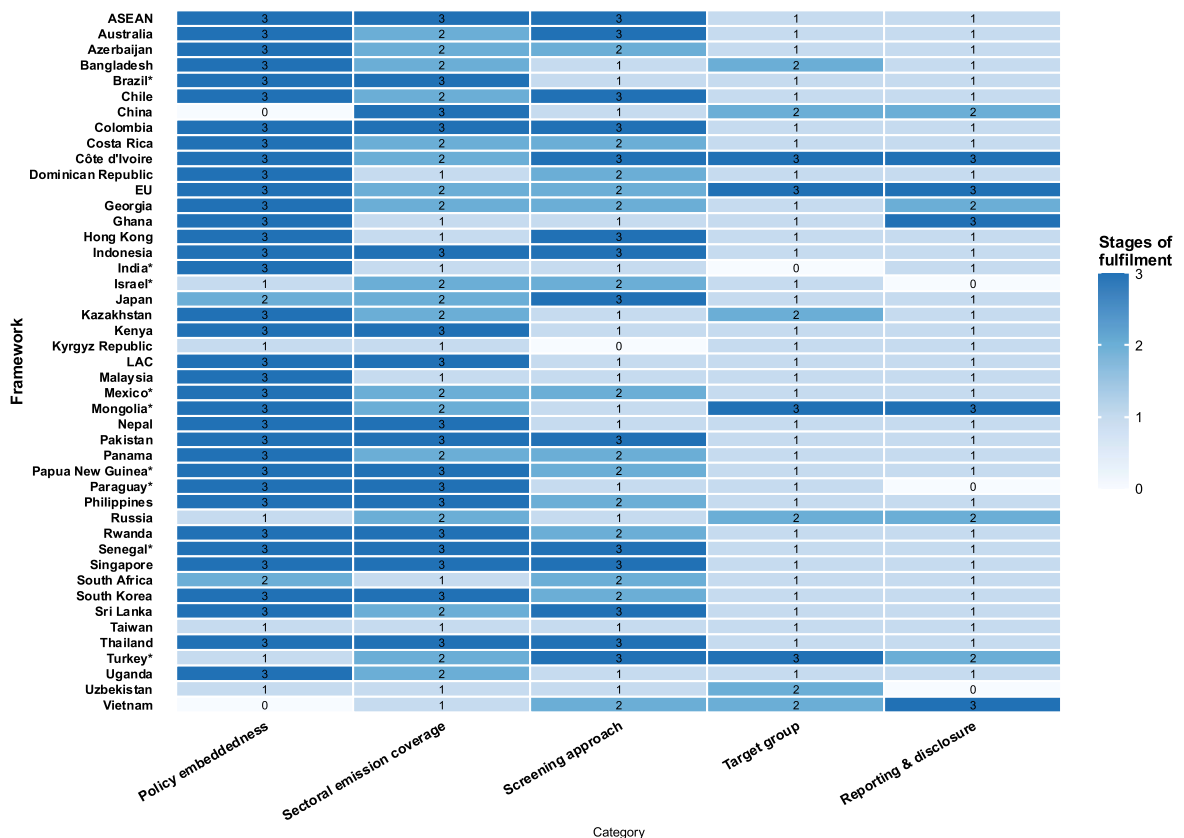


Figure 1. Assessment of taxonomies – Overview.

Source: Own graph based on a criteria-based assessment of countries. * Frameworks are still in the development phase. The assessment can therefore not be regarded as final. 0 = no contribution; 1 = little contribution; 2 = moderate contribution; 3 = significant contribution.

Most countries outline the importance of their taxonomy to mobilize the resources needed to achieve the net-zero targets pledged in their NDCs, embedding the framework in the context, e.g. of the Paris Agreement, the Kunming-Montreal Convention on Biological Diversity and its Global Biodiversity Framework (Brazil) as well as in their national climate and decarbonization or sustainable finance roadmap. Countries like, e.g. Uzbekistan and Turkey do not refer in their taxonomy to other international frameworks at all. Several taxonomies encompass a broader range of environmental objectives ranging from circularity and biodiversity to sustainability goals such as the SDGs. The taxonomies of Colombia, Mongolia, Russia, Rwanda, and South Africa include nature-related aspects such as biodiversity or plan to do so. Some taxonomies already include further social aspects such as gender (Mexico), diversity and a defined set of norms for human rights and First Nations (Australia) or indigenous people (Brazil). The development of a specific social taxonomy after the release of a green taxonomy is also envisaged by South Africa and Brazil. While most countries seem to acknowledge the need to embed their taxonomy into a wider policy context to support the transition, this does not say much about the alignment of the taxonomy with the policies.

Regarding *sectoral emission coverage*, most taxonomies apply an existing sector classification system (NACE or ISIC).⁴ However, some of the environmental goals do not fit easily within this classification system and do not have corresponding classification codes. Examples of such include social resilience, biodiversity, natural landscape, environmental protection, and restoration. Keeping the limitations on the breakdown of sub-sectors in mind, as mentioned in section 3, the analysis shows that the share of emissions from the economic sectors and the number of sectors directly covered in the respective taxonomies varied greatly (Figure 2).

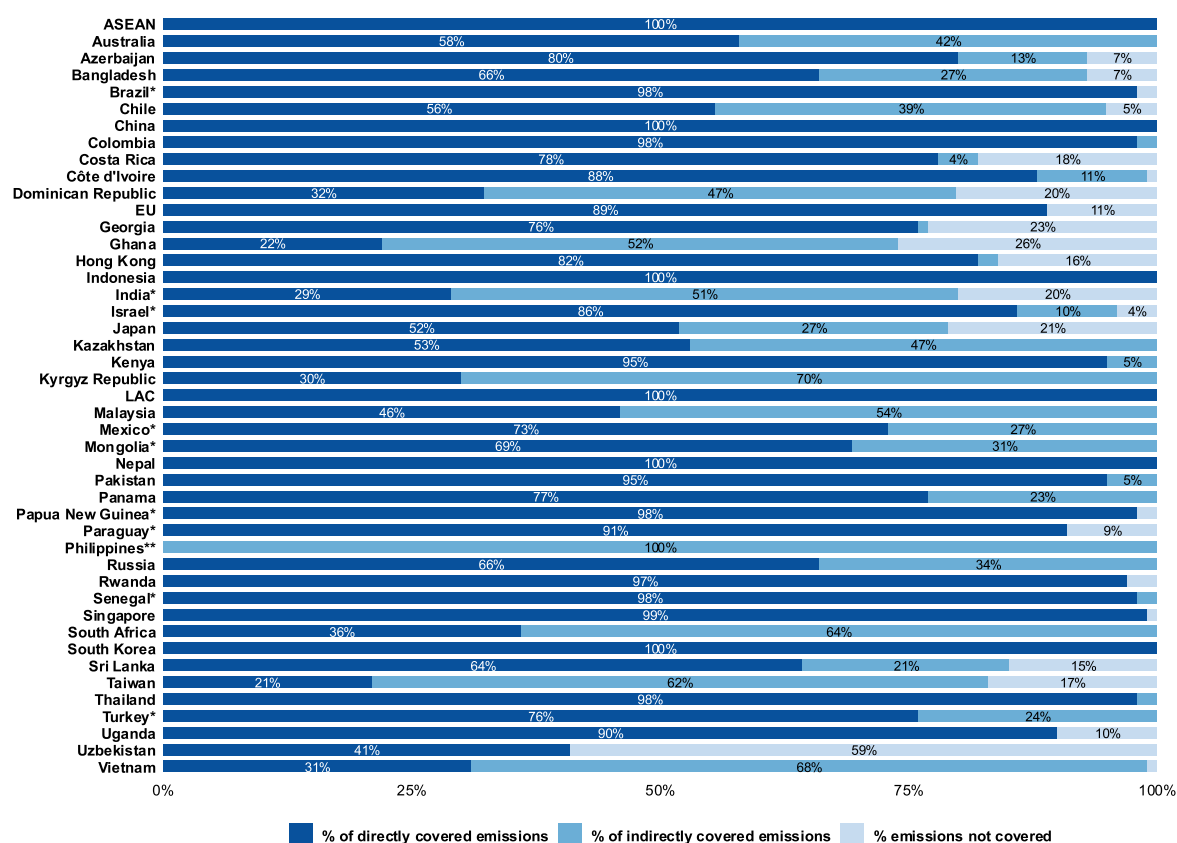


Figure 2. Direct and indirect sectoral emission coverage in GHG-emissions in % in 2022 by taxonomies.

Source: Own graph based on taxonomy frameworks and emission data from 2022 from the WEC, available at: <https://worldemissions.io/>. *Taxonomies are still in the development phase. Thus, this assessment cannot be regarded as final. **The Philippines is a special case as their approach is sector-agnostic and merely principle-based. Thereby, the framework indirectly covers all sectors without explicitly mentioning specific activities.

Nine taxonomies cover less than 50 per cent of emissions,⁵ 15 others cover more than 90 per cent of emissions. Some countries such as Chile have high negative emissions in the 'land use' subsector, which partially offset emissions in other sectors and hence reduce overall emissions.

Some taxonomies focus on high-emitting sectors and key parts of the economy, including energy, manufacturing, transport, and buildings. Others also cover locally relevant sectors, such as agriculture, aquaculture, and fishing in ASEAN and Brazil, or region-specific industries, such as minerals, mining, and metals in Australia and Chile. Carbon capture, storage, and utilization is, for example, explicitly mentioned as a sector in the ASEAN and Singapore taxonomies. Some taxonomies are introduced in phases. Ghana, for example, covers in the initial phase high-priority sectors such as energy and transport, agriculture, forestry, aquaculture, the blue economy, water, waste management, pollution prevention, and building and construction. The second phase expands coverage to additional transitional activities, including green or eco-tourism, sustainable mining of critical minerals, and industry or manufacturing.

As for the *screening approach*, basically three approaches are primarily used to define the eligibility of economic activities for a taxonomy. These approaches partially overlap and are used independently or in combination. Some taxonomies follow a *principles-based approach*. This approach defines a set of guiding principles defining which activities can be funded, such as in the Filipino, Malaysian, and Singaporean taxonomies. In contrast, the taxonomies of China, Kazakhstan (in most parts), Mongolia, Russia, Uzbekistan, and Vietnam follow a *whitelist design*, meaning that an activity is only in alignment if it (i) is specifically listed in the taxonomy and (ii) meets the relevant defined criteria, such as national environmental performance standards. While this simplicity might be considered as positive, this type of classification thus favours specific technologies by defining them as green or sustainable.

Another common approach is the use of TSC, as applied e.g. in Azerbaijan, Colombia, Côte d'Ivoire, Costa Rica, the EU, Hong Kong, Indonesia, South Korea, and South Africa. TSC designs typically combine the following criteria: an economic activity is aligned with the taxonomy if (a) it substantially contributes to at least one environmental goal, meaning technical thresholds are defined at which a given activity is considered to make a real, measurable, and materially positive contribution; (b) it does not cause any significant harm (DNSH) to other goals or activities; and (c) it complies with minimum social safeguards (MSS). MSS are baseline social and business standards that companies must meet for their activities to be considered environmentally sustainable; these draw on the OECD Guidelines for Multinational Enterprises on Responsible Business Conduct (OECD Guidelines) and the United Nations Guiding Principles on Business and Human Rights (UNGPs).

Most taxonomies combine their chosen approach with TSC, MSS, and/or the DNSH principle as well as specific exclusion criteria. ASEAN and ASEAN member states, such as Indonesia, have additionally included the criteria of Remedial Measures to Transition (RMT), meaning that if an activity is identified to do or is foreseen to do significant harm to one or more environmental goals, RMT must be put in place: 'Implementation of RMT needs to be planned which will effectively remove all significant harm within 5 years from the assessment date (ASEAN Taxonomy p.33).

With respect to transitional activities, most taxonomies take an approach that focuses on defining green-aligned practices – often through performance thresholds or the identification of sustainable activities – rather than explicitly recognizing or incorporating transition activities. However, the comparison shows that certain countries employ differentiated approaches to reflect the complexity of the transition and to ensure the inclusion of appropriate safeguards. These include, e.g. the recognition of interim performance improvements (known as the 'amber' or tiered category) used by ASEAN, Singapore, and Hong Kong that allow activities not yet fully green but on the path. Sunset dates or forward-looking pathways embedded in technical criteria are applied by Asian taxonomies, including Singapore and Thailand. ASEAN includes first regional taxonomy guidance on coal phase-out (CPO) with an explicit categorization of coal phase-out activities in the 'green' and 'amber' categories (ASEAN Taxonomy, p.19). Chile categorizes activities in high-emitting sectors such as mining and quarrying, and manufacturing as transitional activities if they have decarbonization strategies in accordance with, e.g. the NDCs and Long-term Climate Action Plan (Chilean taxonomy, p.117). Regarding the taxonomy's *target group*, substantial variation exists in both the breadth of intended users and the extent to which frameworks are mandatory or voluntary. Most taxonomies are voluntary in nature and are designed for a broad set of stakeholders. Several explicitly specify potential users, including policymakers,

financial institutions, corporations, investors, civil society, multilateral development banks, and public sector actors (e.g. Colombia, Ghana, Indonesia, Malaysia, Mexico, Panama, Senegal, Singapore, Uganda), without restricting application to any group. A smaller set is directed primarily at financial sector participants such as banks and institutional investors (e.g. Bangladesh, Georgia, Kenya and Sri Lanka), while others are targeted to specific financial instruments, notably debt products such as bonds and loans (China, Kazakhstan, Russia, Uzbekistan, Vietnam). India is the only framework that does not specify a target group at all; Japan provides illustrative examples rather than defining users formally.

The EU Taxonomy is a mandatory framework applicable to both financial market participants and corporates. In Côte d'Ivoire, the Transition Taxonomy is embedded in a governmental decree, providing it with a formal legal basis. Turkey's draft regulation similarly envisages mandatory application across institutions, organizations, and businesses. By contrast, Brazil and Indonesia foresee a gradual shift from voluntary to mandatory use, while Australia is exploring potential regulatory applications in consultation with stakeholders. Mongolia's taxonomy is currently in a one-year pilot phase and is expected to become binding for financial institutions, investors, and policymakers thereafter. All remaining taxonomies are voluntary guidance documents, including those of ASEAN and LAC. We argue that a taxonomy can only be effective if applied by a broad range of market participants and across a wide set of financial products.

Disclosure and reporting requirements vary considerably across frameworks. The EU taxonomy is the most advanced in this regard, with mandatory annual reporting on taxonomy-alignment for large companies and financial institutions in the EU involving third-party verification. Côte d'Ivoire imposes mandatory reporting requirements on listed administrations/companies, large organizations and small entities and links to transition plans as well as international standards such as IFRS S1 and S2 and CSRD. The taxonomies from Mongolia, Georgia, Turkey and Vietnam have followed suit or are working towards disclosure frameworks but are less mature. Taxonomies focusing on green debt instruments, such as bonds and credits, are automatically subject to reporting requirements (e.g. China, Russia). A larger group recommends disclosure and reporting on taxonomy-alignment, often referencing international standards and frameworks such as GRI, ISSB, TCFD, TNFD, or the SASB materiality map (e.g. Rwanda, Singapore, South Africa), or encouraging disclosure and reporting on taxonomy-alignment without specifying standards (e.g. Azerbaijan, Colombia, Ghana, Hong Kong, Indonesia, Kenya, Mexico, Pakistan, Uganda). A few taxonomies – Israel, Paraguay, Uzbekistan – do not make any specifications on disclosure or reporting.

When comparing regional taxonomies, the EU taxonomy remains one of the most advanced in terms of comprehensiveness, sector coverage, and regulatory backing. ASEAN is also one of the most developed, with several updates, a structured approach and explicit flexibility for transition activities, although heterogeneous national capacities continue to pose implementation challenges. LAC, launched in 2023, sets out guiding principles and core structural elements but does not define quantitative metrics or thresholds. Africa's continental taxonomy (validated July 2025) is still in early stages of operationalizing detailed criteria, while aiming for alignment and reflecting continental development priorities. Overall, the comparison shows that each regional taxonomy reflects its own development context, prioritizes different objectives (mitigation vs adaptation vs social resilience), and progresses at varying speeds in line with regional circumstances.

5. Conclusion and policy recommendations

This article offers a comparative and structured analysis of 45 taxonomy frameworks that have been published and/or adopted or are being developed, by assessing the design of the taxonomies along five criteria.

This rapid proliferation between 2022 and 2025 has produced considerable diversity in taxonomy design and implementation, raising important questions about policy effectiveness, interoperability, and the evolution of sustainable finance governance.

The analysis shows that taxonomies are increasingly used as policy instruments across countries but are generally designed to scale already green activities rather than enable the decarbonization of emission-intensive sectors. Overall, most taxonomies appear to be well embedded in national and international environmental and sustainability policy frameworks. However, coverage of sectoral emissions varies considerably. With respect to the screening approaches, many taxonomies focus on green activities like renewable energy.

Where transition activities are included, technical screening criteria – like emission intensity thresholds – often lack explicit pathways to net-zero alignment. Moreover, mandatory application is typically limited to selected green financial products or a narrow set of market participants. In conclusion, existing taxonomies are not yet fully designed to support a comprehensive transition to net zero.

This research contributes to academic literature on taxonomies and transition finance by providing an *ex-ante* comparative analysis of taxonomies along five transition-related criteria. The results of the comparative policy analysis should, however, be interpreted with caution and with sensitivity to the specific contexts in which the assessments are conducted. In addition, the analysis would benefit from being complemented by *ex-post* evaluations, assessing the actual effectiveness of taxonomies in practice.

In practical terms, it offers an overview of international developments and good practices for designing a new taxonomy and updating existing ones, with particular attention to the integration of the concept of ‘transition’. For national policymakers seeking to develop a new taxonomy, the comparative criteria can inform the overall design, including decisions on sectoral coverage and screening approaches. The findings also have important implications for improving existing taxonomies and for incorporating transitional elements into established frameworks. On this basis, four main areas for taxonomy improvement can be identified:

- First, a clear pathway towards net zero should be embedded explicitly in the screening approach for all relevant sectors and stakeholders in each respective country, especially in transition categories. This will ensure that companies can use the respective taxonomy as a reference for their net-zero transition plans.
- Second, alignment with international climate targets for all sectors should be ensured over time. This can be achieved via periodic revision and adjustment of the framework; hence, taking a dynamic approach. Alternatively, transition pathways can be developed for energy-intensive sectors, thus serving as a reference for corporate transition plans.
- Third, a taxonomy should not be limited to one financial instrument but applied to all relevant financial instruments and actors in the financial sector and in the real economy.
- Fourth, taxonomies should be linked explicitly to reporting requirements that help market participants consider the risks and opportunities related to climate and other environmental risks.

For international policy makers, the analysis highlights that international taxonomies show a variety of different approaches and thresholds. These differences increase administrative burdens for financial market participants that invest in multiple countries. However, many taxonomies take reference to other taxonomies, such as the EU taxonomy, using similar design elements and selection criteria. The analysis can provide a source of information to develop global minimum standards in terms of methodologies, technical criteria, scopes, and screening approaches. Additionally, based on this, (national) policy makers in various countries can implement a recognition mechanism, where investment projects in other countries can be recognized as taxonomy eligible in other regions more easily.

The findings can support greater interoperability between taxonomies, thereby facilitating cross-border climate finance through shared design features, including common environmental performance metrics and overarching principles such as science-based approaches, dynamic scenario analysis, and technology neutrality. Achieving interoperability will require coordination among stakeholders to ensure that assessment frameworks remain effective and applicable across jurisdictions.

Notes

1. Sustainable taxonomies are the most comprehensive, as the term “sustainable” has an ecological, economic, and social dimension. A *green* taxonomy focuses on pure green activities in the sense that they positively contribute to the environmental objectives. *Social* taxonomies focus on the positive contribution to social objectives. *Transition* taxonomies take a more dynamic approach, as they identify activities that are not currently in accordance with the Paris Agreement. Also see section 2.2.
2. The values 0–3 are used to represent categories, but they do not imply a linear relationship between the categories themselves.

3. Available at: <https://worldemissions.io/>. The WEC provides trajectories of GHG emissions until 2050 covering a sample of 180 countries, five sectors, and up to 24 sub-sectors. Hence, the analysis of sector coverage can only be done at a more aggregated level. This means that, if only some sub-sectors or economic activities within a sector are mentioned in a taxonomy, we assume full coverage for that sector. For example, if a taxonomy mentions an economic activity related to forestry, we consider the land-use sector as covered even though there might be specific activities that are not explicitly covered. For the analyzed countries and regions, we use the total emission data in the business-as-usual scenario for 2022 as well as the emissions for the sectors and subsectors (see Supplementary Material III).
4. The use of different industry classification systems is a major challenge for the comparison of the frameworks. Some taxonomies use classifications derived from the UN International Standard Industrial Classification (ISIC), or regional adaptations such as VSIC in Vietnam, SIC in South Africa, ANZSIC in Australia, NAEMA of AFRISTAT in Senegal, and NACE in the EU. Mexico uses NAICS, Brazil CNAE, Kazakhstan EHS codes.
5. Association of Southeast Asian Nations (ASEAN), Brazil, China, Columbia, South Korea, LAC, Mongolia, Philippines, Singapore. The Philippines are a special case here, as its taxonomy uses a sector-agnostic approach that does not classify specific activities.

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Author contributions

CRedit: **Catherine Marchewitz**: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Visualization, Writing – original draft, Writing – review & editing; **Fernanda Ballesteros**: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Visualization, Writing – original draft, Writing – review & editing; **Franziska Schütze**: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Visualization, Writing – original draft, Writing – review & editing; **Nesrine Hadj Arab**: Investigation.

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