

ENCORE: the global infrastructure for screening business risks, dependencies and impacts on nature

Authors: Sebastian N. Bekker¹, Frida Arriaga^{2,9}, Andrea Baquero¹, Jake Bedford¹, Hidde Boom^{12,2}, Sharon Brooks¹, Martin Bruckner^{3,8}, Alena Cierna¹, Sebastian Dunnett¹, Ruth Fletcher¹, Joe Gosling¹, Annelisa Grigg^{1,4}, Martin Halle^{16,15}, Mike Harfoot^{1,17}, Matt Jones¹, Steven King¹, Katie Leach^{1,11}, Mariana Martinez del Rio¹, Olaoluwa Matemilola^{1,5}, Damien Mittempergher¹⁰, Anders Nordheim^{16,7}, Brian O'Connor^{1,14}, Lisa Petrovic^{16,6}, Stephan Pfister³, Sarah Pickering¹, Aime Rankin¹, Alex Ross¹, Justine Saunders^{2,13}, Felix Tin¹, Mark van Oorschot¹², Arnout van Soesbergen¹, James Vause¹, Antonin Vergez¹⁰, Neil D. Burgess¹

1 United Nations Environment Programme World Conservation Monitoring Centre (UNEP-WCMC), Cambridge, England, United Kingdom

2 Capitals Coalition, Den Haag, Zuid-Holland, The Netherlands

3 ETH Zürich, Zürich, Switzerland

4 Global Balance, Cambridge, England, United Kingdom

5 HSBC, London, England, United Kingdom

6 Independent, Genf, Geneva, Switzerland

7 Independent, Nouméa, New Caledonia, France

8 Institute for Ecological Economics, Vienna University of Economics and Business, Vienna, Austria

9 Inter-American Development Bank, Washington D.C., United States of America

10 IUCN, Gland, Vaud, Switzerland

11 Letchworth Garden City, England, United Kingdom

12 PBL Netherlands Environmental Assessment Agency, Den Haag, Zuid-Holland, The Netherlands

13 Scanis Consulting, London, England, United Kingdom

14 United Nations Convention to Combat Desertification (UNCCD), Bonn, North Rhine-Westphalia, Germany

15 United Nations Environment Programme (UNEP) Climate Finance Unit, Geneva, Switzerland

16 United Nations Environment Programme Finance Initiative (UNEP FI), Geneva, Switzerland

17 Vizzuality, Madrid, Spain

Corresponding author: Sebastian N. Bekker (sebastian.bekker@unep-wcmc.org)

Keywords: ecosystem services, pressures, nature, exposure, TNFD, LEAP, tools.

Competing interests: The authors declare no competing interests.

Abstract

Biodiversity and ecosystem services provide the foundation on which the global economy, and by extension all businesses, depend. ENCORE (Exploring Natural Capital Opportunities, Risks and Exposure) has established itself as a key reference for business and financial institution assessment of exposure to risk stemming from nature degradation. It has over 18,000 users, has been used in over 15 assessments at national scale by central banks and others and is recommended for use by businesses and financial institutions by leading initiatives such as the Taskforce on Nature-related Financial Disclosures (TNFD). ENCORE can also support national decision-makers with screening of nature-related risk exposure, in line with the ambition of Target 15 of the Kunming-Montreal Global Biodiversity Framework.

This paper outlines the theory that underpins nature-related assessments. The resulting structure of the ENCORE knowledge base provides information on dependency and impact pathways through which economic activities link to ecosystem components. Our paper is based on the 2024 update to the ENCORE knowledge base that covers 271 economic activities including key value chain links, aligns with the globally recognised International Standard Industrial Classification of All Economic Activities (ISIC), and integrates both qualitative and quantitative data to underpin materiality ratings for five ecosystem services and seven pressures. For this update, we systematically reviewed over 1,600 sources from the academic and grey literature (e.g., 24 company sustainability-related reports) and consulted with 78 industry experts to assess over 15,000 links between economic activities, ecosystem services and pressures on nature to provide this enhanced ENCORE knowledge base.

The analysis presented here cements ENCORE's position as essential infrastructure for businesses, financial institutions, and regulators to screen their exposure to nature-related risk. ENCORE supports actions to include nature in traditional approaches to risk and actions to deliver the global biodiversity agenda.

57	Contents	
58	1. Introduction	4
59	1.1 Theory underpinning nature-related dependency and impact assessments by the private	
60	sector	5
61	1.2 The logic behind ENCORE.....	6
62	2. Methods.....	7
63	2.1 How did we develop ENCORE based on the concepts discussed above?.....	7
64	2.2.1 Structure of the ENCORE knowledge base	7
65	2.2.2 Summary of key design criteria and methodological implications.....	8
66	2.2.3 Targeted literature reviews	8
67	2.2.4 Use of quantitative secondary data and expert assessment to determine materiality	
68	ratings	9
69	2.2.5 Industry expert consultation.....	10
70	3. Results.....	10
71	3.1 Key results from the development of ENCORE's knowledge base	10
72	3.2 ENCORE's uptake and contribution to the nature-related risk landscape: foundational	
73	infrastructure for nature-related assessments.....	15
74	3.3 Applications of the ENCORE knowledge base.....	15
75	4. Discussion.....	18
76	4.1 Future development priorities.....	19
77	4.2 Concluding remarks	20
78	Acknowledgements.....	20
79	References	22
80	Supporting Information	27
81	Annex 1: Additional detailed methodology	27
82	Annex 2: Additional figures.....	27
83	Annex 3: Database of dependencies and pressures	28
84	Annex 4: List of publications that have used ENCORE.....	28
85		
86		

1. Introduction

A whole of society and whole of government approach is needed to address current rates of nature degradation and ecosystem service loss (Convention on Biological Diversity 2022, 2026). This was one of the key messages from the Convention on Biological Diversity (CBD) when it released the Kunming-Montreal Global Biodiversity Framework (KMGBF) in December 2022 (Convention on Biological Diversity 2022). This is echoed in the World Economic Forum's Global Risks Reports, which reflect the views of experts and leaders in business, academia, civil society, international organizations, and the public sector. The 2026 edition of the Global Risks Report found that five of the top 10 perceived risks over a 10-year (long term) time horizon are environmental (Elsner et al. 2026). However, the same report found that environmental risks were among those that had the biggest fall in short term rankings (i.e., in the two-year time horizon). Instead, geopolitical, societal and technological risks made up eight of the top 10 perceived short-term risks in the 2026 report. Examples of such risks include geoeconomic confrontation, misinformation and disinformation, and societal polarization. This suggests that despite broad recognition of environmental risks as major long-term threats, sustained engagement across society and government may be difficult to maintain when more immediate geopolitical, societal, and technological challenges dominate attention.

The recently released Business and Biodiversity Assessment of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) emphasised that *all* economic activities depend and impact on nature and can play a positive part in reversing its degradation (IPBES 2026). For example, companies in the agri-food sector can prevent soil erosion, sequester carbon and help farmers transition to lower-impact practices (Tobin-de la Puente & Mitchell 2026). Similarly, fashion and textiles companies can reduce their own operational footprints by changing textile-dyeing practices as well reducing suppliers' footprints by establishing sustainable sourcing standards (Tobin-de la Puente & Mitchell 2026; World Economic Forum & Oliver Wyman 2026). The Business and Biodiversity Assessment also highlighted the importance of collaboration and collective action in the transition to a just and sustainable future (in addition to individual actions).

The scientific and civil society communities have a role in supporting the private sector to make this transition. The IPBES Business and Biodiversity Assessment suggested that one tangible action these groups can take is to co-develop open access tools, datasets and other resources that enable the private sector to incorporate nature-related considerations into decision-making (IPBES 2026). The Exploring Natural Capital Opportunities, Risks and Exposure (ENCORE) tool exemplifies this approach. ENCORE was developed by Global Canopy, the United Nations Environment Programme Finance Initiative (UNEP FI), and the United Nations Environment Programme World Conservation Monitoring Centre (UNEP-WCMC) to fill a key gap in available tools.

ENCORE is a high-level screening tool, which means that it can support companies and financial institutions who wish to take initial steps in evaluating nature-related risks and opportunities. It can aid with prioritisation and setting direction for further investigation but needs to be complemented with insights from other tools and data sources before final decisions are made. For example, ENCORE does not include perspectives from representatives of Indigenous Peoples or other stakeholders who might be affected by economic activities. This aspect is still very under-addressed in nature-related tools (see Kemp et al. 2026 for review). Indeed, the Nature Tools Compass (UNEP-WCMC 2026) – a resource to support assessments of nature-related dependencies, impacts, risks and opportunities – identified only six out of 74 tools as being able to support scoping of locations that may overlap with Indigenous Peoples' or local community lands. Nevertheless, ENCORE allows users to understand how economic activities may either depend on or impact nature through standardised terminology. It draws the links between concepts such as ecosystem services, ecosystem types and their components,

mechanisms that lead to changes in the state of nature, and pressures that result from economic activities (Natural Capital Coalition 2016; Leach et al. 2019; Keith et al. 2020; United Nations 2024).

In this paper, we first present the theory that underpins nature-related dependency and impact assessments by the private sector. We then show how these concepts can be used to build a global and sector-level database that can inform nature-related screening by diverse economic actors¹. Next, we present the resulting ENCORE knowledge base and its methodology as applied in a tool for decision makers. We then provide examples of uptake, showing how the knowledge base made available via the ENCORE web-based tool can be, and is being, applied for early screening of companies' nature-related dependencies and pressures. We close with reflections on pathways for going beyond screening, to the assessment of nature-related risks, and to implementing positive actions for nature.

1.1 Theory underpinning nature-related dependency and impact assessments by the private sector

The concept that economic activities can both depend and impact on nature is not new. The term 'natural capital' has been used in ecological economics spheres since the 1970s (Missemer 2018). The Millennium Ecosystem Assessment, published in 2005, was one of the first major globally agreed publications that stressed the relationship between nature and economic activities (Hassan 2005). The Millennium Ecosystem Assessment laid the foundation for subsequent efforts to develop a consistent approach for the private sector to identify, measure, and manage their nature-related dependencies and impacts. This thinking was further developed in the report on The Economics of Ecosystems and Biodiversity (TEEB) in Business and Enterprise (and associated sector-specific publications; Bishop 2013), the Natural Capital Protocol (Natural Capital Coalition 2016), and most recently the Taskforce on Nature-related Financial Disclosures (Taskforce on Nature-related Financial Disclosures 2023b). To summarise these various efforts, there is broad recognition that nature (or natural capital, which includes biodiversity) delivers a series of ecosystem services. All businesses and financial institutions (among others), benefit from those ecosystem services. However, under current production practices, most economic activities exert unsustainable pressures on nature. Those pressures lead to negative impacts on nature, such as reductions in quality or availability of ecosystem services, which in turn can negatively impact on people (especially vulnerable groups such as Indigenous Peoples, communities, groups and other affected individuals) as well as economic activities themselves. Impacts on nature occur through certain mechanisms that change the state of ecosystems and their components, such as diseases, climate change, floods or changes in species population sizes. These relationships are presented visually in Figure 1.

¹ In the context of this paper, we define screening as any procedure undertaken to rapidly identify whether an economic activity is likely to have significant dependencies or impacts on nature, adapted from (UK Government 2014).

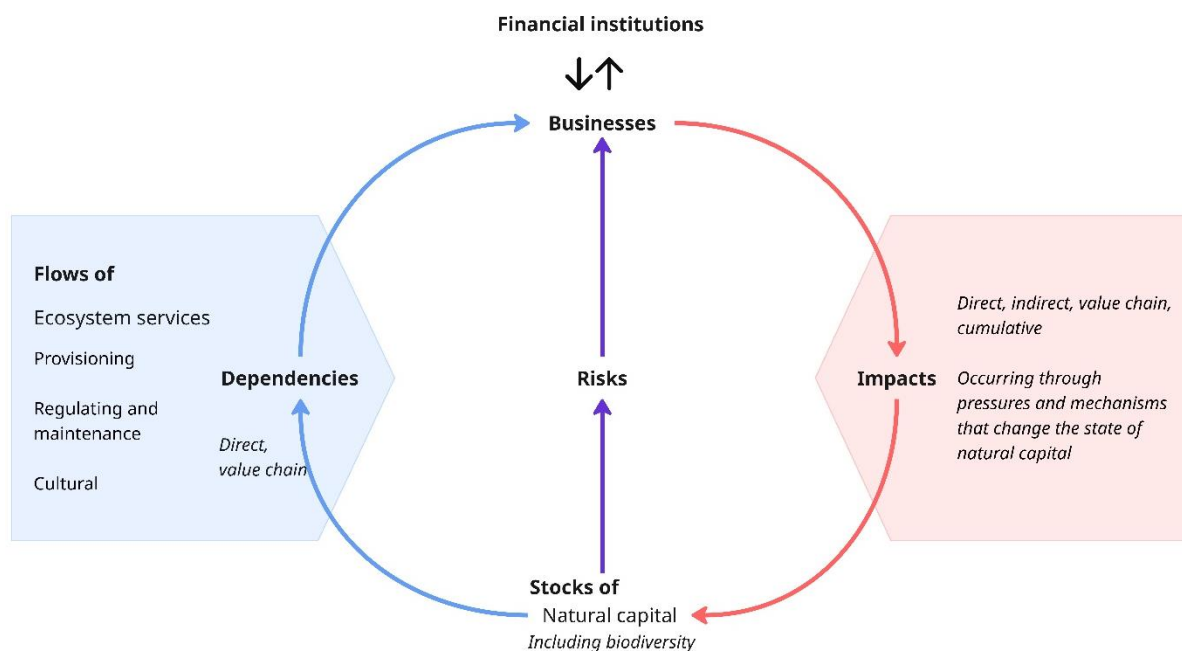


Figure 1: The relationships between biodiversity, natural capital, ecosystem services and business and financial institutions. Example ecosystem services include global and local climate regulation, pollination, and recreation-related services. Example pressures include land use, emissions of toxic pollutants to water and soil, and emissions of greenhouse gases. Definitions of key terms and how they are used in ENCORE are provided in UNEP-WCMC (2024). Source: authors, adapted from IPBES (2026), created in Miro.

The natural capital and ecosystem services framing is not universally supported. Key criticisms (e.g., risk of commodifying nature) and responses (e.g., designing approaches to include non-market instruments) can be found in Schröter et al. (2014), Díaz et al. (2018), Hummel et al. (2019), Díaz and Pascual 2025, and Ferraro et al. (2025). This has resulted in “Nature’s Contributions to People” also being used as terminology, for example in IPBES assessments. While we recognise that natural capital and ecosystem services provide an anthropocentric world view, they are easily understood by the private sector, in wide use and can account for diverse values. Businesses and financial institutions can apply these concepts through a structured process that starts with screening and prioritising their most significant dependencies and impacts on nature and progresses to implementing and monitoring actions to achieve positive outcomes for nature and people.

1.2 The logic behind ENCORE

We developed an initial theory of change for ENCORE in 2016 to outline how we could measure its impact. A simplified version is presented in Figure 2, noting that ENCORE cannot deliver all the outcomes by itself.

The problem statement is that business risk is increasing due to continuing declines in nature, yet these are not always considered in the decisions of businesses and financial institutions. ENCORE aims to close this knowledge gap by bridging the space between the wealth of published conservation science and actionable business intelligence.

At its core, ENCORE contains a synthesis of the evidence for nature-related materiality through linking economic activities with ecosystem services and impacts on natural capital. However, parallel activities include producing guidance, training users, as well as developing new methods to advance functionality, uptake and interoperability of the tool.

ENCORE’s success is susceptible both to external enabling and risk factors. Key among these is the potential risk of a lack of consumer and investor demand for corporate action and a simultaneous dearth of effective policy and regulation. However, in the decade since 2016, the public and investors have increasingly pressured the private sector for action on nature, and policies and regulations have been forthcoming. Examples of the latter include Article 29 of the French Energy-Climate Law, which extended biodiversity-related reporting requirements to investors, and the EU’s Corporate Sustainability Reporting Directive (CSRD).

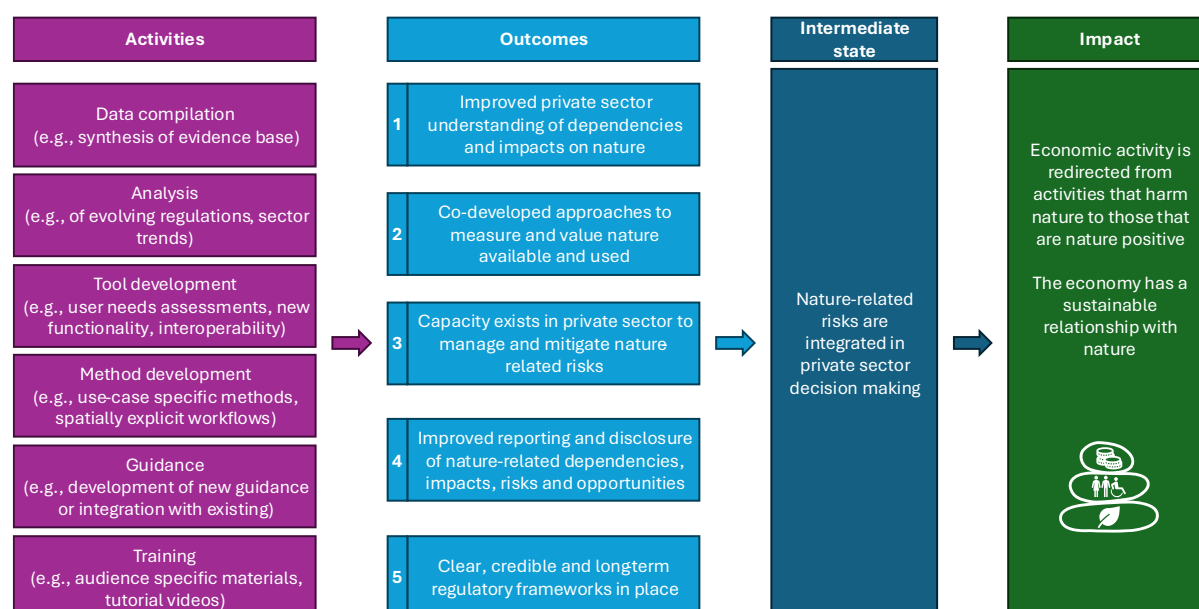


Figure 2: Simplified theory of change for ENCORE. Source: ENCORE partners (Global Canopy, UNEP FI and UNEP-WCMC).

2. Methods

2.1 How did we develop ENCORE based on the concepts discussed above?

2.2.1 Structure of the ENCORE knowledge base

Based on its theory of change (Figure 2), ENCORE needs to support understanding of potential dependencies and impacts on nature associated with different economic activities². As such, the knowledge base needs to provide information on individual components of the dependency and impact pathways and the relationships between them. We stored this information in a relational database, hereafter referred to as the ‘ENCORE knowledge base’. We supported each relationship with evidence from literature review, secondary quantitative data and/or expert judgement.

The 2024 version of the ENCORE knowledge base builds on previous efforts from 2016 to 2019 (Leach et al. 2019; Natural Capital Finance Alliance & UNEP-WCMC 2018). As a summary of our methodological steps, we:

- Conducted targeted literature reviews to define the relationship between different components of the dependency and impact pathways (Section 2.2.3)
- Used quantitative secondary data and expert assessment to determine materiality ratings (Section 2.2.4)

² Throughout the paper, references to ENCORE providing information on dependencies or pressures should be read as *potential* dependencies or pressures given its global, sector average scope.

- Consulted industry experts to gather feedback and ensure the final set of materiality ratings were reflective of average sector practices (Section 2.2.5)

2.2.2 Summary of key design criteria and methodological implications

To facilitate uptake by users, as well as ensure consistency and interoperability with existing resources, we structured the 2024 version of ENCORE's knowledge base to better align with other frameworks, standardised classifications and concepts. These are summarized here.

Firstly, we built the industry classification in ENCORE using *Groups* and *Classes* (levels 3 and 4) of the International Standard Industrial Classification of All Economic Activities (ISIC) Revision 4³. We selected ISIC as it is an authoritative classification that many region- or country-specific classifications are built from. Using ISIC increased both standardisation and granularity of the ENCORE knowledge base, moving from 92 production processes to 271 economic activities. For this, we adapted publicly available crosswalk (concordance) tables linking GICS to the European industry classification NACE⁴ and NACE to ISIC⁵.

Similarly, for the list of ecosystem services we aligned with the United Nations System of Environmental-Economic Accounting—Ecosystem Accounting (UN SEEA EA)⁶, which is referenced for example in the Global Reporting Initiative and TNFD (Global Reporting Initiative 2025; Taskforce on Nature-related Financial Disclosures 2023b). For this, we matched each ecosystem service included in the first version of ENCORE (based on version 4.3 of the Common International Classification of Ecosystem Services; CICES⁷) to Level 1 of the ecosystem services from SEEA EA.

In the impact pathway (red part of Figure 3), we identified a list of 'pressures' and 'mechanisms of change in state' and aligned the categorization of each to the concepts used in the Driver-Pressure-State-Impact-Response framework (European Environment Agency 2007). Using expert judgement, we identified a list of 'ecosystem components' based on Leach et al. (2019) and introduced a distinction by different ecosystem types, which we categorized in line with the biome level in the IUCN Global Ecosystem Typology 2.0. These design choices reflect consistency with the SEEA EA approach and are intended to support ENCORE's interoperability. We used expert judgement to define 1,395 links between ecosystem services and ecosystem components in different ecosystem types.

For many sectors, their greatest dependencies and impacts lie within the broader value chain rather than their direct operations. In response to user requirements, we included information on key value chain links. To build those links, we drew on the Environmentally Extended Multi-Regional Input-Output (EE-MRIO) database developed by ETH Zürich (Cabernard & Pfister 2021).

2.2.3 Targeted literature reviews

We conducted several targeted, systematic literature reviews to populate each 'table' in the ENCORE knowledge base. By 'table' we mean an Excel-compatible data file that contains information pertaining to one of the links displayed in Figure 3. For example, one table describes the links between economic activities and the pressures they potentially exert on nature. We used Google and Google Scholar to identify peer-reviewed studies, books, book chapters and grey literature, including corporate

³ Available at: https://unstats.un.org/unsd/publication/seriesm/seriesm_4rev4e.pdf

⁴ Officially called the Statistical Classification of Economic Activities in the European Community in English, referred to as 'NACE' due to its French title – 'Nomenclature statistique des activités économiques dans la Communauté européenne'. Available at: <https://ec.europa.eu/eurostat/web/nace>

⁵ Available at: <https://unstats.un.org/unsd/classifications/Econ#Correspondences>

⁶ Available at: <https://seea.un.org/en/methodology/ecosystem-accounting>

⁷ Available at: <https://cices.eu/content/uploads/sites/8/2015/09/CICES-V4-3-17-01-13a.xlsx>

sustainability reports and industry publications. Search terms were determined by the focus of each table. For example, the table on links between economic activities and ecosystem services was informed by targeted reviews of literature on nature-related dependencies of those economic activities. As a result, the ENCORE knowledge base synthesizes data from over 1,600 academic and grey literature sources.

The objective of the targeted literature reviews was to identify all existing links between the components of the ENCORE knowledge base, not only the most common links. This ensured that the ENCORE knowledge base could provide information about all potential dependencies and impacts, not just the most frequent or best documented in literature. In all literature searches, we included English language literature based on global data or data from a specific region.

We synthesized information from reviewed literature into a short description of each link. Where our review found that there is no relationship between two components, we marked this as Not Applicable (N/A). Where the targeted literature reviews did not find sufficient data to determine the relationship between two components, we marked this as No Data (ND). All tables populated by information from the literature reviews were reviewed by a minimum of three experts from the pool of authors of this paper.

2.2.4 Use of quantitative secondary data and expert assessment to determine materiality ratings

For all dependencies and pressures, the ENCORE knowledge base provides materiality ratings on a five-point scale from Very Low to Very High, based on pre-agreed criteria denoting the significance or size of dependencies and pressures.

We established the ratings using both quantitative secondary data and qualitative expert assessment. Artificial Intelligence (AI) was not used in any part of the methodology. The addition of quantitative data allows for a more robust, relative approach for the resulting materiality ratings, which facilitates prioritisation (one of most common uses of the ENCORE data). We used qualitative expert assessment where no suitable quantitative data was available or where quantitative data alone could not capture all dimensions of the dependency or pressure in question. The new materiality ratings therefore draw on purely quantitative, purely qualitative or mixed method methodologies (Table 1).

Table 1: Number of materiality ratings in the dependency and pressure tables underpinned by either a qualitative approach, quantitative data or a blended (mixed-method) approach.

Materiality ratings	Method			
	Qualitative	Quantitative	Blended	Total
Dependencies	2,759	0	627	3,386
Pressures	776	1,344	0	2,120

For the ratings based on a purely quantitative methodology, we used a set of indicators from the EE-MRIO database developed by ETH Zürich by building on EXIOBASE version 3.6 (Cabernard & Pfister 2021) and other databases of sectoral environmental footprints (see detail in the EU project deliverable Mittempergher & Vergez 2024). We assigned the materiality ratings based on ‘per 1 Euro of output’ values (e.g., volume of GHGs emitted per 1 Euro of output produced by the economic activity) by splitting values for each economic activity into the five grades on the rating scale (Very Low to Very High) using a natural breaks method (Jenks 1967).

For the qualitative ratings, we used the Delphi method (Mahajan et al. 1976; Mukherjee et al. 2015) to guide the expert assessment. Each rating was assessed independently by two experts from the pool of authors of this paper using questions designed to capture the magnitude of the dependency or pressure. The experts subsequently discussed any mismatches between their assessments to determine the final rating.

We used a blended (mixed-method) methodology for five dependency materiality ratings (Table 1). In such instances, we first identified quantitative data suitable for assessing the loss of functionality for the economic activity if the ecosystem service were disrupted (e.g., data on the amount of biomass or volume of water used by an economic activity per 1 Euro of output). We complemented this with qualitative expert assessments of the replaceability of the ecosystem service, which was also completed using the Delphi method.

For the materiality of all cultural ecosystem service dependencies, we used an exceptional approach. We assigned a rating of Very High to all of them, due to limited data and insufficient scientific consensus on how materiality of dependencies on these ecosystem services should be assessed. We recognise that this potentially overestimates the materiality for these ecosystem services. However, users have the option to justify a downgrade to the materiality of cultural ecosystem services on a use-case-by-use-case basis.

2.2.5 Industry expert consultation

The final step involved reviews by experts who had knowledge of typical industry practices. We selected these experts through a mix of convenience sampling and snowball sampling (“Convenience Sampling” 2018; “Snowball Sampling” 2018). This resulted in a pool of 78 reviewers who were asked to review the materiality ratings assigned to activities for which they held specific knowledge. After their reviews, we used expert judgement informed by the references found in the literature reviews to determine the final materiality ratings.

A fuller account of the methodology, its assumptions and its limitations is given in an accompanying explanatory note (UNEP-WCMC 2024) as well as Mittempergher & Vergez (2024) (see Annex 1).

3. Results

We present Results in three subsections: 3.1 Key results from the development of ENCORE’s knowledge base, 3.2 ENCORE’s uptake and contribution to the nature-related risk landscape, and 3.3 Applications of the ENCORE knowledge base. The latter sub-section focuses on three use cases with example applications of ENCORE.

3.1 Key results from the development of ENCORE’s knowledge base

The structure of ENCORE’s knowledge base is visualized in Figure 3. Example visuals from the ENCORE website are presented in Annex 2 with details on data access in Annex 3. The dependency pathway (yellow part of Figure 3) describes the relationship between economic activities, ecosystem services and ecosystem components. The impact pathway describes the relationship between economic activities, pressures, mechanisms of change in state, and ecosystem components.

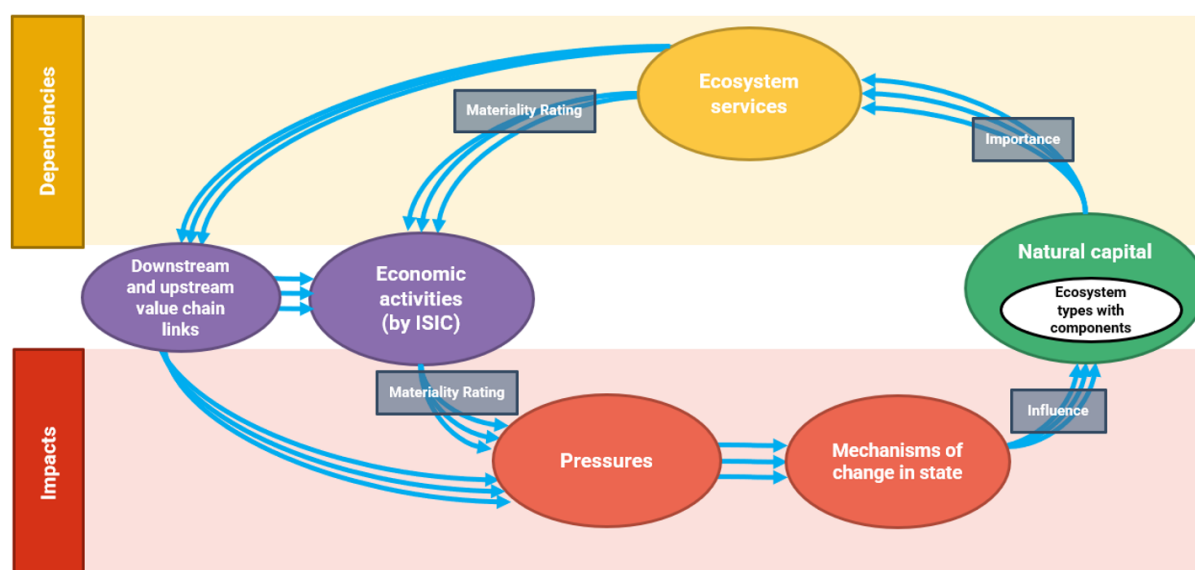


Figure 3: Diagrammatic representation of the ENCORE knowledge base, demonstrating the relationships that are articulated in ENCORE. The dependency pathway is shown in yellow and impact pathway shown in red, built using the methods described in Section 2. Source: authors.

Of the >15,000 *potential* links between the different components of the dependency and impact pathways that were reviewed, 7,516 were identified as *relevant* and 7,654 'Not Applicable'. Relevant links are all links except those that were deemed Not Applicable (i.e., it can reasonably be expected that there is no link between two components).

On the dependency pathway side, we found data to support over 90% (3,386) of *relevant* links between economic activities and ecosystem services (Figure 4). On the impact pathway side, we found data to support over 93% (2,120) of *relevant* links between economic activities and pressures (Figure 5). We also found evidence to support 88 links between mechanisms of change in state and ecosystem components. Figures 4 and 5 show that there are relatively few data gaps (ND values) in the knowledge base for both dependencies and pressures. As shown in Table 1, the materiality of dependencies could not be assessed using solely a quantitative method for any of the 25 assessed ecosystem services. Conversely, none of the 13 pressures were assessed using a blended approach.

The *relevant* links above are supported by 1,633 references, meaning each reference supports 3.4 links on average. This reflects a difference in granularity – the industry classification, pressures and ecosystem services are more detailed than the available literature. For example, all office buildings were deemed to depend to some extent on local climate regulation services provided by urban green and blue infrastructure. However, the literature we found covered 'offices' more broadly, rather than documenting different types of office-based activities and their dependence on these services. As a result, two references (Demuzere et al. 2014; Veerkamp et al. 2021) were used to support links for 98 office-based economic activities. We then assessed the potential materiality of each economic activity's dependence on local climate regulation services individually in the next step of our methodology.

Users can interact with the ENCORE knowledge base in two main ways. First, they can access it via [online functionalities](#) on the ENCORE website, which are well suited for preliminary, high-level materiality screening. Second, they can download the complete ENCORE knowledge base, enabling more detailed assessments by combining ENCORE data with portfolio or company-specific information. For example, users may integrate ENCORE outputs with country-level indicators such as

361 GDP or with organization-specific portfolio data to conduct customized analyses that weight
362 materiality ratings and financial data (e.g., Svartzman et al. 2021).

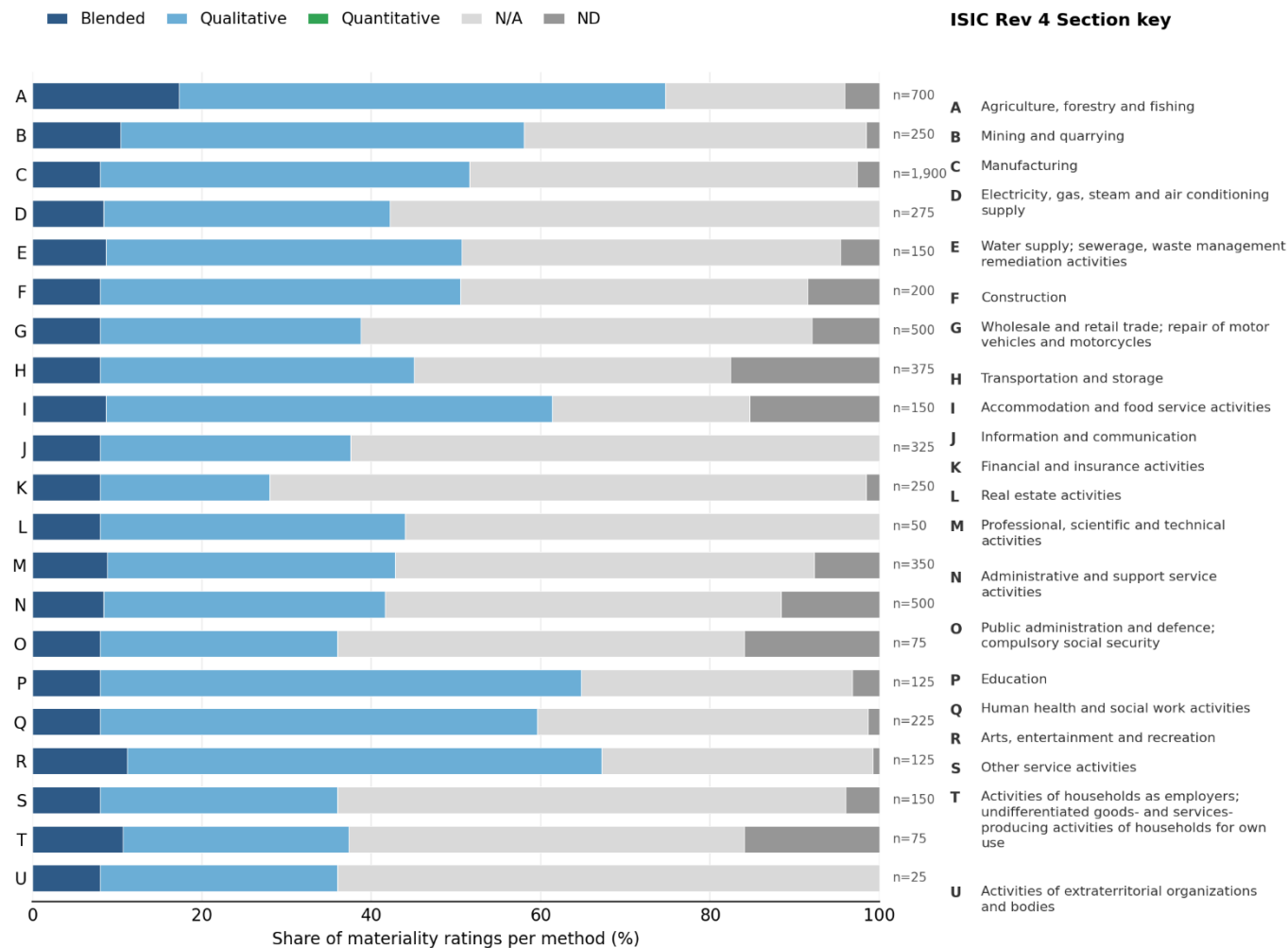


Figure 4: Stacked bar chart showing coverage of materiality ratings for dependencies per method used, including links marked as Not Applicable (N/A) and No Data (ND). n values represent the number of links between economic activities (total of 271 across 21 ISIC Rev 4 Sections) and ecosystem services (total of 25). 'Blended' refers to a mixed-methods qualitative and quantitative approach. Source: authors, generated using Claude Sonnet 5 by Anthropic.

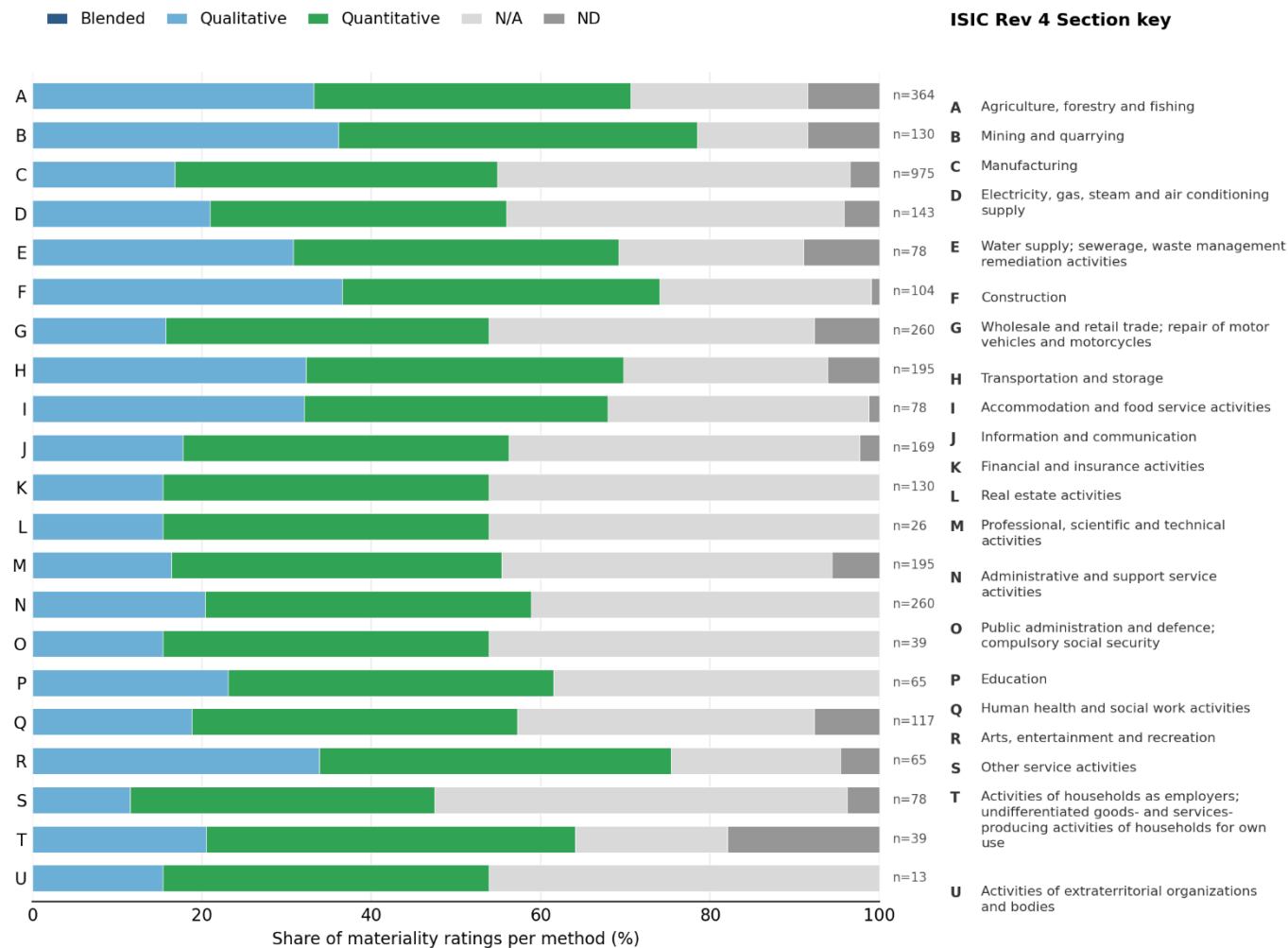


Figure 5: Stacked bar chart showing coverage of materiality ratings for pressures per method used, including links marked as Not Applicable (N/A) and No Data (ND). n values represent the number of links between economic activities (total of 271 across 21 ISIC Rev 4 Sections) and pressures (total of 13). 'Blended' refers to a mixed-methods qualitative and quantitative approach. Source: authors, generated using Claude Sonnet 5 by Anthropic.

3.2 ENCORE's uptake and contribution to the nature-related risk landscape: foundational infrastructure for nature-related assessments

ENCORE's structure and the method we used to build its knowledge base (see Section 2) have facilitated its integration, interoperability, and uptake by the private sector and other stakeholder groups (e.g., central banks, ministries of finance, and academia). Over time, this has allowed ENCORE to evolve beyond being a standalone assessment tool into infrastructure that underpins a broad array of nature-related risk methodologies, analytical tools, disclosure frameworks and policy applications (see examples below). ENCORE is widely recognised as one of the key entry points for organisations undertaking nature-related risk assessments (Broer & Nozeman 2023; Global Canopy 2025; Bailon et al. 2026; Taskforce on Nature-related Financial Disclosures 2026a). For example, recent editions of the *Global Survey of Nature Risk at Financial Firms* (Paisley & Nelson 2024, 2025) identify ENCORE as the most widely used framework among financial institutions for assessing nature-related risks. ShareAction's 2025 survey found that 41% of the largest asset managers in the world now use ENCORE (Sood et al. 2025). ENCORE's science-based methodology has also informed the work of international organisations such as the World Economic Forum and has been incorporated into leading guidance for corporate nature-related disclosure, such as the TNFD (Taskforce on Nature-related Financial Disclosures 2023a; World Economic Forum 2020).

Since 2021, the ENCORE platform has experienced sustained growth, reaching more than 18,000 registered users by 1 September 2026⁸. Users span a diverse range of economic actors, including financial institutions (across banking, insurance, investment), businesses, academic institutions, governments, intergovernmental organisations, and civil society organisations (as evidenced by diversity of publications in Annex 4).

The broad uptake of ENCORE has helped establish a common understanding, conceptual framework and evidence base for assessing exposure to nature-related risks across the economic and financial system. ENCORE has therefore made progress towards several of its target outcomes (Figure 2). For instance, its uptake by a wide range of businesses and financial institutions shows that it is contributing to improving understanding of dependencies and impacts on nature (outcome 1; Section 3.3.1). Its use in several new methodologies and tools shows that it is contributing to new approaches to measure and value nature (outcome 2; Section 3.3.2). Its inclusion in nature-related reporting guidance shows it is contributing to building capacity to manage and mitigate nature-related risks, and improving reporting and disclosure (outcomes 3 and 4; Section 3.3.1). Lastly, ENCORE's use by central banks, supervisors and other public bodies indicates that it may in time support development of nature-inclusive regulatory frameworks (outcome 5; Section 3.3.3).

3.3 Applications of the ENCORE knowledge base

ENCORE is commonly used across three complementary use cases: 1) enabling assessments for economic actors' nature-related reporting and disclosure efforts; 2) underpinning the wider ecosystem of nature-related methodologies and tools; and 3) informing country-level assessments, financial supervision and public policy.

3.3.1 Enabling assessments for economic actors' nature-related reporting and disclosure efforts

Typically, use of ENCORE for reporting and disclosure efforts entails matching up user-specific data on economic activities to the ISIC activities covered by ENCORE and generating a list of potentially material dependencies and pressures. User-specific data can be a simple list of economic activities

⁸ A 'registered user' means a user who has created and activated an account, but this does not necessarily indicate routine use of ENCORE.

(e.g., an integrated food and beverage company might compile a list of packaging facilities, distribution centres, and mills). Alternatively, additional contextual data can be added to support presentation or interpretation of results (e.g., an asset manager might compile financial data on the companies associated with each economic activity or the type of investment represented).

ENCORE has been integrated in various guidance documents that support nature-related reporting and disclosure efforts. A prominent example is the TNFD's LEAP (Locate, Evaluate, Assess, Prepare) approach. ENCORE is referenced within the Scoping, Locate and Evaluate components of LEAP as an initial materiality screening and prioritization tool (Taskforce on Nature-related Financial Disclosures 2023a; Global Canopy 2025).

ENCORE has supported hundreds of nature-related assessments by individual organisations. As of 31 July 2025, over 1,800 organisations had engaged on nature-related issues by joining the TNFD Forum (Taskforce on Nature-related Financial Disclosures 2025). Of those, 620 organisations, representing more than USD 20 trillion in assets under management, had committed to making voluntary disclosures aligned with TNFD. With over 500 TNFD reports published and ENCORE being a foundational tool used by many of those reports in early assessment stages, the tool has played an important role in guiding organizations in developing their understanding of dependencies and impacts on nature (World Economic Forum & Oliver Wyman 2025). A selection of publicly available TNFD-aligned reports can be found on the TNFD's website (Taskforce on Nature-related Financial Disclosures 2026b), many of which used ENCORE. A further, non-exhaustive list of examples of uptake can be found in Annex 4.

While major progress is still needed, activity around reporting and disclosure of nature-related dependencies, impacts, risks, and opportunities (DIROs) is rising as a result of many organisations' efforts (UNEP Finance Initiative 2019; Zu Ermgassen et al. 2022). This may indicate that the private sector's capacity to assess nature-related DIROs is increasing, which is an important first step towards managing and mitigating nature-related risks.

3.3.2 Underpinning the wider ecosystem of nature-related methodologies and tools

ENCORE's utility is also now growing beyond its own platform, making it an essential component of the emerging infrastructure that supports nature-related activity by the private sector. For example, several leading tools incorporate ENCORE's underlying data and methodology. These include the Swiss Re Institute's Biodiversity and Ecosystem Services Index, the WWF Biodiversity Risk Filter, NatureAlign, and SBTN's Materiality Screening Tool (Retsa et al. 2020; Hyman & Vijay 2024; Nature Finance 2026; WWF 2026). The latter, for example, is recommended to around 300 businesses at Step 1a (Materiality Screening) of SBTN's five-step target-setting framework. Through these integrations, ENCORE supports additional users who rely on its scientific foundations in their own downstream applications.

In this type of use case, ENCORE's data usually gets combined with data that allows for more context-specific analysis. For example, its materiality ratings might be adjusted based on spatial datasets that indicate the state of nature in specific locations. Users then get a more refined estimate of materiality. As with the previous use case, some new methodologies and tools also allow users to directly input their own company or firm specific data (such as locations of direct operations or financial weighting; Annex 4).

Certain emerging methodologies building from ENCORE now also aim to go beyond initial materiality screening and potential risk screening, towards assessing actual risks (Ranger et al. 2023; United Nations Environment Programme 2023b). For example, Ranger et al. (2023) used ENCORE's dependency materiality ratings to underpin part of a Hazard-Exposure-Vulnerability-based nature risk

methodology. This sets the ground for possible further work such as the development of scenarios focused on nature-related risks (European Central Bank et al. 2025) as well as assessment of nature-related risks in value chains (Funke et al. 2026). In these kinds of applications, ENCORE's dependency materiality ratings typically serve as a key input for assessing potential vulnerability of sectors to ecosystem degradation.

Owing to its interoperability, ENCORE is providing a standardised foundation to a complex array of methodologies and tools. The value of underpinning multiple tools lies not only in extending reach but also in fostering methodological consistency and comparability across the emerging nature-related assessment landscape. These new developments are advancing approaches to measure and value nature, which in turn may lead to nature being better integrated in private sector decision-making.

3.3.3 Informing country-level assessments, financial supervision and public policy

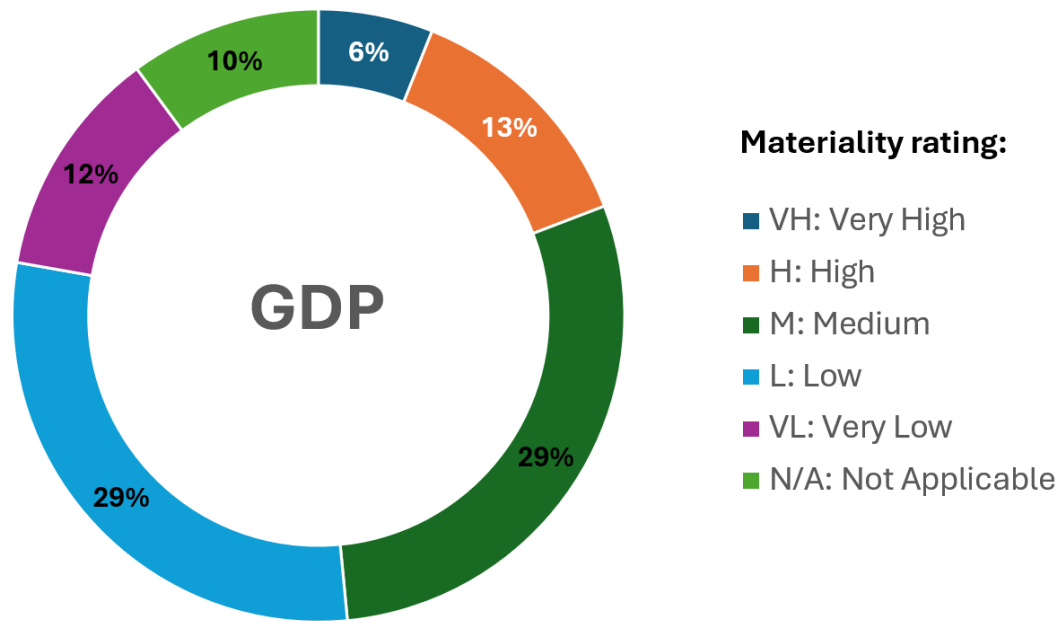
Current ENCORE use is global, with 55% of registered users in Europe, followed by Asia (28%), the Americas (12%), Oceania (3%) and Africa (2%). This highlights international uptake, as well as an opportunity to increase ENCORE's adoption beyond Europe.

Central banks have perhaps been among the most influential adopters of ENCORE, reflecting its credibility as a scientifically robust and internationally applicable data source for assessing exposure to nature-related financial risks. The Network of Central Banks and Supervisors for Greening the Financial System (NGFS) signposts ENCORE within its recently launched practical implementation package as a tool that uses simple terms and allows meaningful progress in risk assessment and supervisory practices (NGFS 2026). This kind of signposting, along with the earlier seminal work of the Dutch Central Bank (van Toor et al. 2020), have contributed to ENCORE being used by over 15 central banks, supervisors, regulators, and other governmental bodies. These include analyses undertaken by Banque de France, Banco de México, the European Central Bank, the Hungarian National Bank, Banco Central do Brasil, the Monetary Authority of Singapore, Bank Negara Malaysia, and the South African Reserve Bank (among others; Annex 4). These applications have helped central banks better understand how nature loss and ecosystem degradation may transmit risks through the financial system, contributing to the understanding of nature-related financial risk as a macro-financial policy issue.

As an example, Figure 6 provides an extract of Colombia's Medium-Term Fiscal Framework (*Marco Fiscal de Mediano Plazo*) – the country's leading macroeconomic policy (Ministerio de Hacienda y Crédito Público 2024). As part of their assessment using ENCORE, they found that 48% percent of Colombia's GDP, equivalent to USD 469.5 billion, is generated by industries with moderate to very high direct dependencies on nature. This is an example of the type of output that organizations can generate by combining ENCORE data with portfolio-level financial data. Such analyses support the assessment of nature-related dependencies and pressures across portfolios, country-level GDP data, or economic variables. In the case of Colombia's Medium-Term Fiscal Framework, ENCORE informed public policy and economic planning at the country level, helping to integrate nature into one of the government's principal macroeconomic planning instruments (Ministerio de Hacienda y Crédito Público 2024). A similar example can be seen in Ecuador where ENCORE analysis helped inform the country's National Biodiversity Strategy and Action Plan (NBSAP), which recognised biodiversity's contribution to national and local economies (Ministerio de Ambiente y Energía 2025). Using ENCORE helped the Ministry of Environment and Energy in Ecuador to identify potential feedback loops between sectors' pressures on ecosystem components that those same sectors depend on.

These examples illustrate how ENCORE-based nature-related dependency assessments are informing fiscal policy, national development, and national conservation planning. More recently, ENCORE’s use was also recommended in a methodological approach to guide nature-positive transition pathways for the United Kingdom’s economy (Lazurko et al. 2026). This new approach for the UK seeks to provide a practical bridge between nature-related targets and real-economy delivery.

Figure 4.2.1. Sectoral dependence on GDP derived from nature and its ecosystem services



Source: UNEP-WCMC (2024).
NTSP: Exploring how Colombia’s economic prosperity depends on the state of the natural environment, Cambridge, United Kingdom.

Figure 6: Colombia’s GDP exposure to nature-related dependencies. Translated by authors from source: Ministerio de Hacienda y Crédito Público (2024).

4. Discussion

ENCORE has provided a standardised approach to translating complex ecological relationships into a structured, sector-specific knowledge base (Section 2.1). This approach has been compared to the use of sector-level emissions data in early climate target setting, which allowed investors and regulators to identify high-exposure sectors and set targets before company-level emissions data existed (World Economic Forum & Oliver Wyman 2025; NGFS 2026). In doing so, ENCORE has provided an entry point for economic actors’ assessments and a baseline on which further tools and guidance have been built (Sections 3.3.1 and 3.3.2). ENCORE is by design a high-level tool, built to support screening at the portfolio and corporate-levels and intended to be used alongside data sources suited to individual decision contexts.

ENCORE’s increasing user base coincides with growing momentum around global biodiversity goals, sustainability disclosure requirements (e.g., CSRD), and emerging nature-related guidance, including TNFD’s LEAP approach and NGFS recommendations. While causality cannot be directly established, this trend suggests that expanding policy and market incentives create enabling conditions for the uptake that our theory of change assumes (Figure 2). As of 1 September 2026, ENCORE has over 18,000 registered users. It has informed nature-related assessments by over 15 central banks and regulators,

has been used in over 50 publications (Annex 4), and had supported 40 (or 80% of) TNFD-aligned reports by companies and financial institutions as of the end of 2025 (Global Canopy 2025). Additionally, the widely cited finding from the World Economic Forum that over half of global Gross Domestic Product (GDP) is moderately or highly dependent on nature and its services is based on analysis that draws from ENCORE (World Economic Forum 2020). The scale and stakeholder diversity of this uptake (Section 3.2) suggests that shared knowledge infrastructure of the kind ENCORE provides is becoming an important foundation for nature-positive pathways.

4.1 Future development priorities

Looking ahead, there are areas in which ENCORE can progress to achieve the desired outcomes and impact shown in our theory of change. Some of these are within the ENCORE partners' control and others pertain to the wider nature assessment space.

4.1.1 Areas under development

The scope of what the knowledge base represents is one area of active development. Ecosystem components and ecosystem types are the intersection point in the ENCORE knowledge base between dependencies and pressures. They underpin all ecosystem services that economic activities depend on, yet they can also be impacted by the pressures exerted by those same activities. This framing does not cover the positive impacts that economic activities can have on natural capital. A new 'opportunities' database is currently under development to address this. It will identify sector-specific actions that benefit both organisations and nature, either by reducing pressures exerted by activities or by creating positive outcomes for nature. Opportunities will be identified wherever the relevant dependency or pressure is already rated moderate, high, or very high.

Where the knowledge base does cover a relationship, a further question is how well it can be measured. The work conducted on the 2024 version of ENCORE allowed for significant progress on quantitative data for several pressures. However, six of the 13 pressures still rely on a qualitative methodology, and of the 25 ecosystem services in the knowledge base, only five had sufficient quantitative data to inform a blended qualitative-quantitative method (Figures 4 and 5). These gaps reflect the data available rather than the method itself. Closing them will require global scale measurement of the pressures economic activities exert and of typical magnitudes of dependence on ecosystem services.

Representation is a further constraint on the materiality ratings. ENCORE has not yet benefited from the integration of Indigenous and Local Knowledge and we will seek to address this in a respectful and inclusive way, adopting free, prior and informed consent and human-rights based approaches (Secretariat of the Convention on Biological Diversity 2004; UN Human Rights Council. Expert Mechanism on the Rights of Indigenous Peoples 2018; IPBES 2026). Such knowledge would help improve estimates of the materiality of both dependencies and pressures on nature in the knowledge base, particularly those that rely on qualitative data. Furthermore, developing materiality ratings for cultural ecosystem services posed a particular challenge. Limited data and the contested status of the underlying concepts (Section 1.1) left no agreed basis for assessment. As such, all dependencies were assigned a precautionary very high rating (Section 2.2.4). Until these gaps are closed, users should investigate such dependencies further through participatory approaches that integrate multiple knowledge systems and the knowledge held by Indigenous Peoples and other affected stakeholders. As the Taskforce on Inequality and Social-related Financial Disclosures (TISFD) matures, interoperability with people, nature and climate disclosure frameworks will be key for a just and articulated transition.

Just as the knowledge in ENCORE is not yet fully representative, neither is its use. Although ENCORE has informed economic actors and regulators globally, its user base remains concentrated in Europe. While the underlying drivers have not been formally assessed, this distribution may reflect a stronger regulatory momentum within Europe, as well as ENCORE having been developed and promoted by partners based in Europe. The ENCORE partners will address this imbalance through targeted regional engagement, building on an update to the ENCORE website's Spanish features in early 2026. Other languages remain a barrier that advances in AI could potentially support, although AI risks and challenges will need careful assessment.

4.1.2 Challenges requiring wider collaboration

Information on dependencies and pressures is not sufficient to provide a full picture of risk. To that end, ENCORE needs to be combined with spatial data and/or company-level data to provide context-specific insights, and this work is already underway (European Central Bank et al. 2025; Garel et al. 2025; Ranger et al. 2023; United Nations Environment Programme 2023a).

Combining data sources in this way depends in turn on a tools landscape built to fit together. Nature-related tools are important mechanisms through which many reporting and disclosure standards and regulations are implemented by the market. ENCORE is only one piece of the nature disclosure puzzle. All tool developers should ideally consider interoperability with other tools, as well as alignment with regulatory frameworks.

Lastly, we recognise that concerns around greenwashing remain prominent in the nature-business-finance space (Montgomery et al. 2024). ENCORE seeks to contribute to addressing these concerns by providing an open and transparent framework. While reporting and disclosure are important, they should be one step along a trajectory towards full sustainability. The private sector needs to then act on the information they collect through their reporting efforts, supported by capacity building and credible, long-term regulatory frameworks. This will require tools across the landscape to provide information not only on nature-related risks, but on the opportunities to mitigate and manage them. Such information would help users develop action plans or have more action-oriented discussions with key stakeholders. Further research could investigate whether dependency and impact visibility influences capital allocation towards transformative change for people, nature, and the economy.

4.2 Concluding remarks

ENCORE plays a key implementation-support role for businesses, financial institutions, central banks and governments as they move to operationalise the TNFD, Target 15 of the KMGBF, and other relevant initiatives, frameworks, and standards. While clear areas for further development remain, the 2024 updates to ENCORE's knowledge base have resulted in a more comprehensive basis for nature-related assessments. Ultimately, ENCORE's true value will lie in the decisions it helps to inform and the positive impacts those decisions can have on nature, people, and the economy. With broader uptake across regions and sectors, use of complementary data sources, and stakeholder engagement, ENCORE can help redefine approaches that have traditionally been blind to the economy's dependencies and impacts on nature.

Acknowledgements

We thank all those who have contributed to the development, testing and refining of ENCORE. A special thanks to Jonathan Gheysens for his contributions to the initial development of ENCORE's dependencies knowledge base. ENCORE has benefited from funding by the Swiss State Secretariat for

610 Economic Affairs (SECO), the MAVA Foundation, the Swiss Federal Office for the Environment
611 (BAFU/FOEN), and three Horizon Europe projects (SUSTAIN, Nature-3B, and VALOR). SUSTAIN was
612 funded by the EU's research and innovation program Horizon Europe under grant agreement No
613 101060320, the Swiss State Secretariat for Education, Research and Innovation (SERI), and by UK
614 Research and Innovation (UKRI) under the UK government's Horizon Europe funding guarantee
615 10038461. Nature-3B receives funding from the European Union's Horizon Europe research and
616 innovation programme under grant agreement No 101182455. VALOR receives funding from the
617 European Union's Horizon Europe research and innovation programme under grant agreement No
618 101181169.

References

- Bailon M, Bor A-M, González Redín J. 2026. Biodiversity measurement approaches: A practitioner's guide for financial institutions. Page 108. 5th edition. Finance for Biodiversity Foundation, Amsterdam, The Netherlands. Available from <https://www.financeforbiodiversity.org/publications/biodiversity-measurement-approaches-guide-5th-edition/>.
- Bishop J. 2013. The economics of ecosystems and biodiversity in business and enterprise. Earthscan, London.
- Broer W, Nozeman R. 2023. Taking Biodiversity into account, PBAF Standard v2023 – Assessment of Photo cover by Benjamin Balazs on Unsplash Dependencies on ecosystem services. Page 42. Partnership for Biodiversity Accounting Financials, Amsterdam, The Netherlands. Available from https://pbafglobal.com/files/downloads/PBAF_standard_assessment_of_dependenciesjune_2023.pdf.
- Cabernard L, Pfister S. 2021. A highly resolved MRIO database for analyzing environmental footprints and Green Economy Progress. *Science of The Total Environment* 755:142587.
- Convenience Sampling. 2018. Page The SAGE Encyclopedia of Educational Research, Measurement, and Evaluation. SAGE Publications, Inc., 2455 Teller Road, Thousand Oaks, California 91320. Available from <https://methods.sagepub.com/reference/the-sage-encyclopedia-of-educational-research-measurement-and-evaluation/i6126.xml> (accessed August 24, 2026).
- Convention on Biological Diversity. 2022. 15/4. Kunming-Montreal Global Biodiversity Framework. Page 15. Convention on Biological Diversity. Available from <https://www.cbd.int/doc/decisions/cop-15/cop-15-dec-04-en.pdf>.
- Convention on Biological Diversity. 2026. The Global Report on Collective Progress in the Implementation of the Kunming Montreal Global Biodiversity Framework: First Draft. Convention on Biological Diversity. Available from <https://s3.amazonaws.com/cbdddocumentspublic-imagebucket-15w2zyxk3prl8/a61b896636c945199136ea9bef08b78b-3>.
- Demuzere M, Orru K, Heidrich O, Olazabal E, Geneletti D, Orru H, Bhawe AG, Mittal N, Feliu E, Faehnle M. 2014. Mitigating and adapting to climate change: Multi-functional and multi-scale assessment of green urban infrastructure. *Journal of Environmental Management* 146:107–115.
- Díaz S et al. 2018. Assessing nature's contributions to people. *Science* 359:270–272.
- Díaz S, Pascual U. 2025. Reciprocity towards nature in the biodiversity science–policy interface. *People and Nature* 7:1129–1138.
- Elsner M, Atkinson G, Zahidi S. 2026. The Global Risks Report 2026: 21st Edition. Page 102. World Economic Forum. Available from <https://www.weforum.org/publications/global-risks-report-2026/>.
- European Central Bank et al. 2025. Nature at risk. European Central Bank, DE. Available from <https://data.europa.eu/doi/10.2866/3014103> (accessed July 28, 2026).
- European Environment Agency, editor. 2007. Halting the loss of biodiversity by 2010: proposal for a first set of indicators to monitor progress in Europe. Publications Office, Luxembourg.
- Ferraro KM, Ferraro AL, Lundgren E, Sommer NR. 2025. The use and abuse of ecosystem service concepts and terms. *Biological Conservation* 308:111218.
- Funke H, Wassénus E, Crona B, Christiaen C. 2026. Making Value-Chain Risks Visible: Extending ENCORE for Systemic Insights. *Business Strategy and the Environment*:bse.71329.
- Garel A, Romec A, Sautner Z, Wagner AF. 2025. Firm-Level Nature Dependence. SSRN. Available from <https://www.ssrn.com/abstract=5196826> (accessed July 24, 2026).
- Global Canopy. 2025. How financial institutions use ENCORE to assess dependencies and impacts on nature. Page 18. Global Canopy, Oxford. Available from <https://globalcanopy.org/wp-content/uploads/2026/01/GC-Using-ENCORE-for-TNFD-LEAP-Approach.pdf>.

Global Reporting Initiative. 2025. GRI 101: Biodiversity 2024. Page 49. Topic Standard. Global Reporting Initiative, Amsterdam. Available from <https://www.globalreporting.org/pdf.ashx?id=24534> (accessed August 3, 2026).

Hassan RM, editor. 2005. Ecosystems and human well-being. 1: Current state and trends / ed. by Rashid Hassan. Island Press, Washington, DC.

Hummel C, Poursanidis D, Orenstein D, Elliott M, Adamescu MC, Cazacu C, Ziv G, Chrysoulakis N, Van Der Meer J, Hummel H. 2019. Protected Area management: Fusion and confusion with the ecosystem services approach. *Science of The Total Environment* 651:2432–2443.

Hyman A, Vijay V. 2024, July. Materiality Screening Tool. Science Based Targets Network. Available from <https://sbtn.shinyapps.io/MaterialityScreeningTool/>.

IPBES. 2026. Summary for policymakers of the Methodological Assessment Report of the Impact and Dependency of Business on Biodiversity and Nature’s Contributions to People. Page (Jones M et al., editors). IPBES secretariat, Bonn, Germany. Available from <https://zenodo.org/doi/10.5281/zenodo.15369060> (accessed February 25, 2026).

Jenks GF. 1967. The Data Model Concept in Statistical Mapping. Pages 186–190 *International Yearbook of Cartography*, 7th edition.

Keith DA, Ferrer-Paris JR, Nicholson E, Kingsford RT, editors. 2020. IUCN Global Ecosystem Typology 2.0: descriptive profiles for biomes and ecosystem functional groups. IUCN, International Union for Conservation of Nature. Available from <https://portals.iucn.org/library/node/49250> (accessed July 22, 2026).

Kemp H et al. 2026. The Past, Present, and Future of Online Biodiversity Knowledge Systems. Annual Review of Environment and Resources DOI: 10.1146/annurev-environ-121224-084200. Available from <https://www.annualreviews.org/content/journals/10.1146/annurev-environ-121224-084200> (accessed August 19, 2026).

Lazurko A, Loerke E, Grub H, Gecchele L, Gkoumas V, Quint J, Dixon C, Murray H, Isaac NJB, Harrison PA. 2026. Co-creation and evaluation of Nature-Positive Transition Pathways for the UK economy. Page 65. Green Finance Institute, WWF, and UK Centre for Ecology & Hydrology, London, UK. Available from <https://www.greenfinanceinstitute.com/wp-content/uploads/2026/07/Nature-Positive-Transition-Pathways-Report-FV-1.pdf>.

Leach K et al. 2019. A common framework of natural capital assets for use in public and private sector decision making. *Ecosystem Services* 36:100899.

Mahajan V, Linstone HA, Turoff M. 1976. The Delphi Method: Techniques and Applications. *Journal of Marketing Research* 13:317.

Ministerio de Ambiente y Energía. 2025. Estrategia Nacional de Biodiversidad 2025 -2030. Page 264. Ministerio de Ambiente y Energía de Ecuador, Quito, Ecuador. Available from <https://www.ambienteyenergia.gob.ec/wp-content/uploads/downloads/2026/03/Estrategia-Nacional.pdf>.

Ministerio de Hacienda y Crédito Público. 2024. Marco Fiscal de Mediano Plazo 2024: Estrategia fiscal para la reactivación económica sostenible. Page 232. Gobierno de Colombia. Available from <https://www.minhacienda.gov.co/pol%C3%ADtica-fiscal/marco-fiscal-de-mediano-plazo/2024>.

Missemer A. 2018. Natural Capital as an Economic Concept, History and Contemporary Issues. *Ecological Economics* 143:90–96.

Mittempergher D, Vergez A. 2024. List of criteria and proposed indicators for measuring dependencies and impacts on biodiversity and ecosystem services. Page 1326. Available from <https://ec.europa.eu/research/participants/documents/downloadPublic?documentIds=080166e50ef74a37&appId=PPGMS> (accessed August 6, 2026).

Montgomery AW, Lyon TP, Barg J. 2024. No End in Sight? A Greenwash Review and Research Agenda. *Organization & Environment* 37:221–256.

- Mukherjee N, Hugé J, Sutherland WJ, McNeill J, Van Opstal M, Dahdouh-Guebas F, Koedam N. 2015. The Delphi technique in ecology and biological conservation: applications and guidelines. *Methods in Ecology and Evolution* 6:1097–1109.
- Natural Capital Coalition. 2016. Natural Capital Protocol. Page 136. Natural Capital Coalition, London. Available from https://naturalcapitalcoalition.org/capitals-approach/natural-capital-protocol/?fwp_filter_tabs=guide_supplement (accessed July 22, 2026).
- Natural Capital Finance Alliance, UNEP-WCMC. 2018. Exploring Natural Capital Opportunities, Risks and Exposure: A practical guide for financial institutions. Page 27. Geneva, Oxford, Cambridge. Available from https://www.unepfi.org/wordpress/wp-content/uploads/2018/11/NCFA_Exploring-Natural-Capital-Opportunities-Risks-and-Exposure_Nov-2018.pdf (accessed August 3, 2026).
- Nature Finance. 2026, August. Nature Align. Nature Finance, Geneva, Switzerland. Available from <https://www.naturefinance.net/making-change/nature-risk/naturealign/>.
- NGFS. 2026. NGFS 2026 Nature Package. Network of Central Banks and Supervisors for Greening the Financial System, Paris, France. Available from <https://www.ngfs.net/en/publications-and-statistics/publications/ngfs-2026-nature-package>.
- Paisley J, Nelson M. 2024. Global Survey of Nature Risk Management at Financial Firms 2024: A Discipline in its Infancy. Page 36. Global Association of Risk Professionals, Jersey City, USA. Available from <https://www.garp.org/white-paper/global-survey-nature-risk-2024>.
- Paisley J, Nelson M. 2025. 2025 Global Survey of Nature Risk Management at Financial Firms: An Emerging Discipline. Page 40. Global Association of Risk Professionals, Jersey City, USA. Available from <https://www.garp.org/white-paper/global-survey-nature-risk-2025>.
- Ranger N, Alvarez J, Freeman A, Harwood T, Obersteiner M, Paulus E, Sabuco J. 2023. The Green Scorpion: the Macro-Criticality of Nature for Finance – Foundations for scenario-based analysis of complex and cascading physical nature-related risks. Page 89. Environmental Change Institute, University of Oxford, Oxford, United Kingdom. Available from https://www.eci.ox.ac.uk/sites/default/files/2023-12/INCAF-MacroCriticality_of_Nature-December2023.pdf (accessed July 28, 2026).
- Retsa A, Schelske O, Wilke B, Rutherford G, de Jong R. 2020. Biodiversity and Ecosystem Services: A business case for re/insurance. Page 60. Swiss Re Management Ltd, Zurich, Switzerland. Available from https://www.swissre.com/institute/research/topics-and-risk-dialogues/climate-and-natural-catastrophe-risk/expertise-publication-biodiversity-and-ecosystems-services.html#.
- Schröter M, Van Der Zanden EH, Van Oudenhoven APE, Remme RP, Serna-Chavez HM, De Groot RS, Opdam P. 2014. Ecosystem Services as a Contested Concept: a Synthesis of Critique and Counter-Arguments. *Conservation Letters* 7:514–523.
- Secretariat of the Convention on Biological Diversity, editor. 2004. Akwé: Kon guidelines. Secretariat of the Convention on Biological Diversity, Montreal, Quebec.
- Snowball Sampling. 2018. Page The SAGE Encyclopedia of Educational Research, Measurement, and Evaluation. SAGE Publications, Inc., 2455 Teller Road, Thousand Oaks, California 91320. Available from <https://methods.sagepub.com/reference/the-sage-encyclopedia-of-educational-research-measurement-and-evaluation/i19094.xml> (accessed August 24, 2026).
- Sood A, Gray C, Vrubleviskis D, Middleton J, Collins M, Warshaw M. 2025. Point of No Returns 2025: A responsible investment benchmark of 76 of the world’s largest asset managers. Page 97. ShareAction, London, UK. Available from <https://shareaction.org/reports/point-of-no-returns-2025>.
- Svartzman R, Espagne E, Gauthey J, Hadji-Lazaro P, Salin M, Allen T, Berger J, Calas J, Godin A, Vallier A. 2021. A “Silent Spring” for the Financial System? Exploring Biodiversity-Related Financial Risks in France. Page 95. Working Paper WP #826. Banque de France, Paris, France. Available from <https://publications.banque-france.fr/en/silent-spring-financial-system-exploring-biodiversity-related-financial-risks-france> (accessed August 3, 2026).

771 Taskforce on Nature-related Financial Disclosures. 2023a. Guidance on the identification and
772 assessment of nature-related issues: The LEAP approach. Page 277. Version 1.1. Taskforce
773 on Nature-related Financial Disclosures, London, UK. Available from
774 [https://tnfd.global/publication/additional-guidance-on-assessment-of-nature-related-issues-](https://tnfd.global/publication/additional-guidance-on-assessment-of-nature-related-issues-the-leap-approach/#publication-content)
775 [the-leap-approach/#publication-content](https://tnfd.global/publication/additional-guidance-on-assessment-of-nature-related-issues-the-leap-approach/#publication-content) (accessed August 10, 2026).

776 Taskforce on Nature-related Financial Disclosures. 2023b. Recommendations of the Taskforce on
777 Nature-related Financial Disclosures. Page 154. Taskforce on Nature-related Financial
778 Disclosures. Available from [https://tnfd.global/wp-](https://tnfd.global/wp-content/uploads/2023/08/Recommendations-of-the-Taskforce-on-Nature-related-Financial-Disclosures-1.pdf?v=1781166870)
779 [content/uploads/2023/08/Recommendations-of-the-Taskforce-on-Nature-related-Financial-](https://tnfd.global/wp-content/uploads/2023/08/Recommendations-of-the-Taskforce-on-Nature-related-Financial-Disclosures-1.pdf?v=1781166870)
780 [Disclosures-1.pdf?v=1781166870](https://tnfd.global/wp-content/uploads/2023/08/Recommendations-of-the-Taskforce-on-Nature-related-Financial-Disclosures-1.pdf?v=1781166870) (accessed July 24, 2026).

781 Taskforce on Nature-related Financial Disclosures. 2025. TNFD 2025 Status Report. Page 34.
782 Taskforce on Nature-related Financial Disclosures, London, UK. Available from
783 <https://tnfd.global/tnfd-2025-status-report/>.

784 Taskforce on Nature-related Financial Disclosures. 2026a, August. Additional Guidance by sector.
785 Taskforce on Nature-related Financial Disclosures, London, UK. Available from
786 [https://tnfd.global/tnfd-publications/?_sft_framework-categories=additional-guidance-by-](https://tnfd.global/tnfd-publications/?_sft_framework-categories=additional-guidance-by-sector#search-filter)
787 [sector#search-filter](https://tnfd.global/tnfd-publications/?_sft_framework-categories=additional-guidance-by-sector#search-filter).

788 Taskforce on Nature-related Financial Disclosures. 2026b, August. Example TNFD reporting: A list of
789 illustrative examples of reporting the TNFD. Taskforce on Nature-related Financial
790 Disclosures, London, UK. Available from [https://tnfd.global/knowledge-hub/example-tnfd-](https://tnfd.global/knowledge-hub/example-tnfd-reporting/)
791 [reporting/](https://tnfd.global/knowledge-hub/example-tnfd-reporting/).

792 Tobin-de la Puente J, Mitchell A. 2026. The Little Book of Nature Business. Page 296. Global Canopy,
793 Oxford. Available from [https://globalcanopy.org/insights/publication/introducing-the-little-](https://globalcanopy.org/insights/publication/introducing-the-little-book-of-nature-business/)
794 [book-of-nature-business/](https://globalcanopy.org/insights/publication/introducing-the-little-book-of-nature-business/).

795 UK Government. 2014, March 6. Guidance: Environmental Impact Assessment. UK Government,
796 London, UK. Available from [https://www.gov.uk/guidance/environmental-impact-](https://www.gov.uk/guidance/environmental-impact-assessment)
797 [assessment](https://www.gov.uk/guidance/environmental-impact-assessment).

798 UN Human Rights Council. Expert Mechanism on the Rights of Indigenous Peoples. 2018. Free, prior
799 and informed consent : a human rights-based approach : study of the Expert Mechanism on
800 the Rights of Indigenous Peoples. Page 20. A/HRC/39/62. United Nations, Geneva,
801 Switzerland. Available from <https://digitallibrary.un.org/record/1642281?ln=en&v=pdf>.

802 UNEP Finance Initiative P for RI. 2019. Fiduciary Duty in the 21st Century. Page 60. UNEP FI, New
803 York, USA. Available from [https://www.unepfi.org/wordpress/wp-](https://www.unepfi.org/wordpress/wp-content/uploads/2019/10/Fiduciary-duty-21st-century-final-report.pdf)
804 [content/uploads/2019/10/Fiduciary-duty-21st-century-final-report.pdf](https://www.unepfi.org/wordpress/wp-content/uploads/2019/10/Fiduciary-duty-21st-century-final-report.pdf) (accessed August 22,
805 2026).

806 UNEP-WCMC. 2024. Explanatory note on the updated ENCORE knowledge base outlining business
807 dependencies and impacts on nature. Page 24. UNEP-WCMC, Cambridge. Available from
808 <https://encorenature.org/en/resources> (accessed July 22, 2026).

809 UNEP-WCMC. 2026. Nature Tools Compass. UN Environment Programme World Conservation
810 Monitoring Centre. Available from <https://wcmc.io/7ae5> (accessed August 7, 2026).

811 United Nations. 2024. System of Environmental-Economic Accounting: Ecosystem Accounting.
812 International Monetary Fund, Washington, D.C.

813 United Nations Environment Programme. 2023a. Nature Risk Profile: A methodology for profiling
814 nature related dependencies and impacts. Page 30. United Nations Environment
815 Programme, Cambridge, United Kingdom. Available from [https://resources.unep-](https://resources.unep-wcmc.org/products/WCMC_RT496)
816 [wcmc.org/products/WCMC_RT496](https://resources.unep-wcmc.org/products/WCMC_RT496).

817 United Nations Environment Programme. 2023b. Nature Risk Profile: A Methodology for Profiling
818 Nature Related Dependencies and Impacts. Page 30. UNEP-WCMC, Cambridge, United
819 Kingdom. Available from https://resources.unep-wcmc.org/products/WCMC_RT496.

820 van Toor J, Piljic D, Schellekens G, van Oorschot M, Kok M. 2020. Indebted to nature: Exploring
821 biodiversity risks for the Dutch financial sector. Page 44. De Nederlandsche Bank,

Amsterdam, The Netherlands. Available from
<https://www.dnb.nl/media/4c3fqawd/indebted-to-nature.pdf>.

Veerkamp CJ, Schipper AM, Hedlund K, Lazarova T, Nordin A, Hanson HI. 2021. A review of studies assessing ecosystem services provided by urban green and blue infrastructure. *Ecosystem Services* 52:101367.

World Economic Forum. 2020. Nature Risk Rising: Why the Crisis Engulfing Nature Matters for Business and the Economy. Page 36. New Nature Economy series. World Economic Forum, Cologny/Geneva, Switzerland. Available from
<https://www.weforum.org/publications/nature-risk-rising-why-the-crisis-engulfing-nature-matters-for-business-and-the-economy/>.

World Economic Forum, Oliver Wyman. 2025. Nature Positive: Corporate Assessment Guide for Financial Institutions. Page 55. Insight Report. World Economic Forum, Cologny/Geneva, Switzerland. Available from https://www.weforum.org/publications/nature-positive-corporate-assessment-guide-for-financial-institutions//?utm_.

World Economic Forum, Oliver Wyman. 2026. 50 Investible Opportunities for a New Nature Economy. Page 45. Insight Report. World Economic Forum, Geneva. Available from
https://reports.weforum.org/docs/WEF_50_Investible_Opportunities_for_a_New_Nature_Economy_2026.pdf.

WWF. 2026, August. WWF Biodiversity Risk Filter. WWF Germany, Berlin, Germany. Available from
<https://riskfilter.org/biodiversity/home>.

Zu Ermgassen SOSE, Howard M, Bennun L, Addison PFE, Bull JW, Loveridge R, Pollard E, Starkey M. 2022. Are corporate biodiversity commitments consistent with delivering 'nature-positive' outcomes? A review of 'nature-positive' definitions, company progress and challenges. *Journal of Cleaner Production* 379:134798.

Supporting Information

Annex 1: Additional detailed methodology

Details on the methodology, criteria and indicators used to develop ENCORE's materiality ratings can be found at: [List of criteria and proposed indicators for measuring dependencies and impacts on biodiversity and ecosystem services](#).

Further details on the limitations of the ENCORE knowledge base are provided in an [accompanying explanatory note](#).

Annex 2: Additional figures

The following are example visuals showing how users can interact with the ENCORE knowledge base on the ENCORE website.

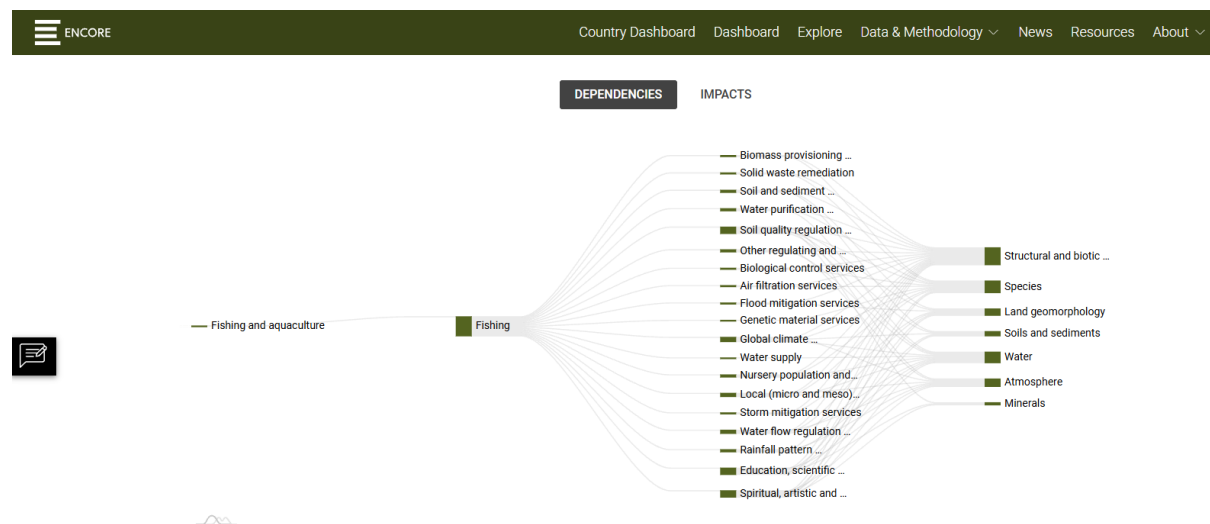


Figure S1: Visualization showing a flow diagram; on the right-hand side users can see ecosystem components, in the middle the ecosystem services, on the left-hand side the selected economic activity (fishing). Links are not weighted and solely reflect that a relationship has been identified between two components of the diagram. Users hovering over the links can obtain the respective materiality ratings. This visualization is available for dependencies and impacts. Source: ENCORE partners (2026).

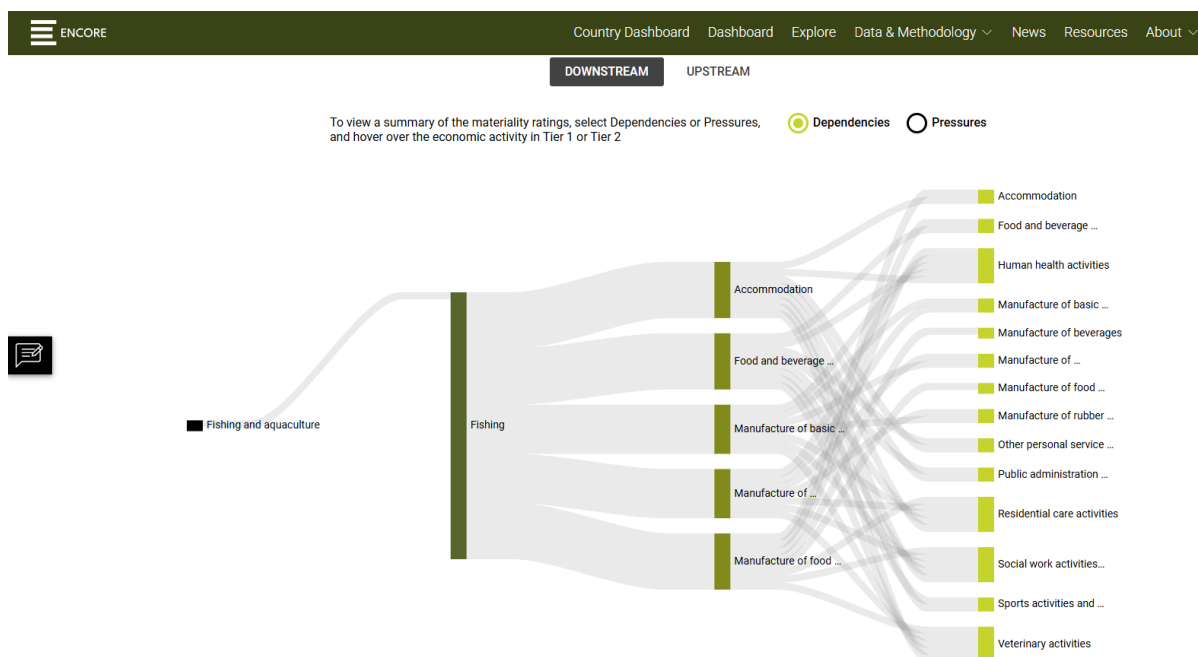


Figure S2: Visualization showing downstream key value chain links as shown on the ENCORE website. The size of the flow between tier 1 and tier 2 activities denotes the number of key value chain links shown. It does not reflect economic flow or materiality ratings. This visualization is available for dependencies and pressures, and upstream and downstream links (two tiers each). Source: ENCORE Partners (2026).

Annex 3: Database of dependencies and pressures

The full database of dependencies and pressures for the 271 economic activities covered by ENCORE is available for viewing and download under a Creative Commons Attribution ShareAlike 4.0 International licence at <https://encorenature.org/en/data-and-methodology/methodology>. The database includes a list of references and online materials that were consulted during its development.

Annex 4: List of publications that have used ENCORE

Table S1: A non-exhaustive list of publications that have used ENCORE.

Publication title	Author(s)	Year	Link
New Nature Economy series	WEF	2020	Link
Indebted to Nature: Exploring biodiversity risks for the Dutch financial sector	Van Toor J, Plijic D, Schellekens G, van Oorschot M, Kok M	2020	Link
Initial Guidance for Business	Science Based Targets Network	2020	Link
Biodiversity Guidance	Capitals Coalition	2020	Link
Biodiversity and Ecosystem Services: A business case for re/insurance	Retsa A, Schelske O, Wilke B, Rutherford G, de Jong R	2020	Link
The Case for a Task Force on Nature-related Financial Disclosures	Global Canopy and Vivid Economics	2020	Link
Quantitative easing and nature loss: Exploring nature-related financial risks and impacts in the European Central Bank's corporate bond portfolio	Kedward et al.	2021	Link

Nature-Related Financial Risks in Brazil	Calice P, Kalan FD, Miguel F	2021	Link
A “Silent Spring” for the Financial System? Exploring Biodiversity-Related Financial Risks in France	Svartzman R, Espagne E, Gauthey J, Hadji-Lazaro P, Salin M, Allen T, Berger J, Calas J, Godin A, Vallier A	2021	Link
Sustainable by Nature: Our biodiversity roadmap	BNP Paribas AM	2021	Link
Robeco’s approach to biodiversity: Towards the integration of nature-related risks, opportunities and impacts in our investments	Bosch L, Kulak M, Peppelenbos L, van der Werf P	2022	Link
An Exploration of Nature-Related Financial Risks in Malaysia	World Bank & Bank Negara Malaysia	2022	Link
Central banking and supervision in the biosphere: An agenda for action on biodiversity loss, financial risk and system stability	NGFS INSPIRE	2022	Link
A Biodiversity Guide for Business	Church R, Walsh M, Engel K and Vaupel M	2022	Link
From impacts to dependencies: A first global assessment of corporate biodiversity risk exposure and responses	Collaco de Carvalho SH, Cojoianu T, Ascui F	2022	Link
The economy and banks need nature to survive	Elderson F	2023	Link
Why Biodiversity Matters	ZSL and Caceis Investor Services	2023	Link
Dependencies and impacts of the Mexican banking sector on ecosystem services	Martinez-Jaramillo S, Mora F, Escobar-Farfán LOL, Montañez-Enríquez R	2023	Link
Taking biodiversity into account: PBAF Standard v2023 – Assessment of Dependencies on ecosystem services	Partnership for Biodiversity Accounting Financials (PBAF)	2023	Link
Biodiversity-related Finance Risks – why it matters and how can we measure them? Case study of Georgia	Nikuradze E, Tvalodze S	2023	Link
Nature-related Financial Risks: a Conceptual Framework to guide Action by Central Banks and Supervisors	Network for Greening the Financial System	2023	Link
A supervisory framework for assessing nature-related financial risks: Identifying and navigating biodiversity risks (OECD Business and Finance Policy Papers)	OECD	2023	Link
Fiscal Year 2023 Activity Report	Government Pension Investment Fund (GPIF) of Japan	2023	Link
Living in a world of disappearing nature: physical risk and the implications for financial stability	Boldrini S, Ceglar A, Lelli C, Parisi L, Heemskerk I	2023	Link
Fidelity’s Nature Roadmap	Fidelity	2023	Link
Managing nature risks: From understanding to action	Evison W, Ping Low L, O’Brien D	2023	Link
Socioeconomic and spatially-explicit assessment of Nature-related risks: The case of South Africa	Hadji-Lazaro P, Calas J, Godin A, Sekese P, Skowno A	2023	Link
Nature Risk Disclosures 2023	Norges Bank Investment Management	2024	Link

Nature-related financial risks in our own account investments: An exploratory case study and deep dive in electric utilities	Tiems I, Smid V, Ginther C	2024	Link
Study for a methodological framework and assessment of potential financial risks associated with biodiversity loss and ecosystem degradation – Final report	European Commission: Directorate-General for Financial Stability, Financial Services and Capital Markets Union, Trinomics, IASA, Czieleski, M., Dekker-Hufler, C. et al.	2024	Link
A case study on nature data: Development Bank of Southern Africa	Development Bank of Southern Africa and Oliver Wyman	2024	Link
Biodiversity loss and financial stability as a new frontier for central banks: An exploration for France	Hadji-Lazaro et al.	2024	Link
Nature on the investment agenda: A portfolio analysis of impacts and dependencies	NEI	2024	Link
Assessing nature-related risks in the Hungarian financial system: Charting the impact of nature's financial echo (OECD Environment Working Papers, No. 243)	Boffo R. et al.	2024	Link
Sustainable by Nature: Our Biodiversity Roadmap – 3-Year Update	BNP Paribas	2024	Link
Nature guidance for the mobile industry	GSMA and Quantis	2025	Link
Assessing the impacts and dependencies on nature: A case study using a diversified UK asset owner portfolio	Campbell F, Pilkington J, Cairns E, Backhouse L, Lukas H	2025	Link
Financing our natural capital: A practical guide for FIs getting started on nature financing	Singapore Sustainable Finance Association	2025	Link
Study on Nature-Related Financial Risks in Zambia	UNDP	2025	Link
Global review of models for scenario analysis: capabilities and gaps in informing the CBD Kunming-Montreal Global Biodiversity Framework	Kim H, Walkden P, Rowe R, Lenzner B, Maney C	2025	Link
European banks face significant vulnerability to ecosystem degradation and climate change	Ceglar A, Marques A, Boldrini S	2025	Link
Firm-Level Nature Dependence	Romec A, Sautner Z, Garel A, Wagner AF	2025	Link
Integrating Nature Into Sovereign Debt Markets: Towards a New Sovereign Debt Nature Assessment Model	Finance for Biodiversity Foundation	2025	Link
Making Value-Chain Risk Visible: Extending ENCORE for Systemic Insights	Funke H, Wassénus E, Crona B, Christiaen C	2025	Link
Loan pricing and biodiversity exposure: Nature-related spillovers to the financial sector (Research in International Business and Finance, 75, 102724)	Becker A, Di Girolamo FE, Rho C	2025	Link
Initial TNFD-aligned Disclosure Report	Nankai Electric Railway Co., Ltd.	2026	Link
TNFD: Getting Started with Data and Metrics	Green Finance Institute	2026	Link

Co-creation and evaluation of Nature-Positive Transition Pathways for the UK economy	Lazurko A, Loerke E, Grub H, Gecchele L, Gkoumas V, Quint J, Dixon C, Murray H, Isaac NJB, Harrison PA	2026	Link
--	--	------	----------------------

878