ENCORE Insights
Country Dashboard

Funded by
the European Union

Methodology

For Country Dashboard version 1

December 2025

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1. Introduction

The ENCORE Insights: Country Dashboard developed under the Horizon-funded Nature-3B project by Global Canopy enables regulators, policymakers, civil society and financial institutions to understand how each of the European Union (EU)'s 27 economies depends on nature and is exposed to nature loss as a result. It combines data about the extent of sectors and subsectors' nature dependency with data on their monetary value to help identify the most critical parts of the economy in terms of exposure to nature degradation. Importantly, it quantifies those dependencies across countries' supply chains and differentiates between their domestic and foreign exposure to allow for more targeted policy responses.

The Country Dashboard is the first of the ENCORE Insights websites. These are satellite projects of ENCORE, produced by the ENCORE partners Global Canopy, United Nations Environment Programme World Conservation and Monitoring Centre (UNEP-WCMC) and United Nations Environment Programme Finance Initiative (UNEP FI). They combine the ENCORE knowledge base with other data to bring new insights about the economy's dependency on nature and its impact on it.

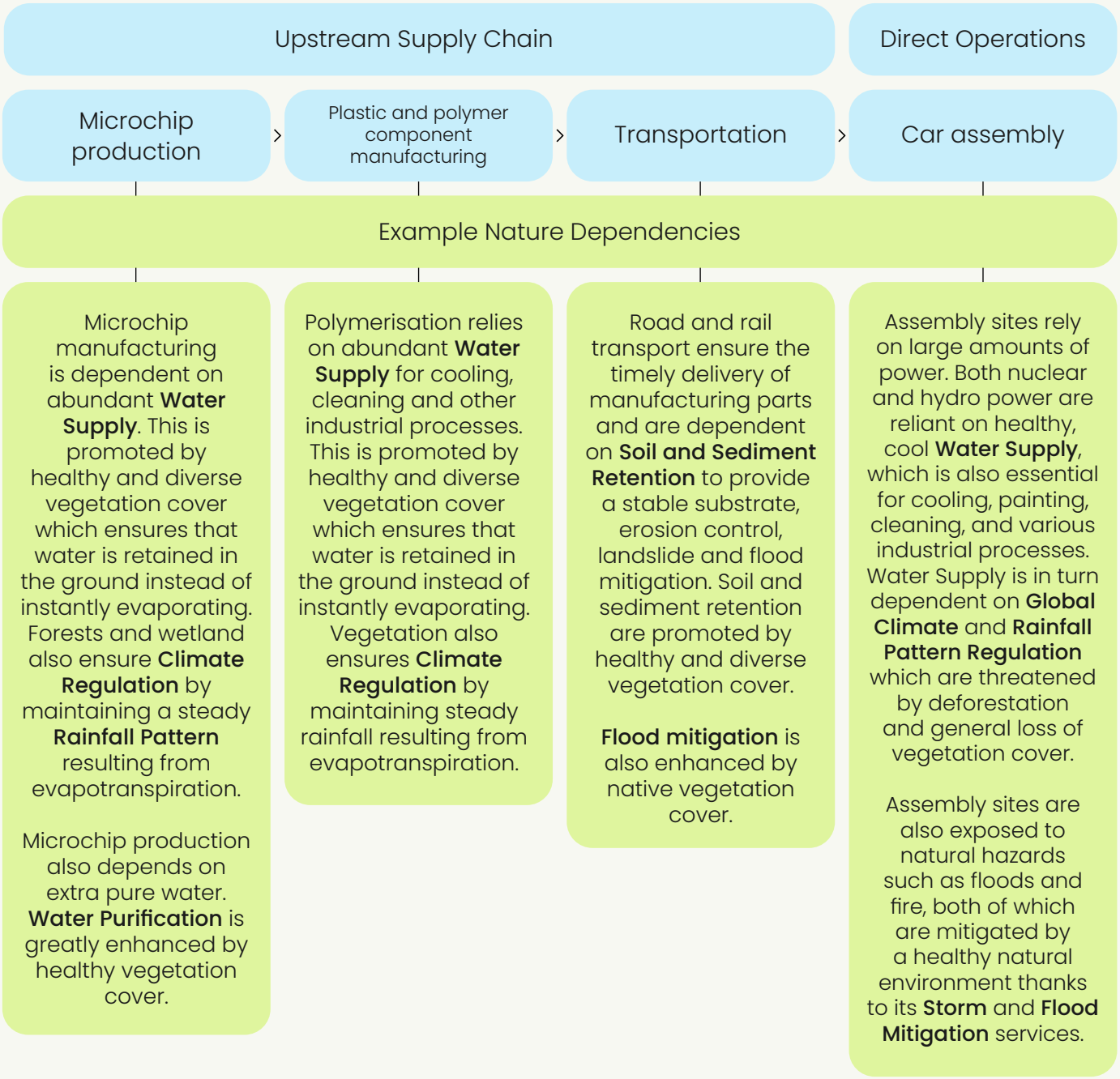
The Country Dashboard quantifies the exposure of EU27 economies on ecosystem services in a visually engaging and accessible format. Additionally, it supports the advancement of open-source and transparent methodologies for nature-related economic risks, providing accountability and catalysing action within the sector. This document sets out the methodology used to calculate individual and aggregate EU economies' exposure to nature loss for Version 1 of the Country Dashboard launched in December 2025.

2. Context

Ecosystem services are the connections between nature and business. Each of these services represents a benefit that nature provides to enable or facilitate economic activities such as clean air and water, pollination for crops and the regulation of climate and fertile soil for food production (United Nations et al., 2021). All economic activities therefore fundamentally depend on nature to some extent as nature provides the raw materials, resources and essential processes necessary for the production of goods and services (Figure 1). This dependence exposes companies and national economies to significant risks as disruptions to natural systems can affect production either directly or propagate through supply chains. All industries are exposed to nature-related risk to some degree, with consequences for national economic stability and public health. To effectively address and mitigate this exposure, it is important to quantify these dependencies on nature at the national and sector level.

Figure 1

Simplified supply chain schematic showing how the production of cars is dependent on nature at multiple points in the supply chain. The ecosystem service dependencies are simplified for illustrative purposes and are not exhaustive.



3. Data

The analysis of nature dependencies combines two main datasets: ENCORE and EXIOBASE. ENCORE provides an indication of an economic activity's dependence on nature but it does not provide any data on the monetary value of this activity. EXIOBASE, on the other hand, is a global dataset based on national accounts that assigns a monetary value to economic sectors and subsectors in each country. By bringing these two datasets together, the Country Dashboard sheds light on sectors and subsectors' monetary exposure to nature loss. EXIOBASE also describes supply chain linkages within and between countries, which allows the Country Dashboard to quantify exposure across a country's international supply chain.

3.1 ENCORE

3.1.1 Data Description

ENCORE was developed by Global Canopy, UNEP-FI and UNEP-WCMC with funding from the Swiss State Secretariat for Economic Affairs (SECO) and the MAVA Foundation. ENCORE was launched in 2018 with the original aim to support financial institutions and companies to understand how their activities rely on nature. The ENCORE knowledge base provides linkages between economic activities and the ecosystem services upon which they depend. In 2024, it was updated under the SUSTAIN project. The 2024 updated version has been used in this analysis[1].

Footnote 1

For further information, see the ENCORE update and methodology: https://encorenature.org/resources/explanatory-note-on-the-updated-encore-knowledge-base-outlining-business-dependencies-and-impacts-on-nature

3.1.2 Economic Activities classification

The ENCORE economic activities are categorised using the UN's International Standard Industrial Classification of All Economic Activities (ISIC Rev 4). ISIC divides economic activities into Sections, which are further broken down into Divisions, Groups and Classes (Figure 2). This provides materiality ratings for 271 economic activities based on either ISIC group or class level (levels 3 and 4).

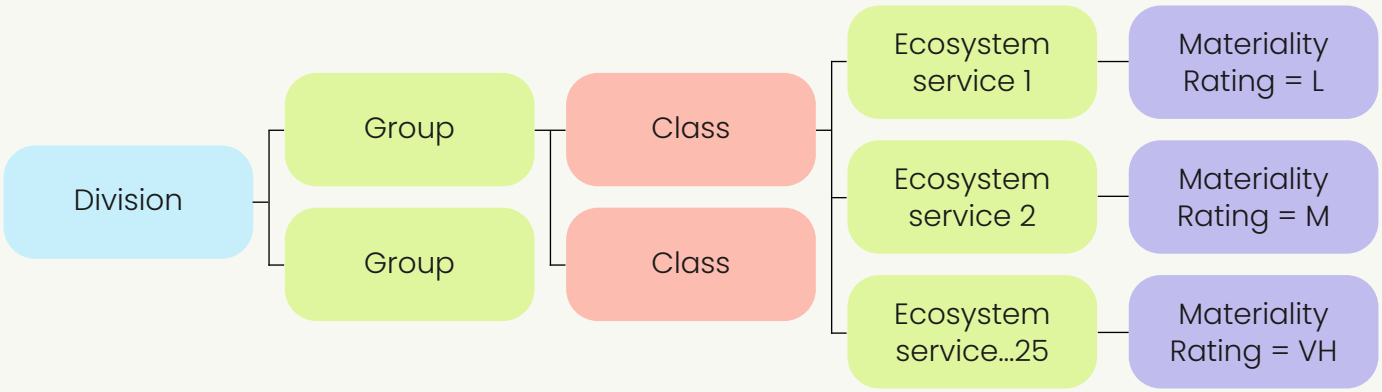


Figure 2

Schematic of the structure of ISIC economic activities, association to ecosystem services and allocation of materiality ratings. Ecosystem Service materiality ratings are provided either at the Class or Group level.

3.1.3 Ecosystem Services

In ENCORE, ecosystem services are defined as the connections between nature and business with each ecosystem service representing a benefit that nature provides to enable or facilitate economic activities. Ecosystem services are classified according to the UN System of Environmental Economic Accounting Ecosystem Accounting categorisation of ecosystem services (United Nations et al., 2021). This comprises 25 ecosystem services[2] within three categories:

1. **Provisioning services** (i.e. those related to the supply of food, fibre, fuel and water).
2. **Regulating and maintenance services** (i.e. those related to activities of filtration, purification, regulation and maintenance of air, water, soil, habitat and climate).
3. **Cultural services** (i.e. the experiential and non-material services related to the perceived or realised qualities of ecosystems whose existence and functioning enables a range of cultural benefits to be derived by individuals).

For a full description of each of the 25 ecosystem services in ENCORE, see Appendix 6.1.

Footnote 2

Some ecosystem services are considered Final ecosystem services and other intermediate. For the purposes of this analysis, we have included all 25 ecosystem services, both final and intermediate.

3.1.4 ENCORE Materiality Ratings

In ENCORE, an ISIC economic activity's dependence on nature is assessed by assigning a materiality rating to each of the 25 ecosystem services on which it depends, so that each activity has 25 **ENCORE Materiality Ratings**. Materiality ratings provide an indication of the significance of an economic activity's potential nature-related dependencies at a typical global level. The term 'material' in this context refers to *"significant or important to consider in the decision-making process"* (ENCORE, 2024)[3]. Materiality ratings use a rating scale of Very High (VH), High (H), Medium (M), Low (L) and Very Low (VL). If an economic activity does not depend on a given ecosystem service, it is assigned Not Applicable (NA). It is assigned No Data (ND) where there is insufficient evidence to assign a rating. See Appendix 6.2 to understand these dependency ratings further.

Footnote 3

https://encorenature.org/resources/explanatory-note-on-the-updated-encore-knowledge-base-outlining-business-dependencies-and-impacts-on-nature

3.1.5 Data Limitations

The qualitative links between economic activities and ecosystem services in the ENCORE knowledge base are high-level, global links. Therefore, where there is a dependency link recorded for an economic activity, it does not mean that all production engaging in that activity has that dependency (you can read more about the limitations in the ENCORE knowledge base here).

ENCORE's materiality ratings represent a typical level of nature-related dependency at a global scale and are not location-specific. This means, for instance, that a sector's dependency rating on *'pollination services'* is the same everywhere, regardless of its geographical location. This spatial non-specificity becomes more limited for regulating services, for example, a sector's rating for material dependence on ***'flood mitigation services'*** will be the same everywhere, even though the actual exposure is highly localised.

Additionally, these ratings are not designed to be compared across different ecosystem services. Whilst they can be used to compare a single ecosystem dependency between sectors (e.g. comparing water use dependency between rice cultivation and plastic manufacturing), they should not be used to compare the materiality of different ecosystem services against each other (e.g. comparing the 'very high' materiality of a sector's *'water supply'* to its 'very low' materiality for *'pollination services'*).

Finally, the materiality rating of a sector or subsector purely relates to the *direct, physical* exposure of its own operations. In the case of the financial and insurance industry, this means that the materiality of investments, loans or underwriting activities is not taken into account. As a result, indirect, financed exposure is excluded by this macro-economic assessment and should be calculated separately using financial portfolio data to trace exposure across the whole portfolio.

3.2 EXIOBASE

3.2.1 Data Description

EXIOBASE[4] is a global multi-regional input-output (MRIO) database that maps the complex economic flows within and between sectors and

Footnote 4

https://exiobase.eu/

countries to detail national production, global supply chains and final consumption patterns (Stadler et al., 2018). Data from national accounts – particularly Supply-Use Tables (SUTs) – is harmonised and linked with international trade data to enable analysis of the global production and interconnectedness of goods and services. Data is provided for 163 subsectors using the NACE categorisation system (Statistical Classification of Economic Activities in the European Community: NACE code, revision 1). Coverage is provided for 44 countries, which are located mostly in the EU and in the OECD, and 5 'rest of the world' regions.

EXIOBASE version 3.9.6 (compiled 2020) has been used in the analysis. The core EXIOBASE 3.9 model uses SUTs up to 2020 and now-casted[5] up to 2022 using global trade and macro-economic data.

Footnote 5

Now-casting in EXIOBASE is the process of updating the multi-regional input-output (MRIO) database to more recent years for which official, fully compiled data is not yet available. It uses macroeconomic data and bilateral trade statistics as proxies to estimate the current economic structure, bridging the time gap between the latest complete database (e.g., 2020) and the present.

3.2.2 Data Limitations

EXIOBASE, like all MRIO models, is built on Leontief input–output theory, which assumes:

- Fixed production relationships: each industry uses a fixed proportion of inputs to produce one unit of output with no substitution between inputs is allowed.
- Homogeneous products and producers: all firms within a sector in a given country are assumed to produce a single, identical product mix using the same technology.
- No price or behavioral dynamics: changes in demand are met through proportional increases in production — there are no market adjustments, supply constraints, or feedback effects.

As a result, the model's estimated supply chain flows may be inaccurate.

Furthermore, as EXIOBASE relies heavily on 'now-casting,' the reliability of the data for more recent years is lower. The current analysis uses now-casted data to 2022 based on 2020 data. It should therefore be noted that the impact of the Coronavirus pandemic is not adequately captured in post-pandemic years as well as more recent changes in the geopolitical climate and global trade tariff impacts.

4. Analysis Methodology

4.1 Overview

This analysis quantifies nature dependencies of national economies within the EU27. To quantify the economic significance of different parts of the global supply chain, we combine direct and total dependencies with an 'origin of trade' perspective. This allows us to quantify dependencies based on the origin (domestic vs imported value-added) and supply chain tier (direct and total supply chain), moving beyond a simple direct and indirect exposure to nature loss to provide a more complete and granular picture of a country's total economic exposure via its whole supply chain. It informs policymakers which vulnerabilities from nature loss are through domestic production and which are embedded in imports, allowing for a

more targeted policy response. To the best of our knowledge, this is the first nature dependency analysis differentiating between domestic and foreign dependencies[6].

The analysis integrates the two key datasets: ENCORE for sector-level direct nature dependency materiality ratings and EXIOBASE for monetary estimates of national sectoral production through in-country exchanges and global trade flows.

The core of the approach involves the following steps:

1. **Whole supply chain dependencies:** Calculating consolidated materiality ratings from the ENCORE direct materiality ratings for relevant parts of the supply chain, at home and abroad (section 4.3.1).
2. **Monetary value decomposition:** Calculating value-added components (for both domestic and foreign production) from EXIOBASE to represent the economic significance of different parts of the supply chain (section 4.3.2).
3. **Derived Metrics:** Combining the economic components with the materiality ratings to derive the monetary value, or proportion, of a sector or country under high nature dependency (section 4.5.1).

Decomposing dependencies and economic value into domestic and foreign terms allows users to query nature dependencies in multiple dimensions to answer questions such as: How does a country's reliance on nature through domestic production compare to its reliance on nature through imports? The Country Dashboard provides a user with the ability to view exposures across these multiple dimensions to query for comprehensive assessment.

The subsequent sections detail each step of this analytical process (summarised in Figure 3), from data preparation, core calculations to the final derivation of dependency scores and their use in the Country Dashboard. The whole analysis is implemented in Python v3.13.2.

Footnote 6

Svartzman et al. (2021), Ranger et al. (2024) and Ceglar et al. (2025) differentiate between direct and indirect exposure, with indirect exposure potentially including both domestic and foreign exposure.

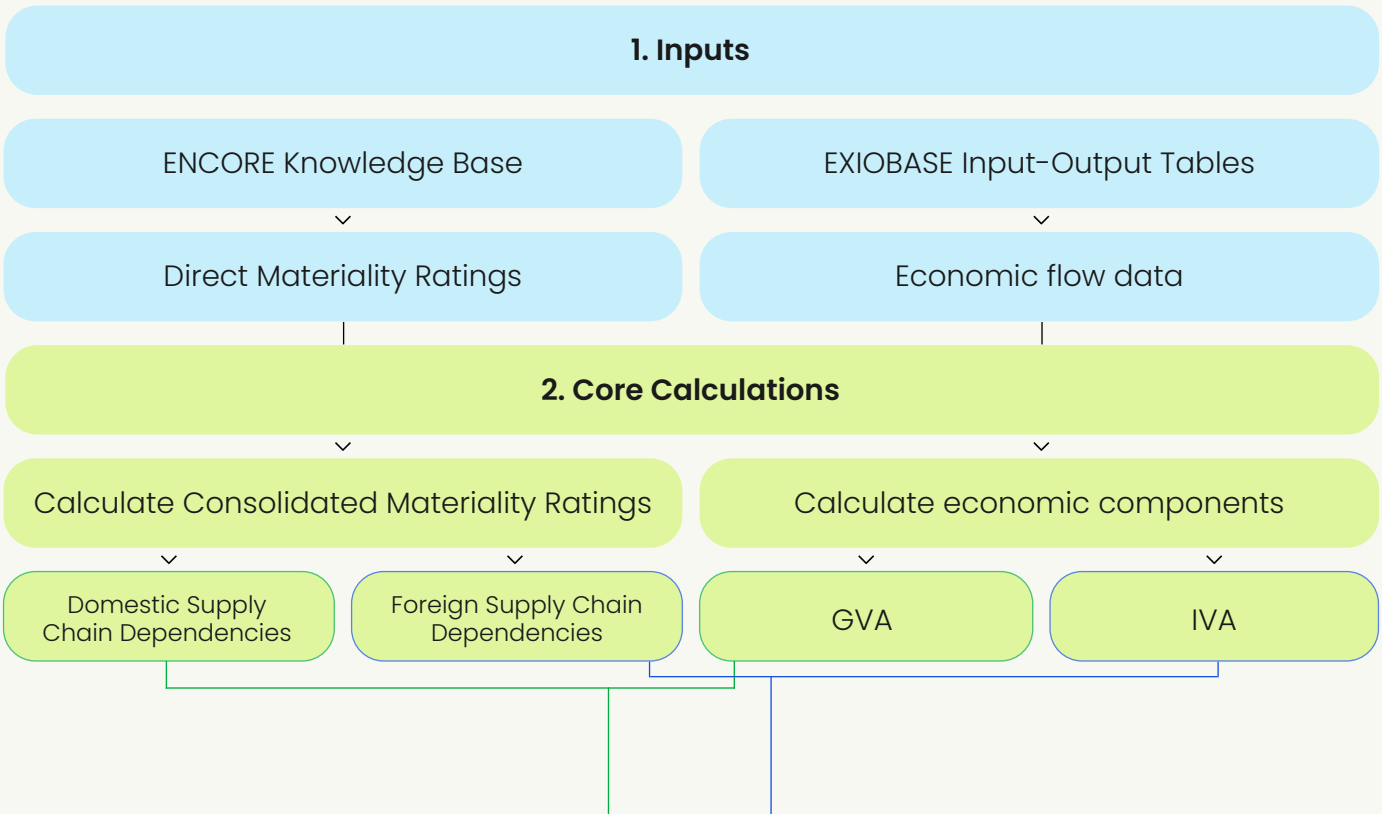
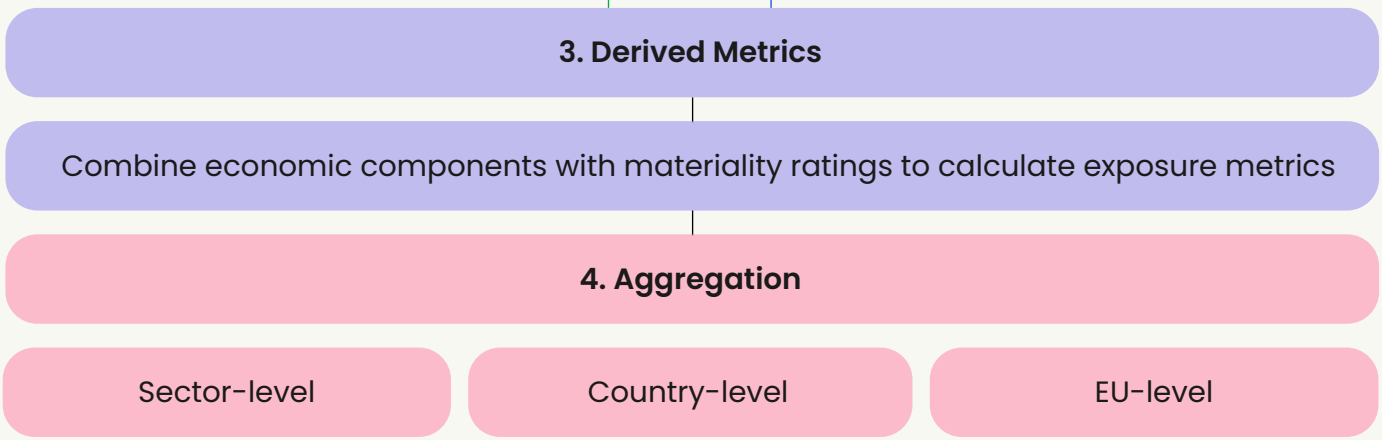


Figure 3

Summary of analysis workflow showing input data, core calculations, derived metrics and aggregation.



4.2 Materiality Ratings

4.2.1 Direct Materiality Ratings

In ENCORE, an ISIC economic activity's dependence on nature is assessed by assigning a materiality rating to each of the 25 ecosystem services on which it depends, so that each activity has 25 ENCORE Materiality Ratings. Materiality ratings provide an indication of the significance of an economic activity's potential nature-related dependencies at a typical global level. The term 'material' in this context refers to "significant or important to consider in the decision-making process" (ENCORE, 2024). Materiality ratings use a rating scale of Very High (VH), High (H), Medium (M), Low (L) and Very Low (VL). If an economic activity does not depend on a given ecosystem service, it is assigned Not Applicable (NA). It is assigned No Data (ND) where there is insufficient evidence to assign a rating. See Appendix 6.2 to understand these dependency ratings further.

Table 1
Values applied when converting the categorical ENCORE materiality ratings to numerical ratings.

ENCORE Materiality Rating	Assigned Numerical Score
Very High (VH)	1
High (H)	0.8
Medium (M)	0.6
Low (L)	0.4
Very Low (VL)	0.2
No Data (ND)	0
Not Applicable (NA)	NaN

This sector concordance approach means we lose the granularity of ecosystem service ratings at the ISIC sector level. However, this approach was selected to meet the requirements of users expressing a preference for NACE sectors. It also ensures that the precision of EXIOBASE data is retained, as mapping EXIOBASE onto ENCORE would require splitting the EXIOBASE values between ENCORE ISIC sectors.

As ENCORE Materiality Ratings do not have a geographical component (e.g. the subsector *'Manufacture of electrical machinery and apparatus'* in Country A has the same materiality rating for each ecosystem service as *'Manufacture of electrical machinery and apparatus'* in Country B), a matrix representing **Direct Materiality Ratings**, D_{direct} , was generated

to reformat the data into a country-sector format for subsequent calculations. This results in a matrix with the 25 ecosystem services on the rows and EXIOBASE country-subsectors on columns with materiality ratings for each ecosystem service duplicated across each country-subsector pair. Therefore, the 25 ratings assigned to any given subsector are identical across all countries in the matrix.

4.2.2 Consolidated Materiality Rating

As a subsector has materiality ratings for each 25 ecosystem services, a single **Consolidated Materiality Rating** is calculated to summarise its overall dependency. This consolidated rating is derived from aggregating **Direct Materiality Ratings** from the D_{direct} matrix using the method defined by Hirschbuehl et al. (2025) to integrate three key aspects of dependency. This gives a more comprehensive score compared to a simple average or maximum:

i. **Breadth of Dependency** (score 1): Measures the diversity of a subsector's reliance on nature by counting the number of different ecosystem services it depends on normalised by the total number of ecosystem services. A high score here indicates a sector is exposed to a wide range of potential physical dependencies.

ii. **Average intensity of dependency** (score 2): Captures the typical level of reliance across all services, preventing the score from being skewed by a few low- or high-impact services.

iii **Peak Dependency** (score 3): Highlights the single most critical exposure. It captures the assumption that a high dependency on a single ecosystem service poses a significant, concentrated risk, even if other dependencies are low. This ensures that the most significant dependency is not understated.

The equation used for the consolidated dependency score is:

$$D_{consolidated} = ⅓\ Score_1 + ⅓\ Score_2 + ⅓\ Score_3$$

Where:

$Score_1$ = Normalised number of different sectoral ecosystem dependencies

$Score_2$ = Mean materiality rating of all ecosystem service dependencies

$Score_3$ = Maximum strength of any individual dependency

The *'water supply'* ecosystem service is excluded from this calculation to avoid double counting. As a final ecosystem service, *'water supply'* reflects the combined contributions of other ecosystem services—including water flow regulation and water purification—which are already separately included in the ENCORE knowledge base (United Nations et al, 2021).

4.2.3 Nature Dependencies

Whilst the **Direct Materiality Ratings** provides a measure of a subsector's *direct* physical dependencies on ecosystem services, we require the total dependency across a subsector's supply chain in order to understand the

economic value exposed. Nature dependencies across the whole supply chain are therefore calculated to represent the average dependency score of a subsector's suppliers, weighted by their total economic importance to the sector using each supplier's share of inputs from the Leontief Inverse matrix (B)[7]. This captures the importance of a supplier within the supply chain as well as their dependency on nature, giving more weight to a larger supplier than a smaller one.

Footnote 7

This calculation logic for upstream dependencies is aligned with the method by Swartzman et al, 2021.

For a subsector, Nature Dependencies are calculated in two different dimensions:

1. **The Domestic Nature Dependency Rating** ($D_{domestic}$) is the mean weighted **Consolidated Materiality Rating** of its producer and all its upstream domestic suppliers, representing the mean dependency embodied in goods and services sourced from within the same country;
2. **The Foreign Nature Dependency Rating** ($D_{foreign}$) is the mean weighted **Consolidated Materiality Rating** of all its foreign suppliers, representing the mean dependency embodied in goods and services sourced from other countries.

Specifically:

$$D_j^{\,supply\ chain} = \frac{\sum_i D_i B_{i,j}^{comp}}{\sum_i B_{i,j}^{comp}}$$

Where

D_i is the Consolidated Materiality Rating from the $D_{consolidated}$ matrix of the supplier subsector i,

$B_{i,j}^{comp}$ is the total output required from supplier i to satisfy demand from j from the Leontief Inverse, filtered for either domestic or foreign suppliers,

$\sum_i B_{i,j}^{comp}$ is the total Leontief Inverse coefficients from all supplier subsectors i, filtered for either domestic or foreign suppliers.

Whilst Direct Materiality Ratings (D_{direct}) do not vary geographically, **Nature Dependency Ratings** ($D_{domestic}$) and ($D_{foreign}$) are influenced by the location and mix of suppliers within a subsector's supply chain. This results in varying upstream nature dependencies for the same subsector in different countries, reflecting regional variations in economic structures. The chosen method for calculating total supply chain nature dependencies is a weighted mean to provide an estimate of the overall risk profile embodied in a subsector's supply chain. This method can dilute the influence of highly dependent subsectors and smooths the overall dependency profile. Therefore, the results from this analysis provides an indicative comparative assessment of exposure between subsectors within countries and further analysis would be required to identify critical single dependencies within supply chains.

Nature Dependencies are averaged across subsectors to obtain their corresponding sector-level Nature Dependency.

4.3 Monetary Value Decomposition

To differentiate between the domestic part of the supply chain and the foreign imported part we calculate **Gross Value Added (GVA)** for each

country-subsector to quantify domestic production, and **Imported Value Added (IVA)** to capture the value added generated in another country used in domestic production through imports:

i. **Gross Value Added (GVA)** captures the value created by domestic industries and labour that ultimately serves either domestic consumption or exports. It directly measures the value - added generated *within the country's borders* that is linked to a subsector's activity. It also contributes to a country's GDP.[8]

ii. **Imported Value Added (IVA)** is the economic value generated in *another country* that is embodied in a country's final demand or exports. Whilst not part of GDP, this captures a country's economic reliance on upstream production occurring abroad. This is calculated as the sum of Imported Value Added in Domestic Final Demand and Imported Value Added in Gross Exports.[9]

These economic components are calculated from core matrices and vectors in EXIOBASE: the *A* matrix (direct requirements), *Z* matrix (intermediate consumption), *Y* matrix (final demand), *B* matrix (Leontief inverse) and *x* vector (total outputs) as per the calculations below.

Footnote 8

GVA does not completely decompose into Domestic Value Added in Final Demand (DVA_{fd}) and Domestic Value Added in Exports (DVA_e) as DVA_e includes some double counting terms as a full accounting decomposition was not undertaken. Therefore, the sum of DVA_{fd} and DVA_e is slightly greater than GVA.

Footnote 9

This is equivalent to the term Foreign Content (FC) in Koopman et al. (2013)'s decomposition of Trade in Value-Added Exports.

4.3.1 GVA Calculation

Gross Value Added (GVA) for each country-subsector is calculated from EXIOBASE using the factor income approach by multiplying the diagonal matrix of direct value-added coefficients ($\hat{V}$) by the total output vector (x) as detailed below.[10]

$$GVA = \hat{V}\,x$$

Where:

$\hat{V}$ (Value-Added Coefficient Matrix) *is* a diagonalised matrix of value-added coefficients where each diagonal element $v_{(r,i)}$ is the ratio of value-added to gross output for the producing country *r*, subsector *i*. This is derived by summing the direct input coefficients for subsector *i* (column *i* of the *A* matrix) and subtracting from 1. The resulting vector of value-added shares is then diagonalised.

$$v_{(r,i)} = 1 - \sum_{(s,j)} a_{(s,j),(r,i)}$$

x is the total output vector for each country-subsector.

Footnote 10

Alternatively GVA can be calculated using the production method where GVA is the total output of a sector (x vector) minus the value of intermediate goods and services (column sums of Z matrix).

4.3.2 IVA Calculation

Imported Value Added (IVA) is the sum of the Foreign Value Added in Final Demand (FVA_{fd}) and Foreign Value Added in Gross Exports (FVA_e) for each country, subsector *(c,j)*:

Total IVA = FVA in Final Demand + FVA in Gross Exports

These FVA components are calculated using the *VB* matrix which links value added to final demand via the Leontief Inverse matrix, representing the underlying value-added production structure of the global economy. An element $VB_{(r,j)(s,k)}$ from this matrix represents the total value added

originating from producing subsector *j* in country *r* that is required to produce one unit of final demand from consuming subsector *k* in country *s*.

The *VB* matrix is the product of two key matrices:

$$VB\ matrix = \hat{V}\ B$$

Where:

$\hat{V}$ (Value-Added Coefficient Matrix) is a diagonalised matrix of value-added coefficients where each diagonal element $v_{(r,i)}$ is the ratio of value added to gross output for the producing country *r*, sector *i*. This is derived by summing the direct input coefficients for sector *i* (column *i* of the *A* matrix) and subtracting from 1:

$$v_{(r,i)} = 1 - \sum_{(s,j)} a_{(s,j),(r,i)}$$

The resulting vector of value-added shares is then diagonalised. The use of $\hat{V}$ is designed to avoid double counting in the *A* matrix by representing the value added by primary factors of production excluding intermediate inputs. It captures the value created at each stage of production rather than the total value of output.

B (Leontief Inverse Matrix) is the matrix $(I - A)^{-1}$, where *I* is the identity matrix and *A* is the Direct Requirements Matrix. B captures all direct and indirect intermediate linkages showing the total output required from every subsector to satisfy one unit of final demand from any subsector.

The *VB* matrix is multiplied by the relevant final demand or gross export vector as per the formulae below, representing the value added originating in subsector *i* of country *r*:

$$FVA_{fd(r,i)} = \sum_{(s',j)} \sum_{(s \neq s')} v_{(s,k)}\, b_{(s,k)(r,j)}\, Y_{D(r,i)}$$

$$FVA_{e(r,i)} = \sum_{(s',j)} \sum_{(s \neq s')} v_{(s,k)}\, b_{(s,k)(s',j)}\, E_{(s',j)}$$

Where:

- $FVA_{fd(r,i)}$ is Foreign Value Added embodied in Final Demand
- $FVA_{e(r,i)}$ is Foreign Value Added embodied in Exports
- *r, i* is the producing country *(r)* and, subsector *(i)*
- *s, j* is the consuming country *(s)* and subsector *(j)* of final output
- *s, k* is used as a summation index, representing a foreign country *(s)* and sector *(k)* supplying value-added to country r
- $s \neq r$ indicates that the value-added originates in a foreign country *(s)* that is different from the country under analysis *(r)*
- Y_D represents the domestic final demand vector
- E represents the gross exports vector (as calculated below).

4.3.3 Gross Exports Calculation

Gross exports (*E*) are calculated using the fundamental input-output

identity which states that a country's total output (x) must equal the sum of domestic intermediate use ($Z_{domestic}$), domestic final demand ($Y_{domestic}$), and exports (E).[11] Rearranging this identity allows for the calculation of exports for each country-sector:

$$E = x - (Z_{domestic} + Y_{domestic})$$

4.3.4 Decomposition limitations

The underlying logic for the calculation of the decomposed terms uses the VBY matrix to avoid double counting in the A matrix by capturing the value created at each stage of production rather than the total value of the output. The adopted approach follows the calculation logic presented by Aslam et al., (2017) to calculate the content of domestic and foreign value added in exports (equivalent to Domestic Content and Foreign Content in Koopman et al., (2014) terms). As a result, these do include some double-counting due to complex supply chains and re-importing goods as intermediate inputs. Therefore, the sum of Domestic Value Added in Final Demand and in Gross Exports is marginally greater than GVA. Similarly, the sum of FVA in Final Demand and FVA in Gross Exports marginally overestimates total IVA.

In comparison to more complete value-added in trade decomposition frameworks such as those proposed by Borin and Mancini (2023), Koopman et al., (2014) and Wang et al., (2013), this 'simplified' decomposition was selected to be relevant and interpretable for end-users. This approach aims to provide insights into nature dependencies within different parts of a national economy's supply chain by origin for policy analysis, whilst acknowledging it contains elements that would be excluded in a strict national accounting (GDP) context.

4.4 Derived Metrics and Dashboard Elements

The Country Dashboard is designed to identify critical parts of a country's economy exposed to nature loss by bringing together dependency data with sectors' monetary value. Critical subsectors are defined as those possessing both high monetary value and high nature dependency. Metrics are therefore derived from these two components to differentiate these vulnerabilities: **Nature Dependency** from the domestic or foreign part of the supply chain and an economic value-added component (**GVA** or **IVA**), also called Economic Size.

4.4.1 Exposure Metrics

In order to calculate how much monetary value is exposed to nature degradation for each country and sector, the **Nature Dependency** ratings for each subsector are categorised into high, medium or low dependency groups using the bandings in Table 2 below.[12] Domestic **Nature Dependencies** are used to categorise the country-sectors **GVA** and the foreign **Nature Dependencies** used to categorise the country-sectors **IVA**. The 163 subsectors are then aggregated into 23 sector groups for each country using the groupings and sector mapping in Appendix 6.3.[13] The total value of the sector group's economic value (GVA or IVA) that is categorised as high, medium or low dependency is summed and

Footnote 11

Alternatively, gross exports (E) can be calculated as the sum of all sales to foreign entities, encompassing both foreign intermediate sales (sales of intermediate goods to other countries) and foreign final demand sales (sales of final goods to other countries): $E=Z_{foreign\text{-}intermediate\text{-}sales} + Y_{foreign\text{-}final\text{-}demand\text{-}sales}$

Footnote 12

It should be noted that it isn't appropriate to use the original ENCORE rating scale from Table 1, as the consolidated materiality ratings are not comparable in distribution to the direct materiality ratings.

Footnote 13

This is aligned with the method used by the Joint Research Committee Hirschbuehl et al. (2025) and Evison et al. (2023) based on industry groups from the World Economic Forum (WEF) Strategic Intelligence.

the proportion calculated as a percentage of the sector's total value. This provides a comparison of a sector's dependency relative to other sectors within the country.

Table 2

The score bandings used to apportion the consolidated ecosystem scores into high-medium-low groups. The bandings for our analysis were informed by the distribution of domestic and foreign consolidated dependency scores across all country-sectors.

Dependency Level	Bandings
High	≥0.66
Moderate	≥0.5 and <0.66
Low	<0.5

4.4.2 Country Headline Figures

The sector-level exposure metrics are used to derive headline figures at the country and EU levels. These country- and EU-level metrics are calculated by summing the total economic value across all relevant sectors (for country-level data) or by summing the total economic value across all sectors in all EU27 countries (for the EU-level aggregate). These headline figures provide an indication of dependency for risk prioritisation and screening across economic sectors and countries. They do not represent, and should not be interpreted, as probable or absolute economic losses but instead indicate *relative* potential in-country exposure for comparative analysis for a first step in targeted risk assessment.

The following headline figures are presented on the Country Dashboard (Figure 4):

Domestic Value Highly Exposed: The proportion of a country's domestic economic activity that is highly dependent on nature. This value is calculated by summing the **GVA** of all domestic producers and upstream suppliers' subsectors whose **Nature Dependency** falls within the 'high dependency' category (i.e. a rating of ≥ 0.66). It is presented as both a monetary value and as a percentage of a country's total **GVA**.

Imported Value Highly Exposed: The proportion of a country's imports that are highly dependent on nature. This value is calculated by summing the **IVA** of all foreign suppliers' subsectors whose **Nature Dependency** falls within the 'high dependency' category (i.e. a rating of ≥ 0.66). It is presented as both a monetary value or percentage of a country's total **IVA**.

Total Value Highly Exposed: The aggregate monetary value of a country's economy that is highly dependent on nature. This value is calculated by summing the **Domestic Value Highly Exposed** and the **Imported Value Highly Exposed** to represent the total exposure of the economy to nature loss.

Country Exposure Score: A consolidated score capturing the country's overall dependency on nature calculated as its **Total Value Highly Exposed** as a percentage of the sum of its GVA and IVA.

4.4.3 Exposure Profile

The Exposure Profile matrix visualises the relationship between the economy and nature dependency. A country's overall exposure to nature

loss is a function of two components: a sector's dependency on nature and its economic size, allowing users to compare exposures across multiple views: **Domestic Value** and **Imported Value**.

Sectoral Exposure Profile (Matrix View): A plot that visually positions a country's sectors based on their exposure to nature-related risks. It is a scatter plot with two key axes: Economic Size on the x-axis showing a relative scaled monetary value of a sector's **GVA** or **IVA**; and the **Nature Dependency** of domestic or foreign suppliers respectively on the y-axis showing the sector's dependency on nature. By mapping a sector's **Economic Size** against its **Nature Dependency**, the plot divides sectors into four distinct quadrants that reveal the relative scale of exposure for each sector.

Quadrant Definitions:

1. **Critically Exposed (Upper-right):** Sectors in this quadrant have a large relative Economic Size and a high Nature Dependency. These sectors are highly significant to the economy and also acutely exposed to nature-related risks. Any disruption to the ecosystem services they depend on could have a widespread and severe impact at the national level.
2. **Economic Driver (Lower-right):** This quadrant represents sectors with a large relative **Economic Size** but a low **Nature Dependency**. They are key contributors to the economy with a relatively lower reliance on nature, suggesting a more resilient and less exposed position regarding nature-related risks.
3. **Exposed Niche (Upper-left):** Sectors in this quadrant are characterised by a high **Nature Dependency** but are smaller in relative Economic Size. Whilst relatively less significant at the national level, these sectors are highly dependent on nature. Their high exposure could have significant impacts due to potential knock-on effects through the supply chain or due to their strategic economic importance beyond their size.
4. **Low Exposure (Lower-left):** This quadrant contains sectors with both a relative small Economic Size and a low Nature Dependency. They have a relatively lower impact on the overall economy and a lower reliance on nature, making them the least exposed to nature-related risks.

Dependency Breakdown: A horizontal bar that visualises the distribution of a sector's economic value across different levels of dependency on nature. It is calculated by summing the GVA or IVA for all sub-sectors within a sector and grouping them by their **Nature Dependency** rating. The chart displays the proportions for high (rating ≥ 0.66), medium (rating ≥ 0.5 and <0.66), and low (rating < 0.5) dependency categories as a percentage of the sector's total economic value.

5. Appendix

5.1 Ecosystem Service Definitions

Ecosystem services	Definition
	Provisioning Services
Biomass provisioning services	Biomass provisioning services include the ecosystem contributions to the growth of the following: cultivated plants that are harvested by economic units for various uses including food and fibre production, fodder and energy; grazed biomass that is an input to the growth of cultivated livestock; cultivated livestock and livestock products (e.g., meat, milk, eggs, wool, leather); animals and plants (e.g. fish, shellfish, seaweed) in aquaculture facilities that are harvested for various uses; trees and other woody biomass in both cultivated (plantation) and uncultivated production contexts that are harvested for various uses including timber production and energy; fish and other aquatic biomass that are captured in uncultivated production contexts for various uses; wild animals, plants and other biomass that are captured and harvested in uncultivated production contexts for various uses. Biomass provisioning services are final ecosystem services (except the grazed biomass provisioning services, which may also be an intermediate service to livestock provisioning services).
Genetic material services	Genetic material services are the ecosystem contributions from all biota (including seed, spore or gamete production) that are used by economic units, for example (i) to develop new animal and plant breeds; (ii) in gene synthesis; or (iii) in product development directly using genetic material. This is most commonly recorded as an intermediate service to biomass provisioning.
Water supply	Water supply services reflect the combined ecosystem contributions of water flow regulation, water purification, and other ecosystem services to the supply of water of appropriate quality to users for various uses including household consumption. This is a final ecosystem service.
Other provisioning services - Animal based energy	Physical labour is provided by domesticated or commercial species, including oxen, horses, donkeys, goats and elephants. These can be grouped as draught animals, pack animals and mounts.
	Regulating and maintenance services
Global climate regulation services	Global climate regulation services are the ecosystem contributions to the regulation of the chemical composition of the atmosphere and oceans that affect global climate through the accumulation and retention of carbon and other GHG (e.g., methane) in ecosystems and the ability of ecosystems to remove (sequester) carbon from the atmosphere. This is a final ecosystem service.

Local (micro and meso) climate regulation	Rainfall pattern regulation services are the ecosystem contributions of vegetation, in particular forests, in maintaining rainfall patterns through evapotranspiration at the sub-continental scale. Forests and other vegetation recycle moisture back to the atmosphere where it is available for the generation of rainfall. Rainfall in interior parts of continents fully depends upon this recycling. This may be a final or intermediate service.
Rainfall pattern regulation	Local climate regulation services are the ecosystem contributions to the regulation of ambient atmospheric conditions (including micro and mesoscale climates) through the presence of vegetation that improves the living conditions for people and supports economic production. Examples include the evaporative cooling provided by urban trees ('green space'), the role of urban water bodies ('blue space') and the contribution of trees in providing shade for humans and livestock. This may be a final or intermediate service.
Air filtration services	Air filtration services are the ecosystem contributions to the filtering of air-borne pollutants through the deposition, uptake, fixing and storage of pollutants by ecosystem components, particularly plants, that mitigates the harmful effects of the pollutants. This is most commonly a final ecosystem service.
Soil quality regulation services	Soil quality regulation services are the ecosystem contributions to the decomposition of organic and inorganic materials and to the fertility and characteristics of soils, e.g., for input to biomass production. This is most commonly recorded as an intermediate service.
Soil and sediment retention services	Soil erosion control services are the ecosystem contributions, particularly the stabilising effects of vegetation, that reduce the loss of soil (and sediment) and support use of the environment (e.g., agricultural activity, water supply). This may be recorded as a final or intermediate service. Landslide mitigation services are the ecosystem contributions, particularly the stabilising effects of vegetation, that mitigates or prevents potential damage to human health and safety and damaging effects to buildings and infrastructure that arise from the mass movement (wasting) of soil, rock and snow. This is a final ecosystem service.
Solid water remediation	Solid waste remediation services are the ecosystem contributions to the transformation of organic or inorganic substances, through the action of micro-organisms, algae, plants and animals that mitigates their harmful effects. This may be recorded as a final or intermediate service.

Water purification services	Water purification services are the ecosystem contributions to the restoration and maintenance of the chemical condition of surface water and groundwater bodies through the breakdown or removal of nutrients and other pollutants by ecosystem components that mitigate the harmful effects of the pollutants on human use or health. This may be recorded as a final or intermediate ecosystem service.
Water flow regulation services	Baseline flow maintenance services are the ecosystem contributions to the regulation of river flows and groundwater and lake water tables. They are derived from the ability of ecosystems to absorb and store water, and gradually release water during dry seasons or periods through evapotranspiration and hence secure a regular flow of water. This may be recorded as a final or intermediate ecosystem service. Peak flow mitigation services are the ecosystem contributions to the regulation of river flows and groundwater and lake water tables. They are derived from the ability of ecosystems to absorb and store water, and hence mitigate the effects of flood and other extreme water-related events. Peak flow mitigation services will be supplied together with river flood mitigation services in providing the benefit of flood protection. This is a final ecosystem service.
Flood mitigation services	Coastal protection services are the ecosystem contributions of linear elements in the seascape, for instance coral reefs, sand banks, dunes or mangrove ecosystems along the shore, in protecting the shore and thus mitigating the impacts of tidal surges or storms on local communities. This is a final ecosystem service. River flood mitigation services are the ecosystem contributions of riparian vegetation which provides structure and a physical barrier to high water levels and thus mitigates the impacts of floods on local communities. River flood mitigation services will be supplied together with peak flow mitigation services in providing the benefit of flood protection. This is a final ecosystem service.
Storm mitigation services	Storm mitigation services are the ecosystem contributions of vegetation including linear elements, in mitigating the impacts of wind, sand and other storms (other than water related events) on local communities. This is a final ecosystem service.
Noise attenuation services	Noise attenuation services are the ecosystem contributions to the reduction in the impact of noise on people that mitigates its harmful or stressful effects. This is most commonly a final ecosystem service.
Pollination services	Pollination services are the ecosystem contributions by wild pollinators to the fertilization of crops that maintains or increases the abundance and/or diversity of other species that economic units use or enjoy. This may be recorded as a final or intermediate service.

Biological control services	Pest control services are the ecosystem contributions to the reduction in the incidence of species that may prevent or reduce the effects of pests on biomass production processes or other economic and human activity. This may be recorded as a final or intermediate service. Disease control services are the ecosystem contributions to the reduction in the incidence of species that may prevent or reduce the effects of species on human health. This is most commonly a final ecosystem service
Nursery population and habitat maintenance services	Nursery population and habitat maintenance services are the ecosystem contributions necessary for sustaining populations of species that economic units ultimately use or enjoy either through the maintenance of habitats (e.g., for nurseries or migration) or the protection of natural gene pools. This service is an intermediate service and may input to a number of different final ecosystem services including biomass provision and recreation-related services.
Other regulating and maintenance service - Dilution by atmosphere and ecosystems	Water, both fresh and saline, and the atmosphere can dilute the gases, fluids and solid waste produced by human activity.
Other regulating and maintenance service - Mediation of sensory impacts (other than noise)	Vegetation is the main (natural) barrier used to reduce light pollution and other sensory impacts, limiting the impact it can have on human health and the environment.
Cultural services	
Recreation - related services	Recreation-related services are the ecosystem contributions, in particular through the biophysical characteristics and qualities of ecosystems, that enable people to use and enjoy the environment through direct, in-situ, physical and experiential interactions with the environment. This includes services to both locals and non-locals (i.e. visitors, including tourists). Recreation-related services may also be supplied to those undertaking recreational fishing and hunting. This is a final ecosystem service.
Visual amenity services	Visual amenity services are the ecosystem contributions to local living conditions, in particular through the biophysical characteristics and qualities of ecosystems that provide sensory benefits, especially visual. This service combines with other ecosystem services, including recreation-related services and noise attenuation services to underpin amenity values. This is a final ecosystem service.

Education, scientific and research services	Education, scientific and research services are the ecosystem contributions, in particular through the biophysical characteristics and qualities of ecosystems, that enable people to use the environment through intellectual interactions with the environment. This is a final ecosystem service.
Spiritual, artistic and symbolic services	Spiritual artistic and symbolic services are the ecosystem contributions, in particular through the biophysical characteristics and qualities of ecosystems, that are recognised by people for their cultural, historical, aesthetic, sacred or religious significance. These services may underpin people's cultural identity and may inspire people to express themselves through various artistic media. This is a final ecosystem service.

Table 3

Definition and description of each ecosystem service in the ENCORE dataset from ENCORE methodology (ENCORE, 2024).

5.2 Understanding ENCORE materiality ratings

ENCORE materiality ratings provide the *direct* dependency of *operations* on nature, based on the *physical* exposure from an economic activity's reliance on ecosystem services. This excludes exposure from further up the supply chain and the exposure of financial institutions' investments and insurance policies.

A materiality rating provides the dependency on ecosystem services per 1 Euro of output (it is an intensity measure). Materiality ratings are assessed as a function of two key components: the loss of functionality due to ecosystem service disruption and the financial cost of adaptation. The combined score of these two components produces a rating from very low (VL) to very high (VH) as shown in Figure 6.

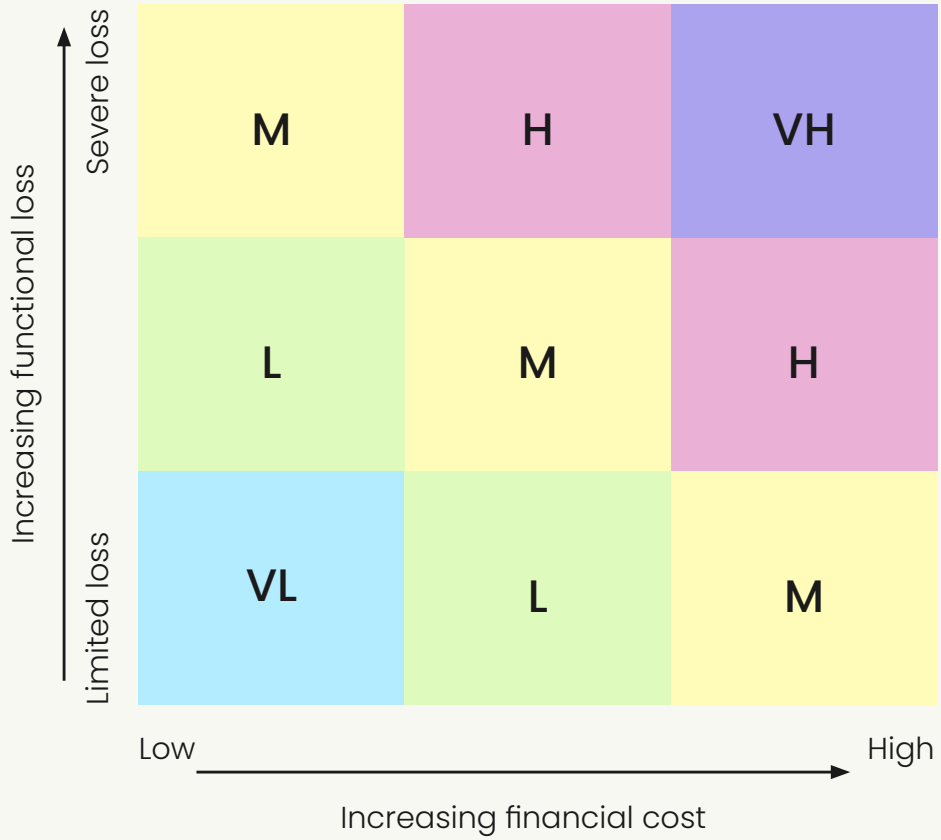


Figure 6

Approach for assigning dependency materiality ratings in ENCORE based on two components: loss of functionality due to ecosystem service disruption and the financial cost of adaptation.

1. Loss of functionality

This component evaluates the impact of an activity on an economic activity if an ecosystem service is disrupted from low to high:

a. Limited loss of functionality: The economic activity can continue as is or with minor modifications.

b. Moderate loss of functionality: The economic activity can continue only with important modifications. This might include slower production or the use of substitutes.

c. Severe loss of functionality: Disruption in the service provision prevents the economic activity from continuing.

2. Financial Cost

This component quantifies the economic burden on an average company within a given economic activity when adapting to a disruption in ecosystem services:

a. Low financial cost: Adaptation to the disruption of the ecosystem services will represent a minor cost to an average company engaging in the economic activity, which will not significantly affect the financial position of the company in the long run.

b. Moderate financial cost: Adaptation to the disruption in the ecosystem service will represent a relatively significant cost to an average company engaging in the economic activity, but the cost would not affect the financial viability of the economic activity for the company.

c. Severe financial cost: Adaptation to the disruption in the ecosystem service will have a significant effect on the financial viability of the economic activity for an average company engaging in the economic activity.

5.3 Sector Groups and Subsectors

Table 4 provides the mapping of EXIOBASE3 NACE sectors to Sector groups used for aggregation from subsector to sector-level.

Table 4
A list of Sector Groups mapped against EXIOBASE NACE sectors used for aggregation.

Sector Group	Subsector (EXIOBASE3 NACE classification)
Agriculture	Cultivation of paddy rice
	Cultivation of wheat
	Cultivation of cereal grains nec
	Cultivation of vegetables, fruit, nuts
	Cultivation of oil seeds
	Cultivation of sugar cane, sugar beet
	Cultivation of plant-based fibers
	Cultivation of crops nec

	Cattle farming Pigs farming Poultry farming Meat animals nec Animal products nec Raw milk Wool, silk-worm cocoons Manure treatment (conventional), storage and land application Manure treatment (biogas), storage and land application
Fishery and aquaculture	Fishing, operating of fish hatcheries and fish farms; service activities incidental to fishing (05)
Food beverages and tobacco	Processing of meat cattle Processing of meat pigs Processing of meat poultry Production of meat products nec Processing vegetable oils and fats Processing of dairy products Processed rice Sugar refining Processing of Food products nec Manufacture of beverages Manufacture of fish products Manufacture of tobacco products (16)
Heat utilities	Steam and hot water supply
Construction	Construction (45) Re-processing of secondary construction material into aggregate
Electricity	Production of electricity by coal Production of electricity by gas Production of electricity by nuclear Production of electricity by hydro Production of electricity by wind Production of electricity by petroleum and other oil derivatives Production of electricity by biomass and waste Production of electricity by solar photovoltaic Production of electricity by solar thermal Production of electricity by tide, wave, ocean Production of electricity by Geothermal

	Production of electricity nec
	Transmission of electricity
	Distribution and trade of electricity
	Manufacture of gas; distribution of gaseous fuels through mains
Water utilities	Collection, purification and distribution of water (41)
	Waste water treatment, other
Supply chain and transport	Transport via railways
	Other land transport
	Transport via pipelines
	Sea and coastal water transport
	Inland water transport
	Supporting and auxiliary transport activities; activities of travel agencies (63)
Chemical and materials industry	Manufacture of textiles (17)
	Manufacture of wearing apparel; dressing and dyeing of fur (18)
	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear (19)
	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials (20)
	Re-processing of secondary wood material into new wood material
	Pulp
	Re-processing of secondary paper into new pulp
	Paper
	Plastics, basic
	Re-processing of secondary plastic into new plastic
	N-fertiliser
	P- and other fertiliser
	Chemicals nec
	Manufacture of rubber and plastic products (25)
	Manufacture of glass and glass products
	Re-processing of secondary glass into new glass
	Manufacture of ceramic goods
	Manufacture of bricks, tiles and construction products, in baked clay
	Manufacture of cement, lime and plaster
	Re-processing of ash into clinker
	Manufacture of other non-metallic mineral products n.e.c.
	Manufacture of basic iron and steel and of ferro-alloys and first products thereof
	Re-processing of secondary steel into new steel
	Precious metals production

	Re-processing of secondary precious metals into new precious metals Aluminium production Re-processing of secondary aluminium into new aluminium Lead, zinc and tin production Re-processing of secondary lead into new lead, zinc and tin Copper production Re-processing of secondary copper into new copper Other non-ferrous metal production Re-processing of secondary other non-ferrous metals into new other non-ferrous metals Casting of metals Manufacture of fabricated metal products, except machinery and equipment (28)
Aviation travel and tourism	Air transport (62) Hotels and restaurants (55)
Real estate	Real estate activities (70)
Mining and metals	Mining of coal and lignite; extraction of peat (10) Mining of uranium and thorium ores (12) Mining of iron ores Mining of copper ores and concentrates Mining of nickel ores and concentrates Mining of aluminium ores and concentrates Mining of precious metal ores and concentrates Mining of lead, zinc and tin ores and concentrates Mining of other non-ferrous metal ores and concentrates Quarrying of stone Quarrying of sand and clay Mining of chemical and fertilizer minerals, production of salt, other mining and quarrying n.e.c.
Retail consumer goods and lifestyle	Retail sale of automotive fuel Wholesale trade and commission trade, except of motor vehicles and motorcycles (51) Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods (52)
Oil and gas	Extraction of crude petroleum and services related to crude oil extraction, excluding surveying

	Extraction of natural gas and services related to natural gas extraction, excluding surveying Extraction, liquefaction, and regasification of other petroleum and gaseous materials Petroleum Refinery
Automotive	Manufacture of motor vehicles, trailers and semi-trailers (34) Manufacture of other transport equipment (35) Sale, maintenance, repair of motor vehicles, motor vehicles parts, motorcycles, motorcycles parts and accessories
Healthcare delivery	Health and social work (85)
Electronics	Manufacture of office machinery and computers (30) Manufacture of electrical machinery and apparatus n.e.c. (31) Manufacture of radio, television and communication equipment and apparatus (32) Manufacture of medical, precision and optical instruments, watches and clocks (33)
Information technology	Computer and related activities (72)
Insurance and asset management	Insurance and pension funding, except compulsory social security (66) Activities auxiliary to financial intermediation (67)
Banking and capital markets	Financial intermediation, except insurance and pension funding (65)
Digital communications	Post and telecommunications (64)
Public services and others	Publishing, printing and reproduction of recorded media (22) Manufacture of coke oven products Processing of nuclear fuel Manufacture of machinery and equipment n.e.c. (29) Manufacture of furniture; manufacturing n.e.c. (36) Recycling of waste and scrap Recycling of bottles by direct reuse Renting of machinery and equipment without operator and of personal and household goods (71)

Research and development (73)
Other business activities (74)
Public administration and defence; compulsory social security (75)
Education (80)
Incineration of waste: Food
Incineration of waste: Paper
Incineration of waste: Plastic
Incineration of waste: Metals and Inert materials
Incineration of waste: Textiles
Incineration of waste: Wood
Incineration of waste: Oil/Hazardous waste
Biogasification of food waste, incl. land application
Biogasification of paper, incl. land application
Biogasification of sewage sludge, incl. land application
Composting of food waste, incl. land application
Composting of paper and wood, incl. land application
Waste water treatment, food
Landfill of waste: Food
Landfill of waste: Paper
Landfill of waste: Plastic
Landfill of waste: Inert/metal/hazardous
Landfill of waste: Textiles
Landfill of waste: Wood
Activities of membership organisation n.e.c. (91)
Recreational, cultural and sporting activities (92)
Other service activities (93)
Private households with employed persons (95)
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