System of Environmental Economic Accounting

Update of the SEEA Central Framework

Draft Guidance Note

Issue A3:

Update of existing information on environmentally-extended input-output tables (EE-IOT)

For Global Consultation
June 2026

Prepared by Nils Brown (Statistics Sweden) (lead author) with support from Nuno Dos Santos Baptista (Eurostat), Niels Shoenaker (CBS Netherlands), Michelle Steenmeijer (CBS Netherlands), Malcolm Gray (Statistics New Zealand), Viveka Palm (Statistics Sweden), Joe St. Lawrence (IMF), and discussed with Task Team A and the SEEA CF Technical Committee

EXECUTIVE SUMMARY

Description of issue

Environmentally-extended input-output tables (EE-IOT) and related analyses are highly relevant and current topics for the update of the SEEA CF in light of recently updated international standards in relevant areas, increasing policy interest in using EE-IOT and related analysis, the increasing global production of statistics based on fit-for-purpose methods and the increasing availability of data to support these production activities. They are mentioned only briefly in SEEA CF 2012. In light of these developments, the following perspectives concerning EE-IOT and analysis should be addressed in the SEEA CF revision process:

- remaining up-to-date with the coverage of input-output tables and analysis in recently updated standards and with current practice in statistics production
- incorporating experience from the growing community of practice on using EE-IOT for statistics production
- formally documenting the increased availability of fit-for-purpose methods and data
- how incorporating the above perspectives in the SEEA CF 2028 can serve to better meet user needs for statistics based on EE-IOT and analysis

Summary of proposals

EE-IOT and analysis is slightly different from other areas included in the SEEA CF update since there already exists a large amount of directly relevant material in existing standards and guidelines. This guidance includes the SNA 2025, the UN Handbook on Supply and Use Tables and Input-Output Tables with Extensions and Applications (hereafter referred to as the UN SUT IOT Handbook) and documents describing methods currently being employed by statistical offices to produce and communicate EE-IOT and related statistics.

In light of this, it is proposed that improvements in the SEEA CF in relation to EE-IOT and analysis focus on introducing and discussing four interrelated areas:

- **The structure of EE-IOTs:** This section would cover the structures of relevant types of input-output tables and environmental extensions and would aim to present an EE-IOT focussed summary of existing material in UN SUT IOT Handbook supplemented with necessary information potentially unique the SEEA concerning environmental extensions (residuals and physical resource use). A focus here is on monetary input-output tables, including single regional and multiregional varieties. Hybrid tables where rows of monetary data are replaced with physical data for improved quality are also proposed for inclusion in light of their application in current practice.
- **Compilation and data sources for EE-IOT:** covering methods for producing data the relevant types of input-output tables and environmental extensions, also largely derived from the UN SUT IOT Handbook as well as references to SEEA physical flow accounts concerning environmental extensions. Single regional and multiregional approaches are proposed for consideration.
- **Analytical methods and presentations:** covering methods for producing key indicators. The key indicator to be covered has been identified as consumption-based environmental pressures. It is proposed that the coverage in the revised standard presents the methods for which examples exist in current practice for statistics production. These include single regional input-output analysis, multiregional input-output analysis, single country national account compatible methods, and simplified

single country national account compatible methods. The application of these methods for producing statistics on consumption-based environmental pressures is proposed to be a focus here, though other relevant applications in light of current practice may also be included.

- **Terminology:** In the growing community of statisticians using EE-IOT and analysis a number of somewhat overlapping terms are used to describe the indicator that is here dubbed "consumption-based environmental pressures". Rather than prescribing one term as correct and other terms as incorrect it is proposed through the standard revision to codify this terminology in terms of context and explain the relationship between the terms. In this way the following terms could be largely synonymous (as they seem to be in current practice):

    1. "environmental pressures from domestic final demand"
    2. "consumption-based environmental pressures" and
    3. "environmental footprint"

  where the first term represents a formal definition understood mainly by experts and (in particular SNA experts), the second also a formal definition more in line with SEEA terminology and the third one that is well-understood by users.

For each of the areas, the guidance note proposes three variations in level of detail that can be included in the final SEEA CF 2028 on the issue (referred to as small, medium and large). In deliberations on this issue, it was noted that EE-IOT were important analytical tools for the SEEA CF but also noted that input-output tables are not included in the integrated framework of the SNA.

In light of these contrasting perspectives, it is therefore proposed that text on EE-IOT and analysis should be included in the updated SEEA CF in a manner equivalent to the SEEA CF 2012 Chapter 6 level of discussion on integrating and presenting the accounts. This equates to providing a medium level of coverage with regard to explaining the structure of EE-IOTs, the compilation and data sources, analytical methods and presentations and terminology for EE-IOTs. Explanations of the differences between low, medium and high levels of coverage for each of these topics are provided in Tables 2, 3, 4 and 5 in the GN.

Questions for Global consultation

The questions below are for reference only. Please submit your responses through the online form available here: Consultation form: Guidance Note on Issue A3 – Fill out form.

1. Do you agree with the recommendation to use a medium level coverage for *the structure of EE-IOTs* in the SEEA CF 2028 (see Table 2)?
    a. Yes
    b. No
    c. Not sure
2. Do you agree with the recommendation to use a medium level coverage for *compilation and data sources for EE-IOT* in the SEEA CF 2028 (see Table 3)?

a. Yes

b. No

c. Not sure

3. Do you agree with the recommendation to use a medium level coverage for *analytical methods and presentations* for EE-IOT in the SEEA CF 2028 (see Table 4)?

    a. Yes

    b. No

    c. Not sure

4. Do you agree with the recommendation to use a medium level coverage for *terminology surrounding EE-IOT* in the SEEA CF 2028 (see Table 5)?

    a. Yes

    b. No

    c. Not sure

5. Do you have any other comments on the Guidance Note?

Table of contents

1 INTRODUCTION

1. The short description of issue A3 "Update of existing information on EE-IOT" from October 2024 is:

> "The SEEA CF could incorporate, at a high level, new insights and improved descriptions on environmentally-extended input-output tables (EE-IOT) analysis, which take into account recent advances in this area (e.g. FIGARO, MRIO GLORIA, etc)."

2. SEEA CF 2012 Section 2.4 Combining physical and monetary data notes that "compiling and contrasting monetary and physical data in meaningful ways are at the heart of the SEEA philosophy" (United Nations et al., 2012, par. 2.86), which seems to apply particularly to input-output analysis, which was first extended to environmental modelling in the late 1960s and early 1970s and is therefore a well-established analytical method. EE-IOT and related analyses are highly relevant and current topics for the revision in light of recently updated international standards in relevant areas, increasing policy interest in using EE-IOT and related analysis, the increasing global production of statistics based on fit-for-purpose methods and the increasing availability of data to support these production activities.

3. The remainder of this Guidance note covers:

- Review of existing measurement and research
- Conceptual options and treatments
- Recommendations on conceptual treatments
- Other considerations in advancing the issue

2 SUMMARY OF EXISTING MEASUREMENT AND RESEARCH

2.1 Treatment of EE-IOT and analysis is other relevant standards and guidelines

4. IO tables in and of themselves are purely economic accounting presentations. IO analysis as originally presented by Wasily Leontief is not either a purely environmental-economic technique, rather can equally be applied to social and economic analytical ends. In light of this, there is considerable treatment of IO-related issues relevant for the SEEA and for EE-IOT and analysis in existing UN standards and guidance in the purely economic realm.

5. The SNA 2025 (United Nations et al., 2025) presents IO tables in Chapter 36. Here, the production of input-output tables is presented as a transformation of supply and use tables. SNA 2025 notes that supply and use tables are part of the integrated framework of the SNA (and presented thoroughly in SNA 2025 Ch. 15). IO tables are not included in the SNA's integrated framework. Nevertheless, Chapter 36 notes that "For many analytical purposes, though, a transformation from a pair of supply and use tables into a single input-output table where row and column totals are equal brings very considerable advantages" and also that IO tables "are analytical constructs that inevitably involve some degree of modelling and assumptions in their compilation." (para. 36.2).

6. Chapter 36 more broadly covers issues related to deriving symmetrical input-output tables from supply use tables. It includes the following sections:

a. **Section B – Flexibility in the supply and use tables:** Largely concerning adjustments that can be made to supply and use tables when being used for the purpose of deriving input-output tables

b. **Section C – Deriving an input-output table:** Largely concerning a broad description of the analytical methods for producing input-output tables from supply use tables (in particular concerning the treatment of secondary products) as well as an introduction of the Leontief analysis

c. **Section D: Multi-country tables**: Highlighting amongst other things the value and uses of multi-country tables and highlighting the challenges involved in their compilation. Multi-country input-output tables have not previously been covered in for example the SNA 08.

7. Chapter 36 nevertheless only aims to give "give a feel for the sort of operations necessary to transform national supply and use tables into national input-output tables as well as compilation of multi-country input-output tables" SNA 2025, para 36.4. It rather refers to another UN document, The UN Handbook on Supply and Use Tables and Input-Output Tables with Extensions and Applications (United Nations, 2018, hereafter the UN SUT IOT Handbook) as well as the website of the International Input-Output Association for more detail concerning the issues covered in the Chapter.

8. Chapter 36 also makes reference to analytical applications and indicator derivation that can be supported by input-output tables and analyses, though does not make an attempt to describe these in depth. Rather Chapter 36 refers to a more complete explanation of purely economic applications such as trade in value added (TiVA) and global value chains (GVC) in SNA 2025 Chapter 23 on Globalisation. SNA 2025 also notes that "the development of … estimates on trade in value added, as supplementary information, is encouraged" (Preface, SNA 2025). Though TiVA and GVA are not of course of direct relevance for environmental applications, it is important to note that their inclusion in the SNA 2025 represents a development beyond the SNA 2008, which makes no explicit mention of them. "Environmental footprints" are also briefly mentioned in SNA 2025 Chapter 36 as an example of indicator derivation, though no reference for further explanation is provided for them there.

9. The presentations of TiVA indicators and the global value chain thematic account furthermore provide interesting templates to underpin how the EE-IOT and related analyses may be presented in the SEEA CF 2028. The presentations include a brief introduction of the relevance of each method from the user perspective and the global context of the world economy. The section on TiVA also includes a simplified example to illustrate the relevance. They also include references to relevant handbooks and guides with more detailed compilation information, a brief qualitative presentation of the core input data and the key indicators that can be produced with each method.

10. The potential for EE-IOT to support environmental-economic analyses and indicators is mentioned elsewhere in the SNA, for example Chapter 2 National accounts and its contribution to measuring well-being and sustainability:

> (The SEEA) … "can thus support the derivation of many indicators (e.g. footprint indicators) and types of analysis (e.g. extended input-output analysis)" SNA 2025 para. 2.86.

This potential is also mentioned in Chapter 15: supply and use tables:

> "The supply and use tables (and input-output tables) inform several national and international policy issues, including: … Climate change, for example, … , environmentally-extended input-output tables.." SNA 2025 para. 15.7.

11. And in Chapter 35: Measuring the sustainability of well-being:

> "A separate accounting application related to the measurement of environmental flows is the compilation of input-output tables which incorporate additional rows alongside the standard set of products. The additional rows, which concern things like water use, energy use, greenhouse gas emissions, material flows and ecosystem services, may be recorded in monetary or physical terms. These environmentally extended input-output tables are likely to be of significant relevance in the development of extended economic models aimed at assessing the implications of alternative climate and nature related policies. *SEEA Applications and Extensions* provides an introduction to environmentally extended input-output tables." SNA 2025 para. 35.97

12. Descriptions relating to input-output analysis arise in two main sections in the SEEA Applications and Extensions: Section 3.2 Environmentally extended input-output tables (EE-IOT) and Section 3.3. Techniques for the analysis of input-output data.

13. Section 3.2 Environmentally extended input-output tables (EE-IOT) aims "to introduce the main types of EE-IOT, examine key components of their compilation, and discuss some of the associated measurement issues". The information in this section is summarized in the following paragraphs.

14. The section includes an explanation of the structure and mathematical relationships in a single-region input-output (SRIO) table (Section 3.2.2), hybrid IO tables (Section 3.2.3) and international multiregional input-output tables (Section 3.2.4). These summaries address both monetary data and associated environmental extensions (natural inputs and/or residuals). Section 3.2.5 on measurement issues addresses the ways in which and the reasons why information about specific countries included in an international MRIO may differ from that in SRIOs for the same countries. It continues with a discussion of the relative advantages and disadvantages of using an MRIO approach or a SRIO approach (with a domestic technology assumption) for analysis focussed on a specific country.

15. The introduction to Section 3.3 Techniques for the analysis of input-output data includes a brief review of input-output modelling from the early 1930s through the 2010s followed by review of the basic mathematical framework of input-output analysis (the Leontief analysis). Subsequent parts of Section 3.3 cover multiplier analysis, attribution of environmental flows to final demand, decomposition analysis and the use of input-output modelling in computable general equilibrium models.

16. The UN SUT IOT Handbook is a comprehensive guide. Of relevance here is that it includes an overarching introduction to SUTs and IOTs, compilation processes for SUTs, processes for transforming SUTs into IOTs, compilation of physical supply and use tables and environmentally extended input-output tables. It also includes guidance on compilation of regional supply and use tables, and multicountry supply and use tables (MCSUT).

17. the UN Handbook on Supply and Use Tables and Input-Output Tables identifies the possibility of presenting monetary input-output tables either per industry (based on the international ISIC classification) and per product (based on the international CPC classification).

18. The UN SUT IOT Handbook describes the structures for the key types of single country input-output (SCIO) tables which are relevant for EE-IOT and analyses. namely:

a. The domestic input-output table. This includes:

    i. All domestic intermediate uses (by product/industry of production and product/industry of use)
    ii. Value added and imports by product/industry of use
    iii. Final uses (by category of final use and product/industry of production),

b. The input table for imports. This includes:
    i. Domestic intermediate use of imported products by importing product/industry and product/industry of production
    ii. Domestic final use of imported products by product/industry of production and category of final use

c. The input-output table: This is a summation of the domestic input-output table and the input table for imports

19. The UN SUT IOT Handbook also describes monetary multi country input-output (MCIO) tables (Chapter 17). The format for these is as follows:

a. Intermediate use by product/industry and country of use and product/industry and country of production
b. Final uses by category of final use and product/industry and production and country of final use
c. Imports from the rest of the world by product/industry of use
d. Value added by product/industry of use and country of production

20. In such a way the MCIO tables follow a similar format to the single country input-output tables. The UN SUT IOT Handbook further provides an introduction to the specific methods required for compiling multi-country input-output tables.

21. Chapter 13 in the UN SUT IOT Handbook describes in detail the compilation of physical supply-use tables. The derivation of the PIO from PSUT is described as analogous to the compilation of monetary IO tables from monetary supply and use tables (which is described in detail in UN SUT IOT Handbook Chapter 12). There is also a description of “hybrid input-output” tables where monetary rows in the table (i.e. the use of a certain product/industry) are replaced by physical values.

22. The UN SUT IOT Handbook also describes the production of environmentally-extended input-output (EEIO) tables in Chapter 13. The basic format is where monetary input-output tables (Chapter 12) are supplemented with a vector with physical data classified by product/industry of use.

23. It is also interesting to note that the recently approved UN Framework for Measuring the Sustainability of Tourism (United Nations World Tourism Organization & United Nations Statistics Division, 2024) mentions EE-IOT and analyses extensively for recording the environmental impacts of tourism.

2.2 Development of global multiregional input-output tables

24. Whilst countries with well-developed systems for national accounts regularly produce and disseminate input-output tables, the production of multi country input output tables largely falls outside of the purview of national statistical offices. Nevertheless, in the last 15 years or so, many multi country input-output tables with global coverage, so called global multiregional input output (GMRIO) tables have been produced (see Table 6 in the annex to this document). As shown in the table, the majority of such approaches have been developed by research institutions. Nevertheless, there are a few examples of compilation by international organisations. Examples of these include Eurostat's FIGARO and the OECD ICIO tables. A starting point for such tables is countries' own SCIO tables. Such data need to be supplemented with trade data with classifications connecting exporting countries with importing countries. These data are produced at a global level; however, it is often noted that the sum of global exports does not match with the sum of global imports. This is a contributing factor to the need to apply balancing procedures in such tables. The heterogeneity of input data, the need for balancing and the level of aggregation are key contributors to observed variation in the data between different GMRIOs. A common decision in balancing for example is which input data should be held constant and which input data should be adjusted in order to achieve the necessary balance between supply and use in input-output tables.

25. Many of the GMRIO initiatives noted in Table 6 also include environmental extensions (i.e. as those theoretically explained the UN SUT IOT Handbook). These environmental extensions include greenhouse gas emissions, emissions of air pollutants, land use, water use, biodiversity, energy use and material use. As noted in a forthcoming review by the OECD, these extensions use a wide variety of data sources and are at very differing stages of maturity. Given the relatively large amounts of data entailed in such extensions, an overall assessment of quality is very complex. In general, the forthcoming review by the OECD notes that:

a. Environmental extensions for GHGs are relatively well-developed, though methods do diverge considering the allocation to products/industries

b. Data on material use are also reasonably well-developed

c. Measurement of air pollutants and water use are conceptually more challenging, and location and sub annual time aspects are a more important aspect here

d. Data on water use are only available on very high levels of aggregation, which are then subdivided to economic activities based on assumptions

e. Multiple datasets for land use exist, but sources and methodologies vary widely

f. Data on ecosystem services are currently very limited.

2.3 Examples of current practice and policy relevance

26. Alongside the development in data sources relevant for EE-IOT, many examples of current production practices can be noted. Examples include the following[1]:

a. The Netherlands statistical office currently produces consumption-based environmental pressures for greenhouse gas emissions, material use, land use, biodiversity and water.

b. Eurostat produces environmental footprints for GHG emissions with breakdowns by greenhouse gas for all EU member states as well as material and energy footprints

c. The UK publishes official statistics on GHG emissions from consumption and material footprint

d. Statistics Sweden publishes official statistics on environmental pressures from consumption. This includes greenhouse gas and other air emissions.

e. Statistics New Zealand publishes official statistics on consumption-based greenhouse gas emissions

27. Table 7 in the annex of this note provides some more information about these examples and amply demonstrates the breadth of current statistics practice in terms of time series coverage, geographic variables (countries and regions of production and consumption), product and industry coverage, categories for final demand and methods of production. The table focusses specifically on the production of consumption-based environmental pressures rather than other current applications of EE-IOT. Table 7 is not exhaustive either concerning current practice. The IMF in a recent data gaps initiative (DGI) report noted that France, Germany and Italy also regularly update statistics on consumption-based greenhouse gas emissions (IMF, 2025). The same IMF document reported China requested guidelines for the

[1] Material: Grondstofvoetafdrukken Nederland, 2010-2021 | Compendium voor de Leefomgeving

GHG: Broeikasgasvoetafdrukken Nederland, 2010 - 2021 | Compendium voor de Leefomgeving

Land use: Nederlandse landvoetafdrukken, 2010-2021 | Compendium voor de Leefomgeving

Biodiversity: Nederlandse biodiversiteitsvoetafdrukken, 2010-2021 | Compendium voor de Leefomgeving

Water: Nederlandse watervoetafdrukken, 2010-2021 | Compendium voor de Leefomgeving

UK: Carbon footprint for the UK and England to 2022 - GOV.UK

UK material footprint: England's material footprint - GOV.UK

New Zealand: Greenhouse gas emissions (consumption-based): Year ended 2023 (provisional) | Stats NZ

production of consumption-based greenhouse gas emissions. Denmark also regularly produces and updates statistics on consumption-based greenhouse gas emissions[2].

28. Table 7 also focusses on "consumption-based environmental pressures", used here as synonymous with environmental pressures embodied in domestic final demand. There are also relevant EE-IOT examples of indicator production beyond this narrow concept. In the Netherlands, data are produced that follow the supply chains of specific industries, so called production footprints (Wilting & in 't Veld, 2025). This reflects work by Statistics Sweden to produce statistics on greenhouse gas emissions in value chains[3]. Statistics Sweden also uses EE-IOT methods to produce environmental indicators for the Swedish building and real estate sectors in accordance with Sweden's environmental quality objectives[4]. Meanwhile, Eurostat is currently involved in a project applying EE-IOT and analysis for the purpose of supporting businesses (and particularly SMEs) to calculate their environmental footprints based on monetary data.

29. Policy interest in consumption-based greenhouse gas emissions in particular is underscored by the fact that they have been included in the IMF DGI project (IMF, 2025). Meanwhile in Sweden, Brown et al. (2022) note the use of consumption-based greenhouse gas emissions for monitoring of the environmental quality objectives for reduced climate impact and the generational goal. Brown et al. (2022) further notes the use of consumption-based environmental pressures more broadly to support the UK's 25 Year Plan for the Environment, and for the development of policy aimed at mitigating overseas deforestation in the EU. EE-IOT is also relevant beyond government policy development, and has also been referenced for the purpose of financial reporting (Partnership for Carbon Accounting Financials, 2025).

3 OPTIONS AND POSSIBLE TREATMENTS

30. Previous sections in this guidance have noted that there is a wealth of material relating to input-output tables in high-level standards and guidance documents that have been published since the SEEA CF 2012. As also shown in the review, new methods have also been applied in the practical production of statistics based on EE-IOT and there is an increasing global interest in indicators that can be produced with EE-IOT from a statistical perspective. A first task of the SEEA update is therefore to ensure that the SEEA CF 2028 keeps pace with these developments concerning EE-IOT and analysis. In order to do this, there are a number of separate areas that should be addressed:

a. The structure of EE-IOTs

b. Compilation and data sources for EE-IOTs

c. Analytical methods for statistics production

[2] https://www.statistikbanken.dk/aftryk1

[3] https://www.scb.se/hitta-statistik/statistik-efter-amne/miljo/miljoekonomi-och-hallbar-utveckling/miljorakenskaper/pong/publikationer/utveckling-av-statistik-om-vaxthusgasutslapp-i-industrins-vardekedjor/

[4] https://www.boverket.se/sv/byggande/hallbart-byggande-och-forvaltning/miljoindikatorer---aktuell-status/

d. Terminology

In developing these options, attention has been paid in particular to the descriptions of input-output tables in the SNA, and specifically how they have been updated to include more information in the SNA 2025 than in the SNA 2008.

3.1 The structure of EE-IOTs

31. The UN SUT IOT Handbook presents the most in-depth description of input-output tables in general. It even includes a section presenting a derivation of the Leontief analysis for relevant environmental extensions. At the same time Chapter 36 in the SNA 2025 also presents somewhat overlapping material, with the obvious caveat that the UN SUT IOT Handbook (alongside other literature) provides more extensive coverage. At a very basic level then, the SEEA CF 2028 should make reference to the structural descriptions pertaining to EE-IOT principally in the UN SUT IOT Handbook. A somewhat more extended text may also be useful in the SEEA CF 2028. Firstly, this would make it possible to identify specific aspects of table structure that are significant for EE-IOT as opposed to input-output analysis more generally and to condense otherwise disparate explanations in the UN SUT IOT handbook and elsewhere (e.g. SEEA Applications and Extensions) for the specific purpose of EE-IOT and analysis. This applies not least to the structure of data on natural inputs and residuals which are to a great extent SEEA specific. A more extended text may also be relevant to communicate that EE-IOT and analyses are explicitly included in the SEEA CF 2028. This would also be valuable to present up-to-date formats that are specific for the environmentally-extended case and specific for the environmental accounts. In the single regional format of monetary input-output tables this would include the following:

1. The input-output table
2. Input table of imports (relevant for certain current methods)
3. Input-output table with net exports
4. Natural inputs and residuals

32. In light of the examples of current practice (see Table 7), it is also relevant here to describe a hybrid input-output table, where rows of monetary data in the input-output table are replaced with physical data. A separate description could be included considering the multi country input-output tables, which could summarize the overall format of such tables.

33. The inclusion of some explanatory text would also reflect the treatment of input-output tables in the SNA 2025, which also makes reference to the UN SUT IOT handbook at the same time as including some explicit explanatory text.

34. Physical input-output tables are mentioned in the UN SUT IOT Handbook; however, their structure is not presented. It is neither clear in the text of the UN SUT IOT Handbook the extent to which it makes an actual distinction between physical input-output tables (PIOT) on the one hand and environmentally-extended input-output tables (EE-IOT) on the other. There is potential of course to describe the structure of a PIOT in the SEEA CF 2028. Having said that, it is beyond current practice and beyond the descriptions in the UN SUT IOT Handbook. It therefore seems of lower priority that the environmental accounts specific descriptions of the extended monetary input-output tables previously considered.

3.2 Compilation and data sources for EE-IOTs

35. Compilation methods and data sources for deriving the monetary elements in EE-IOTs from monetary SUTs are described in detail in the UN SUT IOT Handbook and in SNA 2025. This includes

compilation and data sources for the single regional case and the multiregional case. The UN SUT IOT Handbook describes the methods for compiling physical input-output tables briefly as analogous to the process for compiling monetary tables. Again, the UN SUT IOT Handbook does not make a clear distinction between EE-IOT and PIOT here.

36. It could suffice in the SEEA CF 2028 to reference briefly reference these standards, not least because the strictly monetary parts of such tables are not solely the purview of the environmental accounts. A more extended treatment could present possible options for converting monetary SUTs into EE-IOTs, considering the industry-industry format as compared to the product x product format, and the choices entailed in their compilation (e.g. the product technology, industry technology, fixed industry sales structure and fixed product sales structure). This could be useful since these different assumptions can be more or less relevant for certain environmental applications.

37. Environmental extensions in EE-IOT are further derived from datasets that are defined in the SEEA. These can be in the form of residuals (e.g. greenhouse gas and other air emissions) or natural inputs (e.g. material flows, water use, energy use). They are therefore derived from physical flow accounts as described extensively in SEEA CF 2012 Chapter 3 – Physical flow accounts. In a basic presentation of EE-IOT in the SEEA CF 2028, reference should be made to the corresponding physical flow account Chapter in the new standard. It should also be noted in a basic presentation that adjustment may be needed from an industry perspective (that is most common for SEEA CF physical flow accounts as currently produced) to a product perspective (that is common for EE-IOT-based statistics production).

38. Previous paragraphs considering compilation methods and data sources focus on the single country perspective. MCIO tables do follow a similar procedure as for the single country. However, when compiling MCSUT from single country SUT some additional considerations are necessary. This concerns for example international trade in such tables is accounted for. Additional data are also needed in this process with information connecting importing countries with exporting countries (typically from trade data). It is further important to note that though single country SUT and IOT are in general produced by national statistical offices, multiregional tables are generally not. In this document the potential to use multi country input-output tables for the production of statistics is described at greater length in the section on analytical methods and data for statistics production.

3.3 Analytical methods and data for statistics production:

39. The review earlier in this document has presented a number of EE-IOT methods that are currently applied for statistics production (see Table 7). It is proposed in light of current practice that a focus in this section be on the Leontief demand-pull method that is used to derive consumption-based environmental pressures (consideration of other EE-IOT-based methods is given at the end of this section). Such Leontief demand-pull models currently in use include:

a. Single-regional analysis (with domestic technology assumption)

b. Multiregional analysis (see for example Eurostat's consumption-based greenhouse gas emissions for European Union member states)

c. Single-regional national account compatible (SNAC) method, see (Edens et al., 2015) and a similar method used in the UK

d. Coupled model, or simplified SNAC see for example (Palm et al., 2019)

40. The data requirements for each of these methods are shown in Table 1 below. A basic presentation of such methods could briefly present these methods and refer to relevant sources for more compilation detail. The basic presentation would also include a qualitative description of the advantages and disadvantages for each of the approaches. In a more extended presentation, the major formulae and procedures required for their production could also be presented explicitly in the standard with a view to contributing to improved harmonisation in production. Further text could also present examples based on current practice for statistics production as presented earlier in this document.

Table 1: Data requirements for different types of EE-IOT analysis to produce statistics on environmental pressures from consumption

	Type of analysis			
Type of EE-IOT	Single regional analysis	Multi-regional analysis	SNAC	Simplified SNAC
Single regional EE-IOT	Yes	No	Yes	Yes
Global multiregional EE-IOT	No	Yes	Yes	Yes

41. Table 1 shows different types of EE-IOT that are required to implement each of the analyses in the previous paragraphs. This is relevant since whereas national statistics offices have the ability to produce all data in house for the single-regional analysis it is often beyond the mandate and capacity of said offices to produce multiregional (global) EE-IOT that are required for the other types of analysis. This includes both the monetary and the environmental parts of global EE-IOT. According to current practice in statistics production, national statistical offices use public global EE-IOT from an external source for the production of national statistics. Examples of such tables are given in Table 6 in the Annex to this guidance. It is clear that the methodological choice of which global EE-IOT to use should be mentioned in any basic presentation in SEEA CF 2028. A more extended presentation could further present relevant examples of global multiregional EE-IOT based on Table 6, as well as similar tables for relevant environmental extensions.

42. In referring to methods noted above, a basic presentation should also mention the possibility to apply such analyses using input-output tables with only monetary data or hybrid tables. PIOT are a lower priority here.

3.4 Terminology

43. The terminological issue can be significant since it can affect user understanding, interest and uptake and therefore important to cover in the ongoing standard revision. As a developing area at the interface between national and environmental accounts it is perhaps not surprising that terminological issues may arise in producing and communicating statistics based on EE-IOT and analysis.

44. The central indicator for statistics production can be given many names, none of which are entirely unproblematic. Closest to the terminology of the SNA is the expression ”environmental pressures

from *domestic final demand*". However, this is not terminology that is not necessarily well understood for communicating the statistic.

45. Another term often used for the same indicator is "consumption-based environmental pressures". This is in a SEEA context a natural opposite to "production-based environmental pressures" though not entirely consistent SNA terminology, since it refers to areas of final demand that are explicitly not consumption (i.e. gross capital formation).

46. Finally, the term "environmental footprint" or for greenhouse gas emissions "greenhouse gas footprint" is also used. However, the term "footprint" was initially coined to specifically refer to a physical measure of area, in particular the area on planet earth necessary to support a person or a given community. It is not used specifically in this way when communicating statistics based on EE-IOT and analysis in most current cases, rather as the greenhouse gas example makes clear, it is used to describe environmental pressures in terms of mass rather than area. On the other hand, footprint is widely understood in the user community.

47. Since the above terms are currently in use, the most effective approach may be to codify the use of each of the terms noted, assigning each a specific context. In this way, the most purely technical context would be the expression "environmental pressures from *domestic final demand*" and could be assigned a use in communication between experts. "Consumption-based environmental pressures" could be applied as an official "SEEA" designation of the indicator, and the "footprint" term could be assigned to the application of communicating to users.

4 PROPOSALS AND RECOMMENDATIONS

47. EE-IOT and related analyses are somewhat different to other areas identified for inclusion in the revision of the SEEA Central Framework in so far as there are already many practical examples of statistics production, well-established methods for production and a growing community of users. EE-IOT and analyses are also directly related to existing and recently updated statistical standards and guidelines.

48. Therefore, the work of the SEEA CF update in this area is not explicitly dependent on the resolution of any particular theoretical questions, rather can be based on already existing methods and structures. Theoretical developments are relevant of course also for EE-IOT and analysis more generally, but not necessarily in this process.

49. The recommendations for how EE-IOT and analysis should be treated in the SEEA CF 2028 are based on the following functional requirements:

a. To ensure sufficient coverage of the topic to ensure that SEEA specific aspects of EE-IOT and analysis are covered and presented in a concise format

b. To ensure that the SEEA remains up-to-date in light of the development of other statistical standards including the SNA and the UN framework for tourism

c. To communicate to the global SEEA community the policy significance (as noted in previous sections) of EE-IOT based analyses

50. Tables 2 through 5 summarize the potential scope of text in the SEEA CF 2028 regarding EE-IOT in the four areas covered previously in the note. Each table presents a varying degree of coverage (and therefore text and accompanying tables and figures) – small, medium and large. Input as to which scope should be included in the final text of the SEEA CF 2028 will be sought through global consultation. An

initial recommendation at this stage is that the text in the SEEA CF 2028 should reflect the description in the "medium" category in each table.

51. It is of course recognised that the SEEA CF 2028 will cover a large array of topics and that it is desirable in general to maintain concise text. In light of this an initial recommendation is that amongst the four different areas that are presented in the tables, the most important and most relevant for the SEEA CF (as opposed to any other standard) is the section on analytical methods and presentations, and that this section should be prioritized in the SEEA CF 2028.

52. An important consideration that has been pointed out in the deliberations of the SEEA CF Technical Committee is that the input-output tables are not part of the integrated framework of the SNA (in contrast to supply and use tables which are a part of the integrated framework), rather input-output tables are analytical constructs. On the other hand, in the course of SEEA CF Technical Committee deliberations it was also pointed out that EE-IOT and analyses are very significant for analytical purposes and that it important to recognise this significance in the revised SEEA CF standard text.

53. These contrasting points can be reflected in the position of text on EE-IOT and related analyses in the revised standard. Since the SNA does not include input-output tables in the integrated framework, it would seem inconsistent to include text on EE-IOT in the revised SEEA CF in the SEEA CF 2028 equivalent of the SEEA CF 2012 Chapter 2 – Accounting Structure, since Chapter 2 is intended to be of a more overarching character establishing the central structure of the SEEA. Rather reflecting the expressed analytical significance of EE-IOT and analysis it could be better placed in the SEEA CF 2028 equivalent of the SEEA CF 2012 Chapter 6 – Integrating and presenting the accounts.

Table 2: Recommendations for SEEA CF 2028 for descriptions of the structure of EE-IOTs

Small	**Medium**	**Large**
Reference to relevant sections of UN SUT IOT Handbook for relevant table formats	Incorporate text and structures into the SEEA CF 2028: with a focus on monetary IOT, hybrid tables and environmental extensions.	Include specific coverage of potential PIOT structures

Table 3: Recommendations for SEEA CF 2028 concerning compilation and data sources for EE-IOT

Small	**Medium**	**Large**
Reference to relevant sections of UN SUT IOT Handbook for relevant table formats (monetary tables) and to SEEA CF Chapters for environmental extensions.	Some detail about relevant compilation methods (monetary IOT and environmental extensions) in order to be able to comment more specifically about the relevance of certain compilation methods for EE-IOT and analyses	Some analytical detail about compilation methods, in particular hybrid tables for intermediate use as relevant their application (e.g. better for material use)

Table 4: Recommendations for SEEA CF 2028 concerning analytical methods and presentations

Small	Medium	Large
Reference to sources for relevant methods, with a focus on consumption-based environmental pressures for statistics production (Leontief demand-pull based). Description of relevant structures and potential variables for EE-IOT analysis-based statistics Some mention of other possible and relevant analytical methods	Descriptions and main equations for relevant methods with explanations for consumption-based environmental pressures. Some comment on relevance of methods and multidimensional quality considerations	Real examples of analyses from current production practices for consumption-based environmental pressures. More advanced topics, variables and analyses starting from the Leontief approach

Table 5: Recommendations for SEEA CF 2028 concerning terminology

Small	**Medium**	**Large**
No explicit explanation of terminology	Explanation of terminology for consumption-based environmental pressures including “crosswalks” to relevant terms in SNA	

5 OTHER CONSIDERATIONS IN ADVANCING THE ISSUE

54. The main indicator that is a focus of EE-IOT is that which is termed “consumption-based environmental pressure”. As described in Table 7 a number of variables can already be included in calculating this indicator that make it possible to derive subordinate indicators, such as “environmental pressures embodied in imported products”, or “environmental pressures embodied in domestic production contributing to domestic final demand”

55. There are a number of terms that can be valuable to document in the SEEA glossary. These include:

a. “environmental pressures from domestic final demand”

b. “consumption-based environmental pressures” and

c. “environmental footprint”

And will be supplemented in the process of developing texts for inclusion in the revised standard.

56. A number of issues have arisen in the production of this guidance note that seem more appropriate to be included in compilation guidance rather than in the SEEA CF 2028. For purely monetary aspect of input-output tables, the UN SUT IOT Handbook provides significant detailed guidance of relevance for compilers.

57. Amongst the areas that have been identified for inclusion in this guidance note concerning EE-IOT and analysis (see Table 2 through Table 5) an important gap that would need to be filled is the current lack of official compilation guidance concerning analytical methods and presentations of EE-IOT. This could be produced as a synthesis of some research literature previously referred to (Edens et al., 2015; Palm et al., 2019) as well as methodological documentation in existing statistical practice (Statistics New Zealand, 2026).

58. Meanwhile, though the UN SUT IOT Handbook does go so far as to refer to some specific global multiregional input-output datasets, it does not give in depth consideration to relevant global environmental extensions for specific environmental pressures that may also be relevant to take up in guidance on statistics production with EE-IOT.

59. At this stage it is proposed that revised SEEA CF texts on EE-IOT should focus on consumption-based environmental pressures. Therefore, other potential indicators that have been noted (such as value chain-based measures) are potential candidates for a research agenda.

6 REFERENCES

Brown, N., Croft, S., Dawkins, E., Finnveden, G., Green, J., Persson, M., Roth, S., West, C., & Wood, R. (2022). *New methods and environmental indicators supporting policies for sustainable consumption in Sweden* (ISBN 978-91-620-7032-8). https://www.naturvardsverket.se/publikationer/7000/978-91-620-7032-8/

Edens, B., Hoekstra, R., Zult, D., Lemmers, O., Wilting, H., & Wu, R. (2015). A method to create carbon footprint estimates consistent with national accounts. *Economic Systems Research*, *27*(4), 440–457.

IMF. (2025). *G20 Data Gaps Initiative – Phase Three (DGI-3) Progress Report*. International Monetary Fund. https://www.imf.org/en/News/Seminars/Conferences/DGI/g20-dgi-progress- reports-and-other-documents

Palm, V., Wood, R., Berglund, M., Dawkins, E., Finnveden, G., Schmidt, S., & Steinbach, N. (2019). Environmental pressures from Swedish consumption – A hybrid multi-regional input-output approach. *Journal of Cleaner Production*, *228*, 634–644. https://doi.org/10.1016/j.jclepro.2019.04.181

Partnership for Carbon Accounting Financials. (2025). *Financed Emissions: For financial institutions measuring and reporting scope 3 category 15 emissions—Third Edition*. PCAF. https://carbonaccountingfinancials.com/files/standard-launch-2025/PCAF-PartA-2025-V3.pdf

Statistics New Zealand. (2026). *Consumption-based greenhouse gas emissions (industry and household): Sources and Methods*. Statistics New Zealand. https://datainfoplus.stats.govt.nz/item/int.example/863d05ea-4868-4c1f-a3d6-960d111f18e3

United Nations. (2018). *Handbook on Supply and Use Tables and Input-Output Tables with Extensions and Applications*. United Nations Statistics Division and Department of Economic and Social Affairs. https://unstats.un.org/unsd/nationalaccount/docs/SUT_IOT_HB_Final_Cover.pdf

United Nations, International Monetary Fund, European Commission, Organisation for Economic Co-operation and Development, & World Bank. (2025). *System of National Accounts 2025: Pre-edit Version*. United Nations. https://unstats.un.org/unsd/nationalaccount/docs/2025_SNA_Pre-edit.pdf

United Nations World Tourism Organization & United Nations Statistics Division. (2024). *Statistical Framework for Measuring the Sustainability of Tourism (SF-MST): Final Draft*. United Nations. https://unstats.un.org/UNSDWebsite/statcom/session_55/documents/BG-4a-SF-MST-E.pdf

Wilting, H. C., & in ’t Veld, D. (2025). An overview of accounting approaches for national greenhouse gas emissions; comparing consumption and production footprints in the European Union. *Economic Systems Research*, *37*(3), 402–426. https://doi.org/10.1080/09535314.2025.2463954

7 ANNEXES

Table 6: Summary of global multiregional input-output initiatives (acknowledgement – OECD)

MRIO Initiative	Maintaining institution	Intended use	Core table format	Number of economies	Sectoral detail	Annual time series coverage	Key characteristics
ADB MRIO Aug 2025	Asian Development Bank	Official Asia SUT/IOT system	MRIO tables at current prices, structured into inter-industry, final demand, and value-added blocks	62, 72 or 74 + RoW (depending on edition)	35 economic activities	2000-2024	ADB MRIO provides globally consistent MRIO tables with a strong focus on Asia-Pacific economies, supporting analysis of regional and global value chains.
EMERGING MRIO v2.5	Tsinghua University and partners (UCL, Univ. of Groningen, NTNU), dataset on Zenodo/CEADs	Full-scale MRIO for global emerging economies; high-resolution, NSI-based compilation	Standard MRIO table (134-135 sectors, 245 economies)	Up to 245	Approximately 135 activities	2010; 2015-2019	MRIO initiative designed to improve representation of emerging and smaller economies in global production networks.
EMRIO v2025	Tohoku University	Enterprise-level global supply-chain tracing; environmental accounting; Scope-3; transparency; LCA support	MRIO combining national Input-Output tables with firm-level production and transaction data	121	"17 322 sectors, 9 466 companies and 86 305 subsegments"	2015	First enterprise-level MRIO; globally consistent firm-level transactions; highly disaggregated; supports supply-chain transparency and environmental policy tools
Eora26 v2022	University of Sydney	EE-MRIO / max coverage; heterogeneous sources, high country granularity	Mix of SUT + SIOT; heterogeneous (industry x industry or product x product SIOTs)	190	Full Eora (high resolution) and Eora26 (26-sector) harmonised version	1990-2022	Global MRIO framework emphasising maximum country coverage and consistency across time.
EXIOBASE 3.9	EXIOBASE Consortium	EE-MRIO designed for footprint accounting	Harmonised SUT format (older ESR table)	44+ five RoW regions	163 industries 200 products	1995-2020 (nowcasts for 2021-2022)	Highly detailed MRIO system designed to capture complex inter-industry and cross-border production linkages.
FABIO	Vienna University of Economics and Business (FINEPRINT)	Physical MRIO for agriculture, food and forestry; biomass and resource-flow analysis	Physical multi-regional Supply-Use Tables; hybrid MR-SUT/IO	191 + RoW	118-121 processes and 125-130 commodities	1986-2013	Only global physical MRIO; FAOSTAT-based physical balancing; high-detail biomass flow tracing
FIGARO v2025	European Commission: Eurostat and Joint Research Centre	Official EU inter-country SUT/IOT system	Inter-country SUT/IOT system; industry-by-industry & product-by-product IO tables (6464)	45(EU27 Member States +18 main trading partners)	64 industries 64 products (NACE Rev.2 / CPA 2.1)	2010-2023	Provides a coherent EU-centred MRIO system fully consistent with European national accounts and international trade data.
GLORIAv059	UNEP International Resource Panel and University of Sydney (IELab)	Resource-focused EE-MRIO	MRIO IxI format (Tvy raw format), convertible to standard U/S/Z/A/L/Y IO matrices	Over 160	Detailed sectoral structure	1990-2021	MRIO system used as a backbone for global footprint and production network analysis.

GTAP 10A	Global Trade Analysis Project	SAM/CGE-first global database	Built from SAM/cost structures + reconciled trade; not inherently separated into intermediate vs final trade in the MRIO-style base, so transformation is needed to an ICIO framing	141 countries and regions + RoW (GTAP 10A)	65 sectors	Benchmark years (e.g. 2004, 2007, 2011, 2014)	Benchmark-based MRIO constructed as internally consistent snapshots for specific reference years, primarily designed for CGE modelling.
OECD ICIO v2025	OECD	Designed as reference framework for developing measures of Trade in Value Added (TiVA), GHG footprints and other indicators related to GVCs	ICIO / MRIO in SIOT-based representation	80+ RoW	50 unique activities (ISIC Rev.4)	1995-2022	Globally balanced ICIO tables (including all OECD, EU27, G20 and most ASEAN countries) aligned with national accounts and trade statistics for analysing GVCs and international fragmentation of production
WIOD 2016	University of Groningen	Trade, productivity and GVC analysis; environmental extensions	Inter-country IO tables derived from national SUTs (SNA 2008)	43 + RoW	56 industries (ISIC Rev.4)	2000-2014	SUT-based MRIO with underlying SUTs and socio-economic accounts; harmonised national-accounts approach

Table 7: Selected examples of current practice in producing statistics on consumption-based environmental pressures using EE-IOT and analysis

Producer	Statistic	Website	Environmental pressures	Geographical variables	Product/industry variables	Time series	Categories for final demand	Method
Eurostat	Greenhouse gas emission footprints (in CO2 equivalent, FIGARO application)	https://ec.europa.eu/eurostat/databrowser/view/env_ac_ghgfp__custom_21233344/default/table?page=time:2023	Greenhouse gas emissions (CO2-e)	Country of origin (i.e. producing country/region), country/region of destination (i.e. consuming country/region	64 industries by NACE/ISIC plus households for consumption	2010 - 2023	6 categories of final demand (not exports)	Multiregional input-output analysis

Producer	Statistic	Website	Environmental pressures	Geographical variables	Product/industry variables	Time series	Categories for final demand	Method
Sweden	Consumption-based air emissions	https://www.scb.se/en/finding-statistics/statistics-by-subject-area/environment/environmental-accounts-and-sustainable-development/system-of-environmental-and-economic-accounts/	Greenhouse gas emissions (including separate data for greenhouse gases carbon dioxide, methane, nitrous oxide, F-gases) plus 7 other air emissions	Country of origin (i.e. producing country/region), Sweden as destination country	49 products by CPC/CPA, plus households	2008 - 2023	5 categories of final demand (including exports). Household consumption also by 107 COICOP categories	simplified SNAC
New Zealand	Greenhouse gas emissions (consumption-based): Year ended 2023 (provisional)	https://www.stats.govt.nz/information-releases/greenhouse-gas-emissions-consumption-based-year-ended-2023-provisional/	Greenhouse gas emissions, with separate presentation of carbon dioxide, methane, nitrous oxide, F-gases		7 ISIC categories for consumption	2007 -2023	6 categories of final demand (also exports), 13 categories for household consumption by COICOP	Single region input-output model with domestic technology assumption
Nether-lands	Raw material footprints Netherlands, 2010-2021	Grondstofvoetafdrukken Nederland, 2010-2021 | Compendium voor de Leefomgeving	Raw material inputs - Fossil, metals, non-metallic minerals, bio-based materials	7 countries/regions of origin, Netherlands as destination country	9 ISIC/NACE categories for end use	2010-2021	One category for final consumption (but also data for "production footprints" and whole economy footprint alongside)	Combination of multiregional input-output analysis and simplified SNAC
Nether-lands	Greenhouse gas footprints, 2010 - 2021	https://www.clo.nl/indicatoren/nl060305-broeikasgasvoetafdrukken-nederland-2010-2021	Greenhouse gas emissions	7 countries/regions of origin, Netherlands as destination country	12 CPC/NACE categories	2010-2021	One category for final consumption (but also data for "production footprints" and whole economy footprint alongside)	Combination of multiregional input-output analysis and simplified SNAC
Eurostat	Material footprints	https://ec.europa.eu/eurostat/databrowser/view/env_ac_rmefd__custom_21237547/default/table	Over 50 material types according to MFA classification	27 EU member states	Not applicable	2000-2024	Domestic extraction, imports in raw material equivalents, exports in raw material equivalents, raw material consumption, raw material input,	Hybrid single-regional IO analysis, with domestic technology assumption with extra adaptation

Producer	Statistic	Website	Environmental pressures	Geographical variables	Product/industry variables	Time series	Categories for final demand	Method
Eurostat	Energy footprints (domestic technology assumption)	https://ec.europa.eu/eurostat/databrowser/view/env_ac_pefafp/default/table?lang=en&category=env.env_fp	Domestic energy use in EU (ktoe)	EU27 as a whole	64 CPA product groups	2014-2023	7 categories of final demand, including exports	Single region input-output model with domestic technology assumption
UK	UK and England's carbon footprint to 2022	UK and England's carbon footprint to 2022 - GOV.UK	Greenhouse gas emissions	11 countries of origin, UK as destination country	33 product groups	1990 - 2022	7 categories of final demand, excluding exports	Multiregional model with rebalancing - single country national account compatible method