From NACE to NAICS to Accounts: New Insights from a U.S. Pilot Account of the Environmental Goods and Services Sector

Dennis Fixler, Julie L. Hass, Tina Highfill, Kelly Wentland, and Scott Wentland*
U.S. Bureau of Economic Analysis

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Abstract

As part of a broader effort in the United States to research and develop pilot environmental economic accounts, this paper presents new estimates of an environmental goods and services sector (EGSS). Overall, we estimate that the EGSS gross output was $677.1 billion in 2019, or about 1.8% of the total gross output of the US economy. While these estimates are still very preliminary and not official, one goal of this research is also to provide new insights into classification challenges and measurement issues in producing environmental activity accounts more generally. The pilot EGSS estimates employ an established methodology for constructing satellite accounts for specific sectors of the US economy, which are used to construct thematic accounts related to the environment (e.g., Outdoor Recreation Account, Marine Economy Account). These estimates draw on detailed information from the Economic Census's Industry and Product data, which follows the North American Product Classification System (NAPCS) for products associated with North American Industry Classification System (NAICS) industries. In some cases, we show the U.S. data can provide more fine-grained detail than corresponding data used by Eurostat, for example, which is organized by NACE classifications. In other cases, NACE classifications align better; or, often *neither* align particularly well with classification concepts for particular activities described in SEEA and accompanying technical documentation. In comparing the two classification systems for the purposes of the EGSS accounts, we outline examples of each of these cases, which highlight potential challenges for integrating environmental activity accounts and deriving integrated indicators based on NAICS/NACE classifications. Finally, we provide additional preliminary estimates of the EGSS of the US by CEPA category and discuss next steps to address major classification and measurement issues in the U.S. statistical system as well as broader issues for the SEEA Central Framework.

Authors' emails *(ordered alphabetically)*: dennis.fixler@bea.gov; julie.hass@bea.gov; tina.highfill@bea.gov; kwentlan@gmu.edu; scott.wentland@bea.gov (*contact author)

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1. Introduction

During the 20th century, national income accounting had largely focused on measuring traditional economic activity, like consumption or investment as part of Gross Domestic Product (GDP), or disaggregating output by industry or region. While the United States and many other countries' governments had produced various economic statistics earlier in the 20th century, it was not until the last half of the century when most coalesced around a common set of accounting principles and standards, namely the United Nation's System of National Accounts (SNA).[1] The most well-known of these official estimates, GDP, provides one measure of a country's economy – the market value of all final goods and services in a country over a given period of time. While aggregate economic statistics are critical for measuring a nation's economic growth and performance over time, national statistical offices (NSOs) that produce these statistics continually adapt to the needs of decision-makers in the public and private sectors. For instance, 21st century environmental challenges and policy demands have spurred rapidly expanding interest in environmental-economic accounts, which would track the stocks and flows of environmental (natural capital) assets, ecosystem services, and aspects of the economy related to environmental protection and preservation.

As part of a broader trend of countries collecting and disseminating more information related to the environment, the UN Statistical Commission has adopted two manuals as new statistical standards in the last decade: the System of Environmental-Economic Accounting (SEEA) Central Framework (2012 – SEEA CF) and Ecosystem Accounting (2021 – SEEA EA).[2] These serve to complement the SNA and extend the scope of the national accounts by measuring the assets and services flowing from the environment. Specifically, these satellite accounts complement the SNA by using a common accounting and valuation framework, as they measure physical flows and monetary values of environmental economic activities, assets,

[1] See Coyle's (2015) book *GDP: A Brief but Affectionate History* for a more detailed history of GDP measurement, the national economic accounts, and what is (and is not) measured in these accounts.

[2] Only a portion of the latter manual, SEEA EA, was approved by the UNSC as a statistical standard, designating the chapters on valuation of ecosystem services as still experimental and in need of further development. When it was up for approval, experts from numerous national statistical offices voiced objections to the valuation methods in the manual (e.g., see Brown et al 2021), agreeing with the UNSC, as the SEEA EA chapters included valuation methods seen as incompatible with the SNA framework, among other criticisms.

and ecosystem services, including land, water, fisheries, timber, mineral resources, and other types of natural resources. According to the UN Statistical Division as of 2020,[3] 90 countries now compile or produce at least one account using the accounting approaches prescribed by the SEEA CF or SEEA EA. Many of these countries use these accounts to support public and private decision-making at national and local levels (Boyd 2018), as well as support international reporting on global conventions and agreements like the UN Framework Convention on Climate Change, Convention to Combat Desertification, and the Sustainable Development Goals (SDGs). The UN and, more recently, non-governmental institutions like the International Monetary Fund (IMF) also use information from these accounts for a variety of purposes, like global climate change indicators, to track international progress on the environment and related activities for the purposes of policy analysis.[4]

One country that is notably absent from reporting on environmental economic accounts is the United States. While the U.S. government reports a vast amount of information on the environment and the economy, it does not yet construct SEEA-based environmental economic accounts,[5] as earlier work on these types of accounts was halted in the 1990s.[6] The U.S. has, however, developed pilot accounts as part of a multi-agency research effort to explore the feasibility of constructing accounts using existing data. This included SEEA-based pilot accounts for water (Bagstad et al. 2020), land (Wentland et al. 2021), and various ecosystem services (Warnell et al. 2020, Heris et al. 2021). We extend this research effort by constructing a pilot environmental goods and services sector (EGSS) account,[7] drawing new insights about this

[3] For more information, see: https://seea.un.org/content/frequently-asked-questions#_How_many_countries

[4] See, for example, the IMF's Climate Change Indicators Dashboard which came online in April 2021: https://climatedata.imf.org/

[5] The US Bureau of Economic Analysis (BEA) does, however, produce thematic satellite accounts for Outdoor Recreation and the Marine Economy. They both provide timely and useful statistics for specific aspects of the economy, but this industry-specific approach accounts for only part of the role that environmental activity plays in the U.S. economy and is narrower in scope than the suite of SEEA-based accounts. For more information on these accounts, see: https://www.bea.gov/data/special-topics

[6] For a summary of this effort by the BEA and recommendations for the future of environmental economic accounts in the US, see: National Research Council. 1999. *Nature's Numbers: Expanding the National Economic Accounts to Include the Environment*. Washington, DC: The National Academies Press. https://doi.org/10.17226/6374.

[7] The White House's Office of Science and Technology Policy (OSTP) and the Office of Management and Budget (OMB) had announced in a national strategy for measuring natural capital and environmental-economic statistics, titled "National Strategy to Develop Statistics for Environmental-Economic Decisions: A U.S. System of Natural Capital Accounting and Associated Environmental-Economic Statistics" (2022). The Strategy recommends the

sector from our preliminary estimates while also documenting data and classification challenges that would be relevant for implementation, both in the U.S. and abroad.

Environmental activity accounts are an important set of accounts outlined in the SEEA-CF (Ch. 4). They include a set of functional accounts that quantify transactions in the economy undertaken to protect, rehabilitate, or preserve the environment.[8] Collectively, these accounts comprise three areas of environmental activities in the economy: 1) environmental protection expenditures (EPE), 2) environmental tax and subsidies, and the 3) environmental goods and services sector (EGSS). This paper focuses on the latter; and, it is part of a broader project to eventually develop pilot estimates for all three.[9] While preliminary, these pilot estimates provide the first SEEA-based sketch of the size and growth of the EGSS in the US across two recent periods (2015 and 2019), along with information about the relative size of its components (broken out by Classification of Environmental Activities (CEA) category). We then discuss how a preliminary EGSS account can provide new insights into the supply and use of products for environmental protection and resource management in the U.S. economy.

This work builds on prior efforts in the US (described in the next section) that set out to measure the "green economy" or "green jobs" in ways that predated the SEEA-CF methodology. Methodologically, while we follow methods and scope outlined in Chapter 4 of SEEA-CF, our estimates of the EGSS exploit an established approach used by BEA to produce other satellite accounts (albeit different in scope) like Outdoor Recreation and Marine Economy accounts. This approach relies on leveraging detailed internal data from the Economic Census's Industry and Product data to classify economic activities that are primarily environmental in

development of environmental activity accounts at the initial phase (Phase I) of a long-term plan to produce a full suite of SEEA-based environmental-economic accounts to complement the National Income and Product Accounts.

[8] According to the SEEA-CF manual, these accounts quantify and value "economic activities whose primary purpose is to reduce or eliminate pressures on the environment or to make more efficient use of natural resources" (SEEA-CF, §1.30).

[9] The estimates here are a preliminary version of a project currently under development for the CRIW conference on "Measuring and Accounting for Environmental Public Goods," which is titled "Accounting for Environmental Activity: Measuring Public Environmental Expenditures and the Environmental Goods and Services Sector in the U.S." by the same group of authors. This version is prepared for feedback and discussion at the 2022 London Group on Environmental Accounting. A predecessor of this project, which this project has now subsumed, was titled, "Accounting for Climate Change and Environmental Activity: Implementation Challenges in the US." For citations, please email the contact author (scott.wentland@bea.gov) for the latest draft and most up-to-date estimates.

nature. The structure of this data follows North American Product Classification System (NAPCS) for products associated with North American Industry Classification System (NAICS) industries, which in some cases align well with SEEA-CF definitions (and in other cases not well, as we will discuss at more length later in the paper).

We contribute to the economic measurement literature by advancing practical solutions to a number of key classification and valuation issues faced by users of either the North American Industry Classification System (NAICS) or the European Nomenclature of Economic Activities (NACE) system. While illustrating solutions to some common problems facing national statistical offices, we also pose new questions and challenges for the international statistical community to consider. A common thread through prior research efforts in the U.S. on environmental-economic accounting is that little is known about how far we can get with existing data until we actually try to construct an account. As part of this process, both in this study and prior research, we learn more about the limitations of existing data and we catalog a number of issues that would need to be remedied prior to being produced as a formal statistical product of the national accounts that would be of comparable quality to official estimates in the National Income and Product Accounts (NIPA). This research provides a crucial first step toward developing new environmental economic accounts in the United States, where none had existed before, contributing to a rapidly growing literature on environmental economic accounting. Understanding the landscape of the data and the accompanying accounting challenges is a necessary prerequisite for producing timely, high-quality accounts measuring economic activities that are undertaken to protect, rehabilitate, or preserve the environment.

2. Background

2.1 Satellite Accounts and Statistical Standards: The System of National Accounts (SNA), Classification of Environmental Protection Activities (CEPA), and System of Environmental-Economic Accounts Central Framework (SEEA-CF)

The System of National Accounts (SNA) – the international statistical standard that governs the national economic accounting methodology – provides guidance for extensions or

satellite accounts that move away from a focus about *what* is purchased to *why* or *for what purpose* do these outlays occur. Specifically, in chapter 29 of the 2008 System of National Accounts (SNA2008), it presents extensions to the system of national accounts that support the development of satellite accounts like, for example, tourism, health, and the environment. Regarding the latter, an environmental satellite account identifies the various monetary transactions in the SNA that are directly related to the environment. Specifically, the SNA defines the scope of this account as measuring the following: "environmental taxes, property income and property rights, and environmental protection, natural resource use and management expenditures" (SNA2008, §29.110).

As we noted in the introduction above, international interest in environmental satellite accounts had led to its own manual in 2012, the System of Environmental-Economic Accounts 2012 – Central Framework (SEEA-CF), which extended and applied the methodology from the SNA to establish three main types of accounts: physical flow accounts, monetary flow accounts, and asset accounts (both physical and monetary). Prior to the SEEA-CF, however, numerous countries had classified economic activity as environmental in their national accounts, some variant of an environmental industry satellite account prior to the adoption of the SEEA-CF, which we discuss in more detail in the next few subsections. Initially, the Classification of Environmental Protection Activities (CEPA) was established in the late 1980s to serve this purpose, with a focus on pollution and environmental protection. By the time the SEEA-CF was established in 2012, there was also a focus on natural resource management which led to the development of the Classification of Environmental Activities (CEA). The CEA has two parts: Part I focuses on environmental protection, and Part II on resource management. In recent years, there is an additional focus on resource efficiency. The fourth chapter of the SEEA-CF now serves as the methodological foundation of environmental activity accounts, which includes guidance on how to produce satellite accounts for environmental protection expenditures, environmental goods and services sector (EGSS), and tax and subsidy accounts.

2.2 What is Environmental Activity? Some Conceptual Challenges

Before looking directly at the environmental classifications and what other countries do in a practical sense, it is important to highlight from the SEEA-CF what we are trying to describe conceptually. The SEEA-CF provides the following guidance for deciding whether a transaction's scope is categorically environmental or not. It is based on the concept of main or primary purpose. The SEEA-CF explains this concept as follows:

> *"4.11 The scope of environmental activities encompasses those economic activities whose primary purpose is to reduce or eliminate pressures on the environment or to make more efficient use of natural resources.*
>
> *4.12 These various activities are grouped into two broad types of environmental activity: environmental protection and resource management. Environmental protection activities are those activities whose primary purpose is the prevention, reduction and elimination of pollution and other forms of degradation of the environment…*
>
> 4.13 *Resource management activities are those activities whose primary purpose is preserving and maintaining the stock of natural resources and hence safeguarding against depletion.*"
>
> (SEEA-CF 2012, §4.11-4.13)

Determining the primary purpose needs to follow general principles of classification, i.e., that it is consistent with the definitions of the two types of environmental activity – environmental protection and resource management.

In practice, a Department/Ministry of Transportation might claim that all output for railroads were "environmental expenditures," for example. Their argument might be that the trains reduced the use of road and air transportation, and thus the air emissions from these modes of transportation. Therefore, all expenditures for the railroads should be classified as part of the environmental goods and services sector (EGSS). Based on the application of the 'primary purpose' principle, a national statistical office would likely evaluate this and conclude that, although this may have been one of the results of the expenditures on the railroads, the primary purpose of the expenditures for railroads was rail transport and not primarily for environmental protection. Therefore, the total expenditures on railroads would not be included in the environmental protection expenditure statistics of the government sector as developed

by the national statistical office. It is worth noting, however, that expenditures of the Department/Ministry of Transport that did have a primary purpose of environmental protection, such as the construction of noise barriers along railway lines and roads, would be included.

The example above highlights an important challenge for the U.S. and other countries implementing environmental activity accounts using existing, repurposed statistics: the context through which one set of statistics or estimates was initially developed may not have been constructed initially to be consistent with the guidance regarding the 'primary purpose' principle or other principles set forth in the SNA and SEEA-CF. Therefore, it requires expertise in national accounting to sort through the initial purpose and accounting guidelines of, for example, NAPCS products codes associated with NAICS industries to determine whether these definitions are sufficiently close to the scope of the corresponding expenditure for a formal environmental activity account line item. In the example, if the federal budgeting policymakers include all train expenditures in their definition of environmental protection expenditures, it is necessary that this type of difference is flagged so that a roadmap for constructing the formal accounts would include recommendations for separating out these kinds of expenditures in the underlying source data to be more consistent with SNA and SEEA-CF guidelines and principles.

2.3 Environmental activity accounts – SEEA Central Framework and its predecessors

Methodologies and corresponding statistics describing the Environmental Goods and Services Industry/Sector (EGSS), also called the Environment Industry, have been developed by both national and international institutions. As mentioned in the prior section, SEEA Central Framework's fourth chapter is devoted primarily to environmental activity accounts, describing the scope of these accounts and methods used for measurement.[10] In particular, the environmental goods and services sector is defined and described in Section 4.2 "Environmental activities, products and producers." However, while this is the current statistical standard, it is not the first international guidance devoted to environmental activity. Eurostat, the statistics agency of the European Statistical System (ESS), along with the members

[10] These are described in Chapter 4 of the SEEA Central Framework and on the UN's website in more detail: https://seea.un.org/content/environmental-activity-accounts

of the ESS, have years of experience in collecting data and developing statistics related to environmental activity.

As early as 1999, the OECD and Eurostat provided relatively detailed guidelines for compiling an accounting of this sector. Earlier work on resource management classification was pioneered by Istat, the Italian national statistical office, using techniques from government budget analysis.[11] Building on this work, Eurostat had then developed several iterations of a Classification for Resource Management Activities (CReMA) which were used to inform the SEEA-CF's CEA. Eurostat has published a number of manuals and guidelines for these statistics (e.g., see 2009, 2016a, 2016b). Along with a number of other countries around the world, the EU and the ESS member states now produce a regular set of environmental economic accounts, including an environmental goods and services sector (EGSS) account,[12] environmental protection expenditure accounts (EPEA),[13] and environmental taxes statistics.[14] In fact, since 2017 EGSS statistics are required annual reporting for countries of the European Statistical System (ESS) using standardized questionnaires. Statistics Canada, on the other hand, has taken a slightly different approach in definitions and categories (see Statistics Canada SEGS Survey information).

2.4 A brief history of the U.S. experience with "Green" classification

The United States Government has long collected rich data on economic activity at product and industry levels, which follow NAPCS and NAICS. This fine-grained, detailed data make it possible for U.S. statistical agencies like BEA to compile industry breakdowns of economic activity (e.g., GDP by Industry), Input-Output Accounts, and satellite accounts organized around a specific theme (e.g., Outdoor Recreation, Marine Economy). Other U.S. agencies like the Bureau of Labor Statistics (BLS) and the Census Bureau have used this data and/or this classification system for a variety of purposes, including earlier initiatives to

[11] Ardi, Carolina and Frederico Falcitelli (2007) The Classification of Resource Use and Management Activities and expenditure – CRUMA: Developed by Istat consistently with CEPA2000 for the Resource Use and Management Expenditure Accounts of SERIEE. (https://unstats.un.org/unsd/envaccounting/LondonGroup/meeting12/CRUMA.pdf)
[12] See: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:Environmental_goods_and_services_sector_(EGSS)
[13] See: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Environmental_protection_expenditure_accounts
[14] See: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Environmental_tax_statistics

measure the "Green Economy" or "Green Jobs" that predate the SEEA-CF. We briefly describe some of these initiatives below.

One of the early predecessors to SEEA EGSS was undertaken by a partnership among the U.S. Census Bureau, Environmental Protection Agency (EPA), and the International Trade Administration (ITA). In 1998, the Census Bureau published the results from its Survey of Environmental Products and Services (SEPS), conducted on behalf of the EPA and ITA.[15] Specifically, they defined the environmental industry as, "the manufacture of products, performance of services and the construction of projects used, or that potentially could be used, for measuring, preventing, limiting, or correcting environmental damage to air, water, and soil." The definition also included services related to the removal, transportation, storage, or abatement of waste, noise, and other contaminants. As we noted in the example in section 2.2 above, a key departure from prior efforts and the SEEA-CF is the extent to which transportation is included, particularly if its primary purpose is not environmental. Nevertheless, they found that forty-nine (49) industries (4-digit SIC) met their definitional requirements of produced environmental goods and services: 24 in manufacturing, 22 in services, and 3 in construction. The survey's reference year was 1995. Overall, the results from SEPS estimated the green industry to be $102.8 billion in revenue in 1995, employing 774,000 employees. Tables further categorized the revenue by specific products and services and by media (e.g., air, water, solid waste, energy conservation, etc.).[16]

More than a decade ago, BLS launched a closely related initiative in the US to measure the number of jobs associated with the environment, so-called "green jobs." Officially titled the "Measuring Green Jobs Initiative," BLS collected data in the early 2010s for two reference years (2010, 2011). The initiative had three components: Green Goods and Services (GGS), Green Goods and Services occupation survey (GGS-OCC), and Green Technologies and Practices (GTP). The GSS measured employment associated with the production of green goods and services

[15] https://www.epa.gov/sites/default/files/2017-08/documents/ee-0413_acc.pdf

[16] A more recent study by Census and EPA researchers matched SEPS microdata to data from the Annual Survey of Manufactures and surrounding Census of Manufactures. See Becker and Shadbegian 2009: https://www.degruyter.com/document/doi/10.2202/1935-1682.2117/html

from sampled establishments, which included breakdowns by industry. They identified 325 industries (6-digit NAICS) as potential producers of green goods and services.[17] The GGS identified occupational employment and wages in establishments that produced green goods and services. They defined employment related to GGS that benefited the environment or conserved natural resources. To do this, BLS linked data provided to the existing BLS Occupational Employment and Wage Survey (OEWS) with the same establishment's response to the Green Goods and Services industry survey.[18] Finally, the GTP collected information on more than 35,000 business establishments on their use of green technologies and practices. They defined green technologies and practices as, "those that make their establishment's production processes more environmentally friendly or use fewer natural resources."[19]

Ultimately, the BLS initiative was ended due to budget cuts. This was a critical effort that illustrated tremendous challenges in defining and measuring a new sector of the economy that did not, at the time, have a widely accepted definition or production boundary. The SEEA-CF and subsequent work around the world have clarified many of the issues faced by BLS, but significant challenges remain (which we return to later in the paper).

Around the same time the BLS initiative began, the Economics and Statistics Administration (ESA) of the U.S. Department of Commerce issued a report *Measuring the Green Economy* in 2010.[20] ESA's report defined green products and services as "those with a predominant function of conserving energy and other natural resources, or reducing pollution," electing for both a "narrow" interpretation and a "broad" interpretation of the underlying activity. The "narrow" definition identified 497 green products/services among the 22,000 overall, while the "broad" interpretation included 732 green products/services, which includes products/services where the extent it is "green" is more ambiguous. Lists of these products and services appear in Appendix 1 of the ESA report. Overall, the report concluded that, "green

[17] https://www.bls.gov/ggs/
[18] www.bls.gov/ggsocc/home.htm
[19] www.bls.gov/gtp/home.htm
[20] https://www.commerce.gov/data-and-reports/reports/2010/04/measuring-green-economy
https://www.commerce.gov/sites/default/files/migrated/reports/greeneconomyreport_0.pdf
https://www.commerce.gov/sites/default/files/migrated/reports/appendix2_0.pdf

products and services comprised 1% to 2% of the total private business economy in 2007," with the 1% ($371 billion) corresponding to the "narrow" definition and 2% ($516 billion) corresponding to the more expansive "broad" definition of green products and services.

3. Classifying Environmental Activities (while Standing on the Shoulders of Giants) - Methodology

3.1 General methodological approach

Since we are not the first to attack this problem of classifying economic activities for constructing an environmental goods and services sector (EGSS) account, we leverage both national and international efforts that preceded this one. Given that European EGSS accounts are already in production and their SEEA-based classification methodologies are published, we began by closely examining European classifications. Indeed, one of the foundational accounting goals of the SNA, and by extension the SEEA-CF and SEEA-EA, is that economic accounts produced by national statistical offices should be comparable. Thus, by beginning with aligning our classification approach to existing methods used in the European statistical system, our intent is to facilitate comparability while simultaneously "standing on the shoulders of giants" (to borrow from the Newtonian expression) of those who have been grappling with similar issues implementing SEEA-CF for years. We then draw on prior efforts from the U.S. experience described in the last section, filling in some of the gaps along the way with our own expertise in national income accounting.

One reason this approach is possible is due to a legal reporting requirement under Regulation (EU) No 2015/2174, which directed the development of an indicative compendium of environmental goods and services and economic activities for the European statistical system. These lists identify where in the European statistical system the relevant activities and products for the EGSS can be identified. European countries that report to Eurostat often base their work on these lists. However, as mentioned earlier in the paper, the U.S. statistical system uses different product and economic activity classifications (for example, NAICS rather than NACE or ISIC, NAPSC rather than CPA or CPC) but the list showing the environmental activities to be identified (and the corresponding NACE in the case of industries and the environmental

goods and services and the corresponding CPA and CN product classifications) are a very helpful starting point for trying to identify these environmental activities, products, and services in the systems used by BEA.

3.2 Challenges with translating NACE/ISIC to NAICS

A fundamental challenge with drawing on the European experience with classification is the imperfect mapping of product and industry classifications across systems. There are well-trotted conversion tables for industry classifications, i.e., between NACE/ISIC and NAICS, which can be helpful in this process. However, the environmentally relevant portions of the NACE that need to be found in the NAICS can often be easier to find comparing the verbiage of the categories directly (using keyword searches for example), given that the activities of interest may be found in other categories than are referenced in the conversion tables. One example of this is the environmental product, "Fuel wood." This would be in both NACE 02.20 and 16.10, and the partial activity covering only fuel wood would need to be determined using additional information. NAICS-based product codes developed by BEA from the NAPCS, on the other hand, have only one product: "Firewood and fuel wood containing fuel binder manufacturing." In this instance, the NAICS-based classification system makes it easier to identify this product within our data that more cleanly aligns with the SEEA-CF defined boundary.

Another example where the NAICS classification is more specific, and thus more cleanly aligns with the SEEA-CF definition, is environmental consulting services. NACE classifies this in 74.9 as "Other professional, scientific and technical activities n.e.c.". This means that the environmental portion of this NACE needs to be separated out from other activities, likely necessitating supplementary data to estimate the proportion that is specific to environmental activity. NAICS, on the other hand, has a separate category, 541620, as "Environmental Consulting Services." In other cases, sometimes the terminology is altogether different between the classifications, where the NACE verbiage makes the classification more straightforward. For example, the term Biofuels can be found in the European lists but not in the US lists. In this case, the US uses the narrower term 'Fuel Ethanol' in the product classification rather than the broader term, biofuels.

With 6-10,000 categories in each of the different classifications, finding the relevant industries, products, and services is a massive undertaking. And, determining the portions of mixed activity categories is also very challenging, as we discuss in more depth later in the paper. The other challenge related to the US version of the product classification, NAPCS, is the lack of a description of the product code classification; there is only the name of the group – no extended description. Canada's NAPCS has an extensive description of each of the items in the classification (2017, 2022 forthcoming), but this does not currently exist for our data.

As we summarized in section 2.4 above, a number of studies were undertaken by different US Agencies and Departments prior to the SEEA-CF. While the methodologies of these studies were all different (e.g., EPA and BLS used surveys, ESA used a type of SUT approach, and Brookings (2011) used secondary sources), these initiatives and surveys were helpful in identifying the industries and products in a US context. Especially helpful was the ESA 2010 report, "Measuring the Green Economy," because there was an extensive Appendix with lists for green products and services. As we mentioned earlier, the definition used by the ESA is not the same as the definition of Environmental Goods and Services in the SEEA-CF, so it could not be used without careful consideration; but, it was very helpful, given the lack of extended description of the NAPCS in the US mentioned above.[21]

Finally, another practical challenge was the differences between the product codes used in the internal BEA SUT database and the US NAPCS classification. The BEA is working on converting its internal categories to be better aligned with the most recent version of the NAPCS classification system. However, this will take some time to complete. Although there are correspondence tables that BEA uses, since only the environmental portion of some of the categories is needed here, there are still instances where the official conversion is not appropriate. This was a similar situation encountered using the Eurostat CPC/CPA to NAPCS and ISIC/NACE to NACE matching.

[21] Currently, only the US DOC International Trade Administration (ITA), analyzing date purchased from Environmental Business International, Inc. (EBI), regularly publish data covering the US environmental technologies industry. Although the focus is primarily on export potential, there are also estimates of the total revenues of the environmental technologies. This would be a subset of the total environmental goods and services sector.

3.3 Methodology – coding environmental activities

One of the core issues with classifying environmental activity is that all economic activity does not neatly fit into a finite classification system. In many cases, as we highlighted in examples in Section 2 above, a particular good or service may have a purpose that only partially fits the definition in the SEEA-CF, or there is some ambiguity as to the extent a set of goods/services with a particular production or industry cost fits within the appropriate boundary. We thus developed a coding system to identify the environmental portion of the NAPCS/NAICS category, and every product category was coded drawing on comparisons to corresponding NACE categories coded by the European statistical system as well as our own expertise. If the whole category was environmentally relevant the category was coded "1", partially relevant was "2", and not relevant or outside the boundary was "3." For all of the categories coded 1 and 2, we further coded it according to the CEPA and CReMA classifications currently used by Eurostat. This additional coding allowed for splitting the commodities according to environmental domains, which is useful for understanding the breakout of this activity across domains.

After the environmental products were identified, then those coded '2' (partially relevant category) were examined in more detail. When possible, data from other sources were used to identify that environmentally relevant portion. For example, US Agriculture Department data for organic agriculture production was used for the applicable agriculture products. EPA data for sales of Energy Star labelled appliances (both industrial and household) were used for estimating the production of energy efficient appliances. Fuel-efficient vehicle sales were used to identify the portion of fuel-efficient vehicles that were manufactured. In the Discussion section below, we will discuss additional ways supplemental data might be used to better estimate these partial categories (e.g., using firm-level data from the private sector or other data sources from within the government).[22] Having identified the environmental portions of the products used in the BEA supply and use system as best as possible, the next step is to use BEA's internal SUT data to develop the satellite account for the US environment industry.

[22] Our final classifications will be included as an appendix in a future draft.

3.4 Methodology – a satellite account approach

Our construction of a pilot environmental goods and services sector (EGSS) account follows a satellite account approach, using detailed internal data within BEA's supply-use tables (SUTs). As we highlighted in Section 2.1, satellite accounts are useful for understanding areas of the economy that are not easily identifiable under standard industry classifications, such as NAICS. Most of BEA's satellite accounts begin with detailed supply-use tables (SUTs).[23] The SUTs provide insight into the internal workings of the U.S. economy by detailing the contribution of specific industries and commodities to gross output and value added.[24] The goal of a satellite account is to identify and isolate the production and spending already present in the SUTs for the subject area of interest.

For the EGSS account, we estimate gross output for environmental goods and services by first identifying relevant commodities (goods and services) within the SUTs as described in the prior subsection. Then, in the cases where production of the environmental commodity was comingled with non-relevant production, we used external source data to isolate the share of the commodity's gross output considered to be "environmental." One example is the periodic U.S. Department of Agriculture certified organic survey, which collects detailed crop production and value of sales data from certified organic farms. This detailed crop level information is then matched to the respective BEA product to develop the percentage of the total production that is considered environmental (organic) in its purpose. Most of the agriculture products in the BEA system were able to be matched to the USDA certified organic crops, including wheat, rice, rye, soybeans, apples, eggs, etc.

Official BEA satellite accounts typically include estimates of gross output by NAICS industry. Some satellite accounts also present gross output by activities that are salient to data users. For example, the outdoor recreation satellite account provides estimates of gross output

[23] BEA's growing suite of satellite accounts currently includes travel and tourism; arts and culture; the marine economy; the space economy; and outdoor recreation. https://www.bea.gov/data/special-topics

[24] Gross output represents the market value of the goods and services, reflecting both the value of goods and services that are used in other production processes (intermediate inputs) and the value of goods and services purchased by end-use consumers (final products). Value added or gross domestic product (GDP) represents just the value of final products.

by type of recreational activity, such as boating or bicycling, that includes production from all industries that produce boating or bicycling commodities. Presenting the EGSS estimates by industry would require translating commodity-level data to industries, which is outside of the scope of these preliminary estimates. So for this paper, we use the CEPA/CReMA aggregations to present our gross output estimates, similar to BEA satellite accounts that present gross output by activity. This also facilitates comparability with the European statistical system and countries who have adopted something similar to CEPA/CReMA aggregations.[25]

Currently, the most relevant SUT data we use come from 2015 and 2019. Hence, we provide estimates of gross output for 2015 and 2019 in both producer and purchaser values. The purchaser values include trade margins, or the value added by wholesalers and retailers in the distribution of a commodity from producers to final purchasers and the transport costs paid separately by the purchaser in taking delivery of goods. All values are in current-dollar or nominal terms, meaning there is no adjustment for inflation.

In some cases, source data were not available to separate economic activity for EGS. Therefore, we present tables under two scenarios. In the first scenario, we exclude EGS where we do not have source data to estimate the "environmental" portion of the commodity. This is a more conservative approach to estimating output of this sector that wholly and unambiguously aligns with the definition of environmental activity in the SEEA-CF. In the second scenario, we estimate the environmental share as 10 percent as a way to give some weight to these relevant commodities that were designated as partially relevant. This is still a somewhat conservative approach, but it is illustrative of the relative magnitude of the categories designated as partially relevant. If the gap between these two scenarios was obscenely large, it would be evidence that partially relevant categories might be the driving the overall size of the account. If the gap is small, partially relevant categories could still be economically important, but it would provide some confidence that the conservative approach of including unambiguous categories is a reasonable starting point for EGSS estimates.

[25] An important aspect of a proof-of-concept account is that it not only demonstrates feasibility, but the estimates can also be compared to other accounts that have undergone substantial scrutiny like those in the EU as part of a vetting process. Hence, CEPA/CReMA categories make sense here for this purpose.

There are two important caveats to consider when reviewing these estimates. First, in practice, gross output is composed of sales or receipts, other operating income, commodity taxes, and inventory change. For this paper, we did not have the source data to estimate inventory change for the EGSS. However, we do not think this exclusion substantially impacts our results, and we will explore this further in future work. The second consideration is the potential for double-counting renewable energy. To the extent that renewable energy is used in the production of other environmental goods and services, our estimates would double-count the value of that renewable energy use, which is another topic that should be pursued in future work on this account.

4. Results

4.1 Summary of pilot estimates for the U.S. Environmental Goods and Services Sector

Table 1a shows gross output estimates of environmental goods and services in both producer and purchaser values for 2015 and 2019 by CEPA category under the first scenario (excluding EGS where we do not have source data to estimate the precise "environmental" portion of the commodity). Our estimates show EGS in purchaser values accounted for $588.7 billion of U.S. gross output in 2015, growing to $677.1 billion in 2019. This translates to 1.8 percent of total U.S. gross output in both years. Nominal growth for the EGSS averaged 3.8 percent over the period, slightly slower than the overall U.S. growth rate of 4.2 percent.

One insight gained from this exercise is that Table 1a provides new estimates of the magnitudes of each CEPA/CReMA domain for the U.S. economy, highlighting the relative prominence of waste management and management of water in particular. Waste management represented the largest category in both years, responsible for just over one-quarter of the EGS purchaser value total. Management of water was the second largest category, followed closely by wastewater management and protection of biodiversity and landscapes. These four categories accounted for about 70 percent of total EGS production in 2015 and 2019 in terms of purchaser value.

Table 1b shows gross output estimates under the second scenario, where we use 10 percent as the environmental portion for commodities where we do not have source data to

precisely separate environmental-specific activities in a particular category. The overall effect is to add about $12 billion to the producer values and $14 billion to the purchaser values for each year. While 9 of the 15 categories were impacted by the inclusion, the main difference between the two scenarios is that we now have values for two additional categories, management of forest resources and minimization of the intake of forest resources.

We can also compare these pilot estimates of the US EGSS to their counterparts in Europe. The most recent Eurostat Statistics Explained article (updated 29 June 2022), states that the environmental economy as a whole contributed 2.3 percent to the 2018 GDP of the EU-27. This includes market output, ancillary or final and non-market production. If only market output is considered, the contribution to 2018 EU-27 GDP was 1.2 percent. In this current study of the US EGSS, only gross output is developed so the figures are not directly comparable. Despite this, overall, we find the comparison of the reported magnitudes to be reasonable, given that differences will remain due to measurement differences (e.g., our preliminary, incomplete estimation of partial categories) and underlying differences in the economies. For this to transition to production of an official account, numerous challenges would need to be overcome, including filling data gaps and addressing key classification issues. We discuss some of these in the next section.

Table 1a. Estimates of gross output for environmental goods and services (millions)

		2015		2019	
CEPA	**CEPA category**	**Producer Value**	**Purchaser Value**	**Producer Value**	**Purchaser Value**
10	Protection of ambient air and climate	$1,882	$4,568	$1,864	$6,393
100	Management of water	$99,249	$101,051	$114,754	$116,432
110	Management of forest resources	Unavailable	Unavailable	Unavailable	Unavailable
112	Minimisation of the intake of forest resources	Unavailable	Unavailable	Unavailable	Unavailable
120	Management of wild flora and fauna	$1,059	$1,059	$205	$205
131	Production of energy from renewable sources	$53,108	$55,431	$57,720	$61,294
132	Heat/Energy saving and management	$27,077	$68,955	$27,198	$67,278
20	Wastewater management	$80,916	$82,286	$89,811	$91,335
30	Waste management	$122,012	$149,309	$148,009	$181,420
40	Protection and remediation of soil, groundwater and surface water	$5,975	$9,601	$10,027	$17,721
60	Protection of biodiversity and landscapes	$74,756	$74,756	$86,728	$86,728
70	Protection against radiation	$1,731	$2,216	$2,879	$3,643
90	Other environmental protection	$4,926	$4,926	$5,978	$5,978
Mixed	Mixed	$28,278	$28,987	$33,387	$34,125
Unclassified	Unclassified	$4,641	$5,540	$3,879	$4,589
		$505,608	**$588,682**	**$582,440**	**$677,141**

Note: Scenario 1 - Excluding EGS where we do not have source data to estimate the “environmental” portion of the commodity.

Table 1b. Estimates of gross output for environmental goods and services (millions) (Scenario with 10% environmental portion)

		2015		2019	
CEPA	**CEPA category**	**Producer Value**	**Purchaser Value**	**Producer Value**	**Purchaser Value**
10	Protection of ambient air and climate	$1,882	$4,568	$1,864	$6,393
100	Management of water	$99,249	$101,051	$114,754	$116,432
110	Management of forest resources	$2,688	$3,523	$2,570	$3,510
112	Minimisation of the intake of forest resources	$227	$282	$256	$329
120	Management of wild flora and fauna	$1,409	$1,418	$704	$715
131	Production of energy from renewable sources	$55,594	$58,165	$60,250	$64,005
132	Heat/Energy saving and management	$27,208	$69,123	$27,328	$67,449
20	Wastewater management	$80,916	$82,286	$89,811	$91,335
30	Waste management	$122,302	$149,692	$148,318	$181,840
40	Protection and remediation of soil, groundwater and surface water	$8,164	$11,790	$12,244	$19,938
60	Protection of biodiversity and landscapes	$74,756	$74,756	$86,728	$86,728
70	Protection against radiation	$1,731	$2,216	$2,879	$3,643
90	Other environmental protection	$4,926	$4,926	$5,978	$5,978
Mixed	Mixed	$31,587	$32,664	$37,125	$38,233
Unclassified	Unclassified	$5,275	$6,235	$4,196	$4,966
		$517,913	**$602,692**	**$595,005**	**$691,494**

Note: For EGS where we do not have source data to estimate the "environmental" portion of the commodity, we use a placeholder of 10%.

5. Discussion

5.1 Data Gaps, Nontraditional ("Big") Data, and Other Issues

One of the purposes of this exercise is to press the existing data as far as possible, exploring what is currently feasible and what issues remain. In this section, we discuss many of the remaining challenges that would need to be overcome prior to producing an EGSS account as a regular account, including data gaps and classification/methodological issues. This subsection is not intended to be exhaustive, but is meant to illustrate the types of challenges and discuss potential solutions. As this research develops, new issues will likely be unearthed as well.

The first issue, which has already been discussed at some length, is a well-known issue with constructing satellite accounts based on NAPCS/NAICS (or NACE), which is that the definitions of the product and industry categories do not perfectly align with the underlying account being constructed. In some examples above, a category might contain multiple products, where only some have a purpose that is primarily environmental. In the case of organic farming, an example we discuss above, one can estimate what proportion of the reported agricultural products are organic using alternative data sources (e.g., the U.S. Department of Agriculture) to estimate that proportion. In other cases, the alternative data source might be less clear cut or more difficult to get access to. To be conservative, we explored how our estimates might change if we assigned a low percentage (10% proportion) to these categories. If the U.S. were to produce a formal account to the standards BEA produces other National Income and Product Accounts (NIPAs), then it would require extensive work in estimating these partial product/industry categories. This would require additional source data from government agencies (in some cases, special collections or internal data) and the private sector. In some cases, simple statistics and tabulations from alternative data may not be sufficient, as it may also require more sophisticated statistical analysis or modeling based on that data.

Another way to address misalignment of product/industry categories is to alter the survey collection process or find data that could stand in for firm-level or entity-level

microdata. In fact, the US EPA and Census used to regularly survey firms on related environmental activities decades ago (and as late as 2005[26]). The recent trend for statistical agencies in the U.S., however, has been to find ways to shed their reliance on costly surveys that firms and individuals find increasingly burdensome. Agencies like BEA and the Census Bureau have progressively found ways to incorporate "Big Data" and administrative data as supplements to, or in some cases replacements for, traditional survey data.[27] Hence, if the U.S. would start constructing these accounts now, then it makes sense to employ a 21st century approach by exploring additional ways data sources that already exist (i.e., "nontraditional data" that is collected for some other purpose, but that may be of sufficient quality to be used for statistical purposes) and, to the extent that gaps remain, subsequently deploying more limited (less burdensome) surveys that fill those gaps. For example, if there are ways the Economic Census could be altered to address some of the key data gaps, BEA could work with the Census Bureau and other agencies on subsequent revisions to survey collections such that the underlying SUT data (or other government data) would better align with environmental purpose.

The imperfect alignment of NAPCS/NAICS can also be addressed, at least in part, as part of the ongoing NAPCS/NAICS revision cycle. These classification systems are continuously revised over time to accommodate changing aspects of the economy. However, to this point, since the U.S. does not yet formally produce SEEA-based accounts, it has not had a focus on altering classifications in ways to better align some of these definitions with SEEA explicitly. We cannot speak for our partnering countries like Canada and Mexico, however, as they may (or may not) have been actively prodding revisions in this direction. If the U.S. were to fund the regular production of environmental activity accounts, BEA would need to cooperate with the BLS, Census Bureau, and others on the OMB-led Economic Classification Policy Committee (ECPC) to explore how NAPCS/NAICS could be altered in future revision cycles to better align

[26] https://www.epa.gov/environmental-economics/pollution-abatement-costs-and-expenditures-2005-survey

[27] For a summary of some of these Big Data efforts by the BEA, see: Moyer, B.C. and Dunn, A., 2020. Measuring the Gross Domestic Product (GDP): The Ultimate Data Science Project. *Harvard Data Science Review*, 2(1). https://doi.org/10.1162/99608f92.414caadb. For a summary of uses of nontraditional data sources across the U.S. government and academia for economic measurement, see: Abraham et al. (2019), Editor's Introduction, *Big Data for 21st Century Economic Statistics: The Future Is Now*. National Bureau of Economic Research.

with collection and classification related to environmental activity. We should note that this is a careful, deliberate process, as what revisions are made would need to maintain current levels of usability and quality for existing users of NAPCS/NAICS (like the NIPA accounts). The process will likely take several years (at least).

One potential source of non-traditional data to explore is firm-level disclosures on their annual reports (10Ks) and supplemental/voluntary environmental, social, and governance (ESG) disclosures. According to a recent report by KPMG, 96 (80) percent of the largest (large and mid-cap) firms around the world already publicly report on sustainability (KPMG, December 2020).[28] Given that surveying firms (and adding on to firm-level surveys) is costly, if firms commonly report, for example, environmental R&D expenditures, then this would be an avenue for future exploration to fill the gap left by imperfect alignment of product/industry categories that does not already separate this out in the SUTs. This also requires the accounting definition in the firm-level disclosure to be sufficiently aligned with the SEEA/NIPA accounting definitions. If there is rich data being reported with these disclosures, but the accounting definitions are sufficiently far apart, its usefulness may be limited. An investigation of this data may also reveal a new reason why firms might coalesce around more standardized reporting for ESG information in terms of environmental economic accounts.[29] Finally, an additional limitation of private sector data is that currently ESG disclosures are largely voluntary, and the information is not harmonized around a common set of definitions and classifications. Further work is necessary to understand how this data could be used for environmental activity accounts.

While there are movements toward greater harmonization of this type of information in the private sector, one option that the private sector may consider is a standard consistent with

[28] The large firms sample (labeled "G250) is based on the world's 250 largest companies by revenue as defined in the Fortune 500 ranking of 2019. The large and mid-cap firm sample (labeled "N100") is based on a worldwide sample of 5,200 complies that represent the top 100 companies by revenue in each of the 52 countries and jurisdictions captured in the study.

[29] We should note that there are different conventions in the literature that define "ESG" activities and the reporting of those activities. We follow Christensen, Hail, and Leuz (2021, p. 1,179), and use the terms "ESG," "CSR," and "sustainability" interchangeably while recognizing that there are subtle differences in these terms. In particular, we define ESG activities are those that "assess, manage, and govern" a firm's impacts on society and the environment. Further, we define reporting as "measurement, disclosure, and communication" about these activities.

the definitions and classifications of the SEEA CF and SNA that allow governments to use this information more readily for national accounts. From a self-interest perspective, in addition to the standard benefits to shareholders and other stakeholders that might accrue from the standardization of ESG accounting, if firms report environmental information in a way consistent with the SEEA CF and SNA, the long questionnaires like those administered in Europe or Canada could be substantially shorter (or perhaps even eliminated), thereby potentially reducing costs by having a single set of books for these expenditures and revenues. From a public goods perspective, if firms are providing this kind of information to the public voluntarily anyway, and the U.S. Securities and Exchange Commission (SEC) is also considering requirements for reporting,[30] it may make sense to provide it in a way that would be useful to policymakers and other decision-makers who use national accounts information.[31] As we have found with economic data over the 20th century, this information is most useful to the public when it can be aggregated into digestible national (and regional) statistics like GDP or the unemployment rate, for example, as these provide a more cohesive, overall snapshot of the economy than any single datapoint disclosed by a firm.

Finally, if production of environmental activity accounts were funded in the US, the data gaps above could largely be filled in subsequent years, and the scope of the EGSS could be expanded to include other aspects of this sector besides output. For example, funding for an "official" satellite account could also produce measures of GDP (value added), employment, and compensation. Using BEA's established satellite account module would also allow for adding in inventories and removing double-counting of renewable electricity.

5.2 Challenges using and proposed changes to the CEA Classification

The Environmental Goods and Services estimates presented in Section 4 of this paper use the existing Eurostat CEPA and ReMA classifications for developing these statistics. In this part of the paper, some of our challenges encountered using this classification are presented as well as a short discussion of the proposed revised CEA as developed by Eurostat. Unfortunately,

[30] For example, see https://www.sec.gov/sec-response-climate-and-esg-risks-and-opportunities

[31] See also Vardon et al (2016) and Keith et al (2017) for additional discussion of the use of environmental economic accounts information for policymakers and natural resource management.

only the draft Eurostat classification is available and not the extensive descriptive document supporting the proposal.

5.2.1 Challenges using the existing Eurostat CEPA-ReMA classification

The US work has encountered similar challenges using the current classification as have been noted in the European context, which was explained in various countries' quality reports. For example, the product categories used in the BEA databases and in the NAPCS are not specific enough to precisely identify the environmental activities and identifying a percentage of the mixed category, which is challenging especially when using a SUT approach. But this is more a problem of the product classification rather than the Classification of Environmental Activities (CEA).

Regarding the CEA, there were challenges separating water and wastewater treatment expenditures – which is not only a function of how the expenditures reported. Often the economic entity responsible for these activities are the same and it is not possible to split these two activities from each other. Remediation activities and environmental consulting activities often include a number of different environmental domains. For example, remediation activities can be related to air, soil and water (both surface and groundwater). And the expenditures would be nearly impossible to split. Given the quantitative importance of water, wastewater treatment, and related expenditures, one conclusion from our study is that much more work needs to be done on refining classification of these activities in particular. Small adjustments to product classifications that would better align with SEEA in these categories would potentially make a large impact for enhancing the precision of measuring the EGSS and comparability across countries using similar classification systems.

The treatment of urban parks and recreation areas were also difficult to separate since the formal recreational sport areas, which are often embedded in urban parks. Although land management is typically focused on large rural or wilderness areas, most of the world's population are impacted by the urban environment. Trees in cities have a major impact on heat, rainwater capture, and wellbeing. These urban areas are not as easy to include, as are the large tracts of land are managed by the federal/state governments. The United States has a particularly pronounced challenge here, with a large proportion of its land use being state and federally managed lands.

5.2.2 Eurostat's proposed revision of the CEA for implementation in all countries worldwide

There are three or four levels proposed for the new CEA (see Annex). The proposed first and second levels are shown in the following table (Source: SEEA CF Technical Committee, June

9, 2022). The main change in the proposed revision appears to be the merging of the environmental protection and resource management activities at the first level, although it is possible to separate out these two types of activities at level 2.[32]

Table 2 – First and second level split of proposed CEA classification

LEVEL I	LEVEL II		Correspondence with current version of CEPA CReMA classifications	Environmental protection (EP) or resource management (RM)
1	**Air, climate and energy**		CEPA1, CReMA13A, CReMA13B	EP, RM
	1.1	**Reduction and control of air emissions (excluding energy related measures)**	CEPA 1	EP
	1.2	**Energy from renewable sources**	CReMA13A	RM
	1.3	**Energy savings and management**	CReMA13B	RM
2	**Wastewater and water resources**		[Σ – sum of below]	EP, RM
	2.1	**Wastewater management**	CEPA2	EP
	2.2	**Water savings and management of natural water resources**	CReMA10	RM
3	**Waste and materials recovery**		[Σ – sum of below]	EP, RM
	3.1	**Waste management**	CEPA3	EP
	3.2	**Materials recovery**	[Σ – sum of below]	RM
4	**Soil, surface and groundwater, biodiversity and forest**		CEPA6+CReMA12, CReMA 11A	EP, RM
	4.1	**Protection of soil, surface and groundwater**	CEPA4	EP
	4.2	**Protection of biodiversity and landscape**	CEPA6 + CReMA12 (consolidated in the current version of CEPA & CReMA)	EP (after consolidation of CEPA6 and CReMA12)
	4.3	**Sustainable management of forest resources**	CReMA 11A	RM
5	**Noise and radiation**		CEPA5 CEPA7	EP
	5.1	**Protection against noise and vibration**	CEPA5	EP

[32] "At the second level split the environmental or resource management categories are singled out (so that a bridge with the current CEPA and CReMA can be relatively easily established) and, at the third and fourth level split, in almost all cases, an extra level of granularity is offered with regard to the activities, actions, expenditures that are object of the classification (an exception is for materials recovery where at the third level split we have the split by material type)." (Source: SEEA CF Technical Committee, June 9, 2022)

LEVEL I	LEVEL II		Correspondence with current version of CEPA CReMA classifications	Environmental protection (EP) or resource management (RM)
	5.2	**Protection against radiation**	CEPA 7	EP
6	**Research and development**		[Σ – sum of below]	EP, RM
	6.1	**R&D for air, climate and energy**	CEPA8.1, CReMA15	EP/RM
	6.2	**R&D for waste and materials recovery**	CEPA8.3, CReMA15	EP/RM
	6.3	**R&D for wastewater and water resources**	CEPA8.2, CReMA15	EP/RM
	6.4	**R&D for soil, surface and groundwater, biodiversity and forest**	CEPA8.4, 8.6, CReMA15	EP/RM
	6.5	**R&D for noise and radiation**	CEPA8.5, 8.7, CReMA15	EP/RM
7	**Cross-cutting and other activities**		[Σ – sum of below]	EP, RM
	7.1	**Environmental education and training**	CEPA9.1, CReMA16	EP/RM
	7.2	**General environmental administration, management, regulation, dissemination and consultancy**	CEPA9.2, CReMA16	EP/RM
	7.3	**Environmental activities not elsewhere classified**	CEPA9.4, CReMA16	EP/RM

5.2.3 UN Principles for Developing a Statistical Classification

The first principle is to be sure that there is a clear concept definition. Before further consideration, it would be important to establish the concept, especially since environmental protection (EP) and resource management (RM) are merged. The SEEA-CF defines both EP and RM – hence, a key question becomes: are these still relevant or are new definitions assumed? How are these definitions used to help distinguish the different categories? Are the technical aspects of the activities important to be able to distinguish if the activities should be included or not? The second principle, since EP/RM is a multi-dimensional concept: what are the subgroups? Evaluate that all aspects are included – for example what about ocean resource management? Drinking water? Biological resources?

It should be emphasized in all discussions regarding classification systems that the proposed classification needs to be applicable to all countries. This includes countries that have natural resource-based economies as well as those countries that are more manufacturing or

service-based. This needs to be considered carefully – does this work for all countries? We have the subgroup descriptions but what is the overall concept? A careful discussion of application to all types of economies should be part of how we evaluate and identify all the subgroups.

The new proposal diverges from the SEEA-CF official CEA by excluding categories of resource management for (a) mineral resources (which are not found anywhere but will be more important as we move from a carbon-intensive economy to a materials-intensive one); (b) timber resources (which are only "sustainable" forest resource management is included but not defined); (c) aquatic resources (such as fish in the sea, seaweed, etc. are not included at levels I or II); and, (d) other biological resources. These exclusions make resource management less comparable for countries endowed with many different natural resources, as they report expenditures covering these resource management activities. If the purpose of an accounting standard requires cross-country comparability, we should be thinking more about whether our categories have a developed country bias and whether it includes all aspects of the environment, including activities that are important to ecosystems and oceans. Currently, land-based industrial activities are the primary focus and it does not appear to cover large lake areas or ocean. For example, where would expenditures for shoreline protection activities be classified?

The third principle, define the selection criteria, seems more ambiguous – is it primary purpose only? What about a secondary purpose? Impacts? Technical aspects? Regulation compliance? This step in the classification development seems to be overlooked by Eurostat – and can be an important aspect in evaluating the revised classification as a whole. In addition, this is a classification for environmental activities and not only Environmental Goods and Services. The CEA needs to be able to be used for other purposes than the development of EGSS statistics. It is not clear whether, and to what extent, UN principles for developing or revising a statistical classification have been overlooked.[33]

[33] See: https://unstats.un.org/unsd/classifications/bestpractices/Best_practice_Nov_2013.pdf
Best Practice Guidelines for Developing International Statistical Classifications, pages 5-6

5.3 Questions and comments for the London Group to discuss

1. What is the conceptual definition for this classification?

Are the SEEA-CF definitions of RM and EP still relevant? Or, are new definitions assumed in this proposed classification? How are the EP and RM definitions used to help distinguish the different categories? Are the technical aspects of the activities important to be able to decide if the activities should be included or not?

2. Water – water is increasingly becoming a scarce resource in many parts of the world. And the protection, management and use of water needs some additional consideration. There are several issues.

A. In both the current and proposed CEA classifications water is found in several different places. Does this make sense? Should there be a more unified approach?
B. What is the definition of 'natural water' and is that the boundary that should be used for water as it becomes scarcer and more critical?
C. Why is drinking water still excluded? Drinking water is an extremely important aspect of water management and is needed for human life. Should expenditures related to water supply – including drinking water – be included in the Resource Management for water? Is it practically possible to exclude drinking water when identifying expenditures for water management?

3. How should countries include the categories not covered by the Eurostat classification? If this will be taken to the UN Statistical Commission for approval, as an official statistical classification and needs to be, should it not be a world-wide and not a European-centric classification?

4. How does this classification relate to Climate Change expenditures and Disaster Risk expenditures?

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ANNEX 1. Eurostat's proposal at first level split:

(Source: SEEA CF Technical Committee, June 9, 2022)

Table A-1 - First level split of proposed classification

1	Air, climate and energy
2	Wastewater and water resources
3	Waste and materials recovery
4	Soil, surface and groundwater, biodiversity and forest
5	Noise and radiation
6	Research and development
7	Cross-cutting and other activities

"At the second level split the environmental or resource management categories are singled out (so that a bridge with the current CEPA and CReMA can be relatively easily established) and, at the third and fourth level split, in almost all cases, an extra level of granularity is offered with regard to the activities, actions, expenditures that are object of the classification (an exception is for materials recovery where at the third level split we have the split by material type)." (Source: SEEA CF Technical Committee, June 9, 2022)

Table A-2 Proposal for the structure of the integrated classification of environmental activities (Source: SEEA CF Technical Committee, June 9, 2022)

LEVEL I	LEVEL II	LEVEL III		Correspondence with current version of CEPA CReMA classifications	Environmental protection (EP) or resource management (RM)
1	**Air, climate and energy**			CEPA1, CReMA13A, CReMA13B	EP, RM
	1.1	**Reduction and control of air emissions (excluding energy related measures)**		CEPA 1	EP
		1.1.1	*Prevention of pollution*		
		1.1.2	*Treatment*		
		1.1.3	*Monitoring, measurement and similar*		
		1.1.4	*Other activities*		
	1.2	**Energy from renewable sources**		CReMA13A	RM

LEVEL I	LEVEL II	LEVEL III		Correspondence with current version of CEPA CReMA classifications	Environmental protection (EP) or resource management (RM)
		1.2.1	*Production of energy from renewable sources*		
		1.2.2	*Equipment and technologies for renewable energy*		
		1.2.3	*Supporting services for renewable energy*		
		1.2.4	*Monitoring, measurement and similar*		
		1.2.5	*Other activities*		
	1.3	**Energy savings and management**		CReMA13B	RM
		1.3.1	*Energy savings through in-process modifications*		
		1.3.2	*Energy efficient buildings; other efficient energy-demand technologies*		
		1.3.3	*Monitoring, measurement and similar*		
		1.3.4	*Other activities*		
2	**Wastewater and water resources**			[Σ – sum of below]	EP, RM
	2.1	**Wastewater management**		CEPA2	EP
		2.1.1	*Prevention of pollution*		
		2.1.2	*Sewerage networks*		
		2.1.3	*Wastewater treatment*		
		2.1.4	*Treatment of cooling water*		
		2.1.5	*Monitoring, measurement and similar*		
		2.1.6	*Other activities*		
	2.2	**Water savings and management of natural water resources**		CReMA10	RM
		2.2.1	*Reduction of the intake*		
		2.2.2	*Water reuse and savings, reduction of water losses and leaks*		
		2.2.3	*Replenishment of water resources*		
		2.2.4	*Monitoring, measurement and similar*		
		2.2.5	*Other activities*		
3	**Waste and materials recovery**			[Σ – sum of below]	EP, RM
	3.1	**Waste management**		CEPA3	EP
		3.1.1	*Prevention of pollution*		
		3.1.2	*Collection and transport*		
		3.1.3	*Treatment and disposal of hazardous waste*		
		3.1.4	*Treatment and disposal of non-hazardous waste*		
		3.1.5	*Monitoring, measurement and similar*		

LEVEL I	LEVEL II	LEVEL III		Correspondence with current version of CEPA CReMA classifications	Environmental protection (EP) or resource management (RM)
		3.1.6	*Other activities*		
	3.2	**Materials recovery**		[Σ – sum of below]	RM
		3.2.1	*Wood and paper*	CReMA11B	RM
		3.2.2	*Mineral (metal, stone, glass, ceramics, other)*	CReMA14	RM
		3.2.3	*Plastic*	CReMA13C	RM
		3.2.4	*Textiles*	No direct correspondent	RM
		3.2.5	*Other materials*	No direct correspondent	RM
		3.2.6	*Monitoring, measurement and similar*	CReMA11B, 13C, 14	RM
		3.2.7	*Other activities (related to the recovery of materials)*	CReMA11B, 13C, 14	RM
4	**Soil, surface and groundwater, biodiversity and forest**			CEPA6+CReMA12, CReMA 11A	EP, RM
	4.1	**Protection of soil, surface and groundwater**		CEPA4	EP
		4.1.1	*Prevention of pollutant infiltration*		
		4.1.2	*Cleaning up of soil and water bodies*		
		4.1.3	*Protection from erosion and other physical degradation of soil and water*		
		4.1.4	*Prevention and remediation of soil and groundwater salinity*		
		4.1.5	*Monitoring, measurement and similar*		
		4.1.6	*Other activities*		
	4.2	**Protection of biodiversity and landscape**		CEPA6 + CReMA12 (consolidated in the current version of CEPA & CReMA)	EP (after consolidation of CEPA6 and CReMA12)
		4.2.1	*Protection and rehabilitation of species and habitats*		
		4.2.2	*Protection of natural and semi-natural landscapes*		
		4.2.3	*Monitoring, measurement and similar*		
		4.2.4	*Other activities*		
	4.3	**Sustainable management of forest resources**		CReMA 11A	RM
		4.3.1	*Reduction of the intake of timber resources*		
		4.3.2	*Reforestation and afforestation*		
		4.3.3	*Protection against forest fires*		

LEVEL I	LEVEL II	LEVEL III		Correspondence with current version of CEPA CReMA classifications	Environmental protection (EP) or resource management (RM)
		4.3.4	*Monitoring, measurement and similar*		
		4.3.5	*Others activities*		
5	**Noise and radiation**			CEPA5 CEPA7	EP
	5.1	**Protection against noise and vibration**		CEPA5	EP
		5.1.1	*Prevention and reduction of noise and vibration*		
		5.1.2	*Monitoring, measurement and similar*		
		5.1.3	*Other activities*		
	5.2	**Protection against radiation**		CEPA 7	EP
		5.2.1	*Protection of ambient media*		
		5.2.2	*Transport and treatment of high level radioactive waste*		
		5.2.3	*Monitoring, measurement and similar*		
		5.2.4	*Other activities*		
6	**Research and development**			[Σ – sum of below]	EP, RM
	6.1	**R&D for air, climate and energy**		CEPA8.1, CReMA15	EP/RM
	6.2	**R&D for waste and materials recovery**		CEPA8.3, CReMA15	EP/RM
	6.3	**R&D for wastewater and water resources**		CEPA8.2, CReMA15	EP/RM
	6.4	**R&D for soil, surface and groundwater, biodiversity and forest**		CEPA8.4, 8.6, CReMA15	EP/RM
	6.5	**R&D for noise and radiation**		CEPA8.5, 8.7, CReMA15	EP/RM
7	**Cross-cutting and other activities**			[Σ – sum of below]	EP, RM
	7.1	**Environmental education and training**		CEPA9.1, CReMA16	EP/RM
	7.2	**General environmental administration, management, regulation, dissemination and consultancy**		CEPA9.2, CReMA16	EP/RM
	7.3	**Environmental activities not elsewhere classified**		CEPA9.4, CReMA16	EP/RM