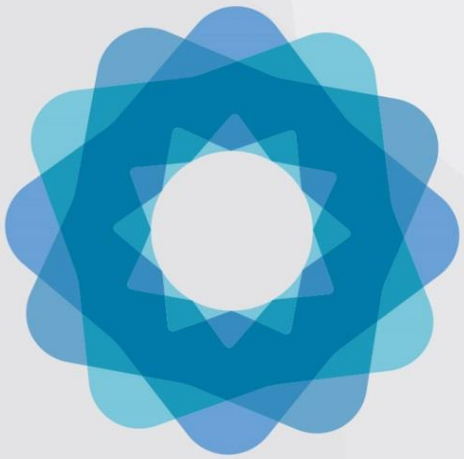

System of Environmental Economic Accounting

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SEEA TECHNICAL NOTE: AIR EMISSIONS ACCOUNTING

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This note is a part of a series of Technical Notes prepared to support the development of data based on the System of Environmental Economic Accounts (SEEA) Central Framework, the first international standard in environmental economic accounting. Since SEEA is not a single account but a series of modules, the accounts in each of the various modules can be developed separately in accordance with the priorities and the resource availability in each country.

The series of Technical Notes is comprised of a) a note addressing general issues that cut across domains focusing on institutional arrangements and institutional processes that encourage efficient implementation of the standard and associated data compilation exercises (see *Institutional Arrangements and Statistical Production Processes for the Implementation of the SEEA-Central Framework*) and b) a number of notes on specific modules. It is recommended that those wishing to develop data related to any of these specific modules should read the cross cutting note in conjunction with the note on the specific modules to be developed.

The notes on modules summarize the data requirements and other operational considerations in 20-25 pages designed to provide sufficient guidance to initiate the development of the accounts. The notes also provide reference information for additional publications that will support the full development of the accounts and provide information on extensions and linkages that can be exploited once the accounts and tables are in place.

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1. Introduction

1. Air Emissions Accounts record and present data on air emissions in a way that is compatible with the National Accounts. The accounts focus on emissions to air which are gaseous and particulate substances released to the atmosphere by establishments and households as a result of production, consumption and accumulation processes. The SEEA air emissions account records the generation of air emissions by resident economic units and by type of substance.

2. Air emissions comprise emissions of greenhouse gases as well as emissions of air pollutants such as SO2, NOx, PM10 etc. Air emissions accounts are distinct from emission inventories. Emission inventories are data on greenhouse gas emissions and emissions of air pollutants assembled following certain reporting formats as agreed upon under international conventions (e.g. UNFCCC[1] and CLRTAP[2]). Air emissions accounts provide data on greenhouse gas emissions and emissions of air pollutants that are fully consistent with the definitions, concepts and classifications of the System of National accounts (SNA). Accordingly, the air emissions by economic activities can be directly compared with macro-economic data.

3. In some situations, the gaseous and particulate substances generated through economic activity may be captured for use in other production processes (e.g., methane gas may be captured in landfill sites to generate energy or CO2 capture by breweries) or transferred between economic units for use in production or for storage (e.g., carbon emissions). These intra-economy flows are not included in air emissions accounts which only record the human caused flows of gaseous and particulate substances from the economy to the atmosphere.

4. This technical note provides an overview of air emissions accounting according to the System of Environmental Economic Accounting 2012 Central Framework (SEEA CF) which was adopted by the United Nations Statistical Commission in 2012 as the international statistical standard for environmental-economic accounts.

5. The general purpose of SEEA Technical Notes is to summarize the key features of accounting for a given topic to support countries in the implementation of the SEEA, and describe what might be a minimum set of information to guide initial efforts in compilation. This technical note will describe the main features of the SEEA accounts for air emissions, and present a core account which is the same as that presented in the SEEA Central Framework account to focus and guide initial compilation.

6. The core account represent a minimum set of information which countries should aim to compile and report, explicitly identifying the most important data items for the module at hand. While the core accounts represent a minimum set, countries may often wish to extend the level of detail in areas deemed particularly policy relevant. The Technical Notes provide highlights of such possible extensions in the explanatory text. The level of detail and industry disaggregation of the

[1] United Nation Framework Convention on Climate Change
[2] Convention on Long Range Transboundary Air Pollution

core accounts is relatively uniform across the set of module-specific technical notes. For the modules where industry disaggregation is relevant, five broad industry classes are identified.

7. In addition to the core account, this technical note presents a combined presentation (see section III). This combined presentation provides countries with a template to present and disseminate an aggregated set of key monetary and physical information relevant to the module at hand from a range of sources (including the SEEA and SNA). The information included in the combined presentations are data items which are of key relevance to policy makers and which, often in combination, are used to calculate particularly important indicators (including the SDG indicators). The level of industry disaggregation mentioned above is maintained, allowing countries to present key information at a sector specific level.

8. The development of core accounts was requested by the UN Statistical Commission at its 44th session in February 2013. The core accounts for air emissions, along with other core accounts such as those for energy, land, and others, constitutes the starting point in the development of common reporting tables in close coordination with international agencies.

9. Section 2 briefly discusses the SEEA CF accounting system for air emissions and presents the core account for air emissions. Section 3 presents the combined presentation for air emissions which serves to bring key information from multiple sources into one table to facilitate the derivation of basic indicators. Section 1 deals with the data sets required to produce the core account including the main concepts, data sources and compilation methods. Section 5 describes how the SEEA core account and related datasets may be extended to address broader issues and linked to other data sets. Section 6 provides references and links to supporting material.

2. SEEA-CF accounts for air emissions

10. The air emissions account focuses on the flows of gaseous and particulate substances at the point they pass from the economy to the environment. To fully account for the flows of particular gaseous and particulate substances, it may be of interest to record the flows of these substances within and between economic units, in addition to emissions to air; however, these flows are not part of the air emissions accounts described in this note.

2.1 Physical Supply and Use Tables for Air Emissions

11. The conceptual foundation of the air emissions account is found in the Physical Supply and use Table (PSUT); however, there is no requirement that a complete PSUT be constructed, since the focus is on the generation and release of residuals to the atmosphere. Rather, emphasis is on determining an appropriate scope for the measurement of air emissions which aligns with the scope and boundaries used in the compilation of the national accounts.

12. The Core account for air is based on table 3.7 in SEEA CF. The left-hand part is the supply table, which shows the generation of emissions by industries and households, by type of substance. For the purpose of accounting for emissions of carbon dioxide, it is recommended that, where possible, carbon dioxide emissions resulting from the burning of fossil fuels should be distinguished from carbon dioxide emissions resulting from the burning of biomass. This allows for a comparison of the amount of fossil carbon added to the atmosphere in relation to the natural carbon cycle.

13. The column for accumulation shows the release of air emissions to the atmosphere from controlled landfill sites as these reflect a release of emissions from production, consumption and accumulation activity in earlier periods. These emissions should be attributed to the waste management units that operate the landfill sites.

14. Air emissions by households may be broken down by purpose (i.e. transport, heating, other) depending on analytical requirements and available information.

15. The right-hand part of the table represents the use table which covers the up-take of emissions by the atmosphere which must equal the total supply.

Core Account 1: Air Emissions Account (tonnes)

	Supply table for air emissions										Use table for air emissions	
	Generation of emissions								Accumulation		Flows to the Environment	
	Industries					Households						
	Agriculture	Mining	Manufacturing	Transport	Other	Transport	Heating	Other	Emissions from landfill	Total supply of emissions	Emissions released to the environment	Total use of emissions
Type of substance												
Carbon dioxide	10 610.3	2 602.2	41 434.4	27 957.0	82 402.4	18 920.5	17 542.2	1 949.1	701.6	204 119.6	204 119.6	204 119.6
Methane	492.0	34.1	15.8	0.8	21.9	2.4	15.5	1.7	222.0	806.3	806.3	806.3
Dinitrogen oxide	23.7		3.5	0.8	2.6	1.0	0.2	0.1	0.1	32.0	32.0	32.0
Nitrous oxides	69.4	6.0	37.9	259.5	89.0	38.0	12.1	1.3	0.3	513.6	513.6	513.6
Hydroflourocarbons			0.3		0.4					0.7	0.7	0.7
Perflourocarbons												
Sulphur hexaflouride												
Carbon monoxide	41.0	2.5	123.8	46.2	66.2	329.1	51.2	5.7	1.1	666.9	666.9	666.9
Non-methane volatile organic compounds	5.2	6.5	40.0	16.4	27.2	34.5	29.4	3.2	0.9	163.3	163.3	163.3
Sulphur dioxide	2.7	0.4	28.0	62.4	8.1	0.4	0.4	0.1	0.0	102.5	102.5	102.5
Ammonia	107.9		1.7	0.2	0.9	2.3	11.4	1.2	0.2	125.9	125.9	125.9
Heavy metals												
Persistent organic pollutants												
Particulates (incl PM10, dust)	7.0	0.1	8.5	9.3	4.4	6.0	2.8	0.5	0.0	38.5	38.5	38.5

16. Some air emissions will occur when resident economic units undertake activity in other countries. Consequently, while the majority of air emissions will be released into the national environment (i.e. atmosphere), some air emissions from resident economic units will be released into the environment of the rest of the world. Consistent with the general definition of the economic boundary using the concept of residence, air emissions accounts for a nation will exclude emissions released within a national territory by non-residents (such as tourists and foreign transportation operations), whereas the emissions abroad of resident economic units will be included.

2.2 Boundary Issues

17. The nature of air emissions means that it is quite possible for air emissions released in one country to be carried through the atmosphere into the territory of another country. While these flows may be of considerable interest in understanding the state and quality of the atmosphere of a national environment, they are out of scope of air emissions accounts, as they occur within the environment.

18. Air emissions accounts also do not record the extent of the capture or embodiment of gases by the environment, for example, carbon captured in forests and soil[3].

[3] Carbon capture is addressed in SEEA – Experimental Ecosystem Accounting under carbon accounting.

19. Included within the scope of the air emissions account is a range of other emissions that are the direct result of economic production processes, namely, the emissions from cultivated livestock due to digestion (primarily methane), and emissions from soil as a consequence of cultivation or of other soil disturbances, arising, for example, from construction or land clearance. Emissions from natural processes such as unintended forest and grassland fires and human metabolic processes which are not the direct result of economic production are excluded.

20. Secondary emissions occur when emissions from various economic processes combine in the atmosphere to create new substances. These new combinations should be considered changes occurring in the environment and are excluded from air emissions accounts.

21. Flaring and venting of residual gaseous and particulate materials into the atmosphere are part of the process of extracting natural gas and crude oil. These releases are included in the air emissions accounts.

22. Emissions from manure collected and spread on agricultural land are within scope of the air emissions accounts. The emissions from the manure are considered flows from the economy, active agricultural production, to the environment.

23. The air emissions generated by industries and households should be measured at the point at which they leave an establishment, that is to say, they should be measured after the substances have passed through any relevant filtering or emission reduction technology or process within the establishment.

24. For example, landfill sites may generate air emissions but may also capture these gases to produce other outputs—for example, energy from methane captured on site—thereby releasing different air emissions direct to the atmosphere. However, only those emissions that leave the establishment should be recorded and attributed to the waste management industry[4].

2.3 Attributing air emissions to source

25. Air emissions are released due to production, consumption and accumulation processes of industries and households. In order to permit effective linking of physical flow data to monetary data, the physical flows of emissions should be classified using the same classifications used in the SNA's supply and use tables (SUTs). For household consumption, it is necessary to consider both the purpose of the consumption and the actual product being used by households. This requires consideration of data classified by the Classification of Individual Consumption According to Purpose (COICOP) and by the Central Product Classification (CPC) as some products may be used for a variety of purposes.

26. The attribution of air emissions is of particular relevance in the measurement of air emissions from durable goods such as cars. Air emissions accounts should attribute the emissions according to the nature of the activity for which the durable goods are being used rather than according to the characteristics of the durable good. Thus, emissions from a car used for private household transport

[4] Emissions from landfill sites will include emissions both from accumulated solid waste and from equipment used to operate the site.

should be attributed to households, while emissions from a car used for the delivery of goods by a retailer should be attributed to the retail industry.

27. In addition to air emissions that are released through the operation of durable goods, there may also be emissions that are leaked into the atmosphere both during the good's operating life and after it has been discarded. These leakages should be recorded as they occur and attributed to the economic owner of the good at the time of the leakage. It may be that the "ownership" of the discarded good is the owner of a landfill site, in which case the leakages should be recorded as part of the overall air emissions from the landfill site and attributed to the waste management industry operating the site.

28. Following the general accounting treatment for the activity of general government units, air emissions generated by government are recorded against the relevant industry activity (e.g., public administration). It is noted that waste management units often operate as part of general government activity. It may be difficult to separate these operations from the broader general government unit by which they are managed. Nonetheless, given the importance of waste management activities in accounting for air emissions, it is recommended that all possible efforts be made to identify these activities separately within the broader suite of general government activities.

29. There is significant policy interest in air emissions, particularly carbon dioxide and other greenhouse gas emissions. The development of a SEEA air emissions account can benefit from two other existing accounting frameworks noted here.

30. The first is the accounting for emissions inventories under the auspices of the United Nations Framework Convention on Climate Change UNFCCC (United Nations, 1994). Many countries compile relevant statistics on greenhouse gas emission inventories on a regular basis and there are close parallels in the accounting for air emissions as described in the SEEA. The main adjustments required to create a bridge between SEEA air emissions accounts and data required for the UNFCCC greenhouse gas emission inventories involve the emissions of residents abroad and non-residents in the territory. The focus of these adjustments is on land, water and air transport and national fishing vessels operating abroad.

31. The second important framework is the energy accounts that are part of SEEA CF. Because a significant source of greenhouse gas emissions is the burning of fossil fuels, there are important connections between the measurement of air emissions and the measurement of energy accounts. Indeed, data contained in energy accounts may provide a good basis for the compilation of relevant sections of air emissions accounts.

3. Combined presentation and Indicators for Air Emissions

32. The combined presentation for air emissions is based on that presented in chapter 6 of SEEA CF. It presents an aggregated set of data which provides enough information to derive indicators relevant for policy issues associated with air emissions. The combined presentation presents data from the PSUT for air emissions combined with other relevant data, primarily from the national accounts.

33. The combined presentation presents a range of physical and monetary information for industries and households using common classifications. It allows the comparison of air emissions by industry with the output and value added of those same industries measured in monetary terms. This combined presentation does not require compilation of a full supply and use table in physical terms. Rather, specific rows and columns within the full framework are selected.

34. The combined presentation for air emissions is presented below. In parts 1-4 of the table, estimates of key economic variables are included. Since all industries produce air emissions, all industries are in scope of the combined accounts, although it may be of interest to focus on some specific industries, for example, electricity generation, steel manufacturing or transport industries, as these industries are often large emitters.

35. The data included in parts 1-4 of the combined presentation are measures of output, intermediate consumption, expenditures for environmental protection purposes and environmental taxes on energy and carbon. These data can provide context to the air emission information. They can be compared with the levels of emissions and can hence assist in providing indicators of industry, household and government responses to air emissions[5].

36. Part 1-4 also includes economic data on household final consumption expenditure (at the intersection of the row "Intermediate consumption and final use" and the column "Households"). The expenditure could be further disaggregated to show the expenditure on products used for the purposes of transport and heating as these household activities are key sources of air emissions.

37. In parts 5 and 6, gross value added and employment are presented. Each of these variables gives an indication of the relative size of each industry and hence assists in determining whether the associated emissions are significant factors for a specific industry and for the economy.

38. Part 7 presents data on the quantity of energy use by industries and households as energy usage is a major factor in the generation of air emissions.

39. In parts 8 and 9 of the table, estimates of total air emissions broken down by type of substance are recorded. They are classified by industry and for households. The industry classification is the same as that used in the classification of the economic variables in parts 1-6. Note that following the general accounting principles, all emissions by government units are recorded against the relevant industry activity (e.g., public administration) rather than in a column entitled "Government".

40. Part 9 presents a subset of total air emissions by industry and households relating to those due to transport activity. Although transport activity will be most concentrated in the transport industry, other industries are likely to generate significant emissions arising from transport activity undertaken as secondary activities. The identification of transport emissions is important from a compilation perspective because adjustments are often needed to account for emissions from transport activity, for example, for that of households, and for resident and non-resident emissions.

[5] These data will also appear in other SEEA accounts, namely the Environment Protection Expenditure Accounts and the Taxes and Subsidies Accounts.

41. In order to obtain the most benefit from the information on these various areas concerning air emissions, it is important to compile time series. Times series of information allow for an analysis of trends and also permit analysis of relationships between different variables that may not be evident in the assessment of data for a single time period. For example, it would not be expected that expenditure on environmental protection would lead to reductions in air emissions in the same accounting period.

42. Overall, this combined account for air emissions shows the benefits of the use of the same classifications and structures for the organization of different data. It permits the assessment of the relative importance of different air emissions by sector of the economy, the derivation of relevant indicators for monitoring changes in air emissions, and the development of models based on the structured data set.

Combined presentation for air emissions

		Industries (by ISIC)							Final Consumption	TOTAL
		Agriculture Forestry & Fishery (ISIC A)	Mining & Quarrying (ISIC B)	Manufacturing (ISIC C)	Electricity, gas, steam & air conditioning supply (ISIC D)	Transport-ation & Storage (ISIC H)	Other Industries	Total Industry	Households	
MONETARY FLOWS	**1. Output by industry** (currency units)	170 737	116 473	1 581 433	195 769	696 332	4 362 799	7 123 543		7 123 543
	2. Intermediate consumption and final	146 006	103 131	1 521 247	180 772	616 833	3 899 641	6467630	491 935	6 959 565
	3. Environmental protection expenditure									
	Protection of ambient air and climate	175	58	351	585	370	419	1958	554	2 512
	4. Environmental taxes (currency units)									
	Carbon taxes	343	22	1 108	23	1 243	2 876	5615	6 985	12 600
	Energy taxes	504	35	2 345	38	2 034	5 433	10389	10 987	21 376
	5. Gross Value Added (currency units)	24 731	13 342	60 186	14 997	79 499	627 136	819 891		819 891
	6. Employment	371	185	1 865	61	1 001	7 448	10931		10 931
PHYSICAL FLOWS	**7. Energy use (PJ)**	194	43	710	967	527	499	2940	650	3 590
	8. Generation of air emissions (tonnes)									
	Carbon dioxide	10 610	2 121	41 434	53 197	29 517	28 828	165707.8	38 412	204 120
	Methane	492	36	16	4	2	237	787	20	806
	Dinitrogen oxide	24		4	1	1	2	31	1	32
	Nitrous oxides	69	6	38	23	261	65	462	51	514
	Hydroflourocarbons	3		28	6	62	2	102	1	103
	Non-methane volatile organic compounds	5	8	40		17	26	96	67	163
	Particulates (incl PM10, dust)	7		9		9	4	29	9	39
	9. Air emissions from transport activity (tonnes)									
	Carbon dioxide	2 673	54	1 065	14	27 748	9 217	40771	18 921	59 692
	Methane					1		1	2	3
	Dinitrogen oxide					1		1	1	2
	Nitrous oxides	28		5		260	50	342	38	380
	Hydroflourocarbons	3				62	2	67		67
	Non-methane volatile organic compounds	4		1		8	6	18	35	52
	Particulates (incl PM10, dust)	1			1	9	2	13	6	19

43. A major objective in designing the combined presentation is to support the preparation of indicators useful for environmental, economic and social policy. The air emissions accounts information is important in informing some of the proposed indicators for the Sustainable Development Goals. For example, one target that can be informed by the combined presentation is 9.4: Absolute levels of emissions in relevant sectors and sub-sectors.

44. These indicators are directly informed by the Air Emissions combined presentation, with the second indicator requiring significant additional information from the forest accounts.

4. Compilation of air emission accounts

45. The Generic Statistics Business Process Model (GSBPM) can be used to support the compilation of SEEA accounts as outlined in the first note in this series "Statistical Production Processes for Implementation of the SEEA Central Framework". Figure 2 briefly outlines the steps in this process below.

Figure 2: Steps in the Generic Statistics Business Process Model (GSBMP)

OVERARCHING MANAGEMENT FUNCTIONS	**1. Specify Needs:** Engage users to identify their detailed statistical needs, propose high level solution options and prepare the business case
	2. Design: Design and develop activities and any associated practical research work needed to define the statistical outputs, concepts, methodologies, collection instruments and operational processes. Specify all relevant metadata as well as quality assurance procedures
	3. Build: Build and test the production solution
	4. Collect: Collect and gather all necessary information (data and metadata), using different collection modes and load them for further processing
	5. Process: Clean data and prepare them for analysis
	6. Analyze: Produce statistical outputs, examine them in detail and prepare them for dissemination. Prepare statistical content and ensure outputs are 'fit for purpose' prior to dissemination. Ensure statistical analysts understand the statistics produced
	7. Disseminate: Release the statistical product and support users to access and use the output
	8. Evaluate: Conduct an evaluation of the process and agree an action plan

46. When building accounts (SEEA or SNA for example) it is often the case that that existing data sources need to be used as much as possible. The Specify Needs, Design and Build phases will often need to be undertaken simultaneously and iteratively, as one evaluates the capacity of existing data sets to meet needs relative to the potential costs of initiating new data development.

47. This section outlines some basic steps that are relevant in the compilation of air emission accounts. The initial compilation of air emission accounts will require several steps that may not need to be undertaken for each data cycle but should be revisited periodically in conjunction with regular budget and planning cycles.

4.1 Specify Needs

48. Those looking to begin compilation of the air emission accounts must first make the business case, defining the analytical and policy uses of the information being compiled. High level institutional and political buy-in should be obtained through stakeholder discussions to ensure a solid basis for institutionalisation of the accounts' compilation. Securing the necessary resources required to implement a project on compilation is important.

49. Countries may wish to begin compilation on a pilot basis, which can help to obtain the political buy-in for a regular compilation of accounts by providing an initial illustration of the information compiled and its associated uses. Compilation on a pilot basis can be a useful exercise in determining data gaps.

4.2 Design and Build

1: Establish institutional arrangements

50. It is important to build strong institutional arrangements from the outset to establish a common goal and combined strategy for compilation of air emission accounts, and to facilitate the exchange of knowledge, expertise and data. Establishing a high level committee of strategic partners will cement political buy-in and can support more cooperative working arrangements and data sharing at the technical level. Technical working groups can then be established under the high level committee. Establishing and maintaining good working relations with the agencies that are the

source for basic data can pay dividends later on in the production process when estimation challenges benefit from expertise in all concerned agencies.

51. For the case of air emission accounts, key strategic partners often include the national statistics office, ministries of energy, ministries of environment and the ministry of planning and/or finance. The roles of these different agencies will depend on the country. Given the importance of energy supply and use in the context of air emissions, the ministry of energy plays a key role in defining the country's energy policies and should be included as a key strategic partner from the outset. It is essential to understand the legal framework which determines the roles and responsibilities of different agencies in order to identify the key partners.

52. The data required to compile the core account will be collected by different members of the National Statistics System. In the case of air emissions, key government institutions typically include the National Statistics Office as well as Government agencies responsible for Energy, Central Planning, Finance and Environment. Furthermore, research organizations and non-governmental organizations could hold key sources of data.

53. These agencies should be approached and included in technical working group arrangements during the design and build phase to establish agreement on the goals, mandates and roles and responsibilities associated in the compilation of the air emission accounts.

2: Define statistical requirements - design outputs

54. Based on stakeholder discussions in the Specify Needs phase, the outcome of the Design phase will provide a basis to examine the adequacy of the existing data and assess where additional information should come from.

55. It will be important to find an appropriate balance between the detail sought by policy makers and analysts and the capacity of the statistical infrastructure to deliver sufficiently robust estimates, especially in the early stages of development. However, it is also important to recognise the demands for detailed estimates so that the development of data sources and systems can anticipate eventual improvements in these dimensions.

3: Define statistical requirements - identify key data items and prioritise

56. Once priorities have been identified, it might be useful to initially focus on the various data items within the core account that are most significant either in a policy context and/or magnitude. For example, in some countries certain types of substances might be more policy relevant and initial work could focus on emissions of these substances.

4: Identify important data sources

57. In developing Air Emissions Accounts there are two main starting points as regards to the main data sources: national emission inventories or energy statistics/balances/accounts. Accordingly two generic compilation approaches are distinguishable: "inventory-first-approach" and "energy-first-approach". Deciding whether to start with energy or emissions data is typically determined by what data can be obtained and what type of cooperation with national experts can be established. It should be noted that a multipurpose data system approach can also be taken where emissions data is

collected at a very detailed level and is used to compile both the air emission account and national emission inventors.

58. The existence of established greenhouse gas data programs at the international level such as the UNFCCC mentioned earlier means that basic data on air emissions are available for a number of countries. However, these data are not prepared using the same concepts and classifications as SEEA; thus adjustments will be required. Table 1 presents the main differences between the UNFCCC data and that required for SEEA air emissions account.

Table 1: Main differences - Air emissions accounts vs. National emission inventories

National emission inventories (territory principle)	Air emissions accounts (residence principle)
• Emissions are assigned to the country where the emission takes place.	• Emissions are assigned to the country where the economic operator causing the emission is resident.
• Emissions are assigned to processes classified according to their technical nature (e.g. combustion in power plants, solvent use).	• Emissions are classified by economic activity, following the NACE classification of the system of national accounts.
• Emissions from international navigation and aviation are assigned to the countries where the associated fuel is bunkered, irrespective of the operator's place of residence.	• Emissions from international navigation and aviation are assigned to the countries where the operator of the ship/aircraft is resident, regardless of where the emission takes place.

59. The primary adjustments are those required to align the estimates with the residency principle of the national accounts and SEEA. This requires removing from the UNFCCC estimates those emissions that arise in the national territory from non-resident agents such as non-resident tourists and non-resident transportation equipment operating in the national economy. Likewise, the emissions from resident tourists or transportation operations that occur outside of the national economy must be added to the UNFCCC estimates.

60. Data sources to make these adjustments will need to be identified if UNFCCC data are to be the basis of the estimates. For example, as noted in Table 1, the emissions from international sea and air transport from bunker fuels will not be in the national inventory. It may prove challenging to adjust the bunkered fuel data from UNFCCC so alternate sources may be needed. For example, total fuel purchased by airlines can be derived from transportation industry surveys and air emissions accounts can be estimated based on these sources.

61. Another example of additional data that can be used to estimate air emission for various transport activities is data on tonnes kilometres of truck transport split by resident and non-resident

producers and by national and international transport, which are used to make the residency adjustments[6].

62. The other major transformation necessary when using the "inventory-first-approach" is the assignment of the national inventory data classified by process to the economic activity (i.e. ISIC industries) and/or household activity producing these emissions. The Manual for Air Emissions Accounts, Eurostat 2015 has a detailed explanation of how this transformation should be established and examples of how it is being done in Europe.

63. Data sources for emissions not included in the UNFCCC will have to be found, for example CO2 emissions from biomass resulting from economic activity such as electricity and heat production and methane emissions from controlled landfills.

64. Given the high correlation between air emissions and the production and use of energy products, a second source that may already exist are the SEEA energy accounts or datasets that can be the foundation of energy accounts such as basic energy statistics for example, or energy balances.

65. Energy accounts will already have been adjusted for the residency principle but additional data will be required to complete the accounts for non-energy related emissions such as for example methane emissions from landfills. Data sources associated with the MFA and waste accounts in SEEA may be of assistance in this regard. If energy accounts are not yet available but energy balances are, then these will also require adjustments for residency. The reporting to the UNFCCC may be a good source for the non-energy related emissions.

66. Economic data programs maybe also be a source of data on energy use or other physical flows that can form the basis for estimating missing components of supply in physical terms.

67. Beyond the link to the SEEA energy accounts, the combined presentation includes data on environmental protection expenditures from the EPEA and taxes from the Taxes and Subsidies account.

68. It is important to thoroughly asses the metadata for the available datasets. First, do the dimensions conform or support those set out for the required accounts. If not, is the shortcoming important or can it be overcome with estimates based on alternate sources? Also, key at this stage is to clearly ascertain the classification, conceptual and coverage differences across the various data sets to be used as basic inputs.

5: Build the mapping and correspondence

69. After identifying potential data sources, assess their suitability for estimating the desired variables identified in the accounts. It is important to thoroughly assess the metadata for the available data sets. First, assess whether or not the definitions conform to/and or support those set out in the design phase. Determine the severity of any shortcomings and whether they can be overcome with estimates based on alternate sources.

[6] See Manual for Air Emissions Accounts, Eurostat 2009

70. Key at this stage is to clearly ascertain the classification, conceptual and coverage differences across the various data sets to be used as basic inputs. Assess if there are readily available concordances between the classification systems and if there are reliable sources that can be used to estimate adjustments for conceptual and coverage differences.

71. As with all accounting work there are a range of challenges centred on aligning the available data with the conceptual definitions and scope required for coherent accounts. For air emission accounting some particular challenges include:

- Adjusting data that is based on the territory principle
- Ensuring that double counting is avoided.

6: Address data gaps

72. If insufficient basic data is available to produce the accounts, it may be necessary to initiate a project to generate the missing data.

73. In some cases where partial data exists but there are some important data gaps it may be a good idea to construct a preliminary account filling in the missing data with the estimates based on related flows or modelling. While such an exercise may not produce a viable account, it may well reveal more about the extent and importance of data gaps thus providing a better foundation for the development of these missing basic data.

74. In the case where basic data must be developed, it is recommended that a separate project be initiated to develop the necessary data. This project should follow the steps in the Generic Statistical Business Process Model[7] (GSBPM) and generic principle as set out in the first note in this Technical Note series. Depending on the organization of responsibilities within the statistical infrastructure of the country this step may involve additional agencies or sectors of the NSO.

75. SEEA compilers will at an early stage need to assure access to these data if it doesn't already exist. A key consideration is the terms of access under current institutional arrangements. These should support cooperative working arrangements and the release of the air emission accounts with sufficient detail to address the policy issues important for the country.

76. In cases where institutional arrangements are not yet established, it should be noted that this step can take considerable effort and time as it will be important for all agencies involved to clearly appreciate the mandate of the other agencies and associated constraints.

77. Establishing and maintaining good working relations with the agencies that are the source for basic data can pay dividends later in the production process when estimation challenges can benefit from expertise in all concerned agencies.

78. Databases for the basic data and the accounts must be established. Given the SEEA links to the SNA, existing database structures and associated processing systems may be a good source for this

[7] United Nations Economic Commission for Europe (UNECE), Generic Statistical Business Process Model (GSBPM) (Version 5.0, December 2013)

development. Some adjustments will be required to add components not in the SNA such as intra-enterprise flows. It is likely that such adjustments will only be significant for a limited set of economic activates, thus efforts should be focused on these areas.

79. Use of the same systems and processes will facilitate aligning of data sets and should help reduce the development costs for the new accounts and facilitate the integration of data for the production of indicators.

4.3 Collect and Process

80. Import and process the data applying the concordances developed in the 'design and build' phase which may be required between the definitions and classifications used in the imported data and those to be used in the estimates[8]. The heterogeneity of the data for air emissions means that validation of data sources at the micro level may be needed to assure the quality of the datasets being used. Care must be taken in assessing data that may have a high degree of variability.

81. Given that data may be acquired from a number of institutions or agencies, it is important to establish data transfer protocols. Invariably agencies require changes/upgrades to systems and these impact data integration if protocols are not in place. It is also important to collect metadata with each period or at least verify that it has not changed so as to be aware of any changes to classification, definitions, etc.

82. Prepare estimates, including the estimation of data for any data gaps. Given the use of proxies to estimate some data and the varying quality and coverage of these, it is likely that different methods will need to be considered for each industry/sector of the economy.

83. As data is taken from different sources, checks should be undertaken to ensure the numbers make sense when put together in the accounts. Where large disparities exist, expert judgement will be needed to understand the cause of these differences, potentially revisiting metadata and making adjustments to the data where needed. Staff in the source agency should be closely consulted throughout this undertaking.

4.4 Analyse

84. Analyses tables and graphic representations including undertaking an analysis of time series where possible and recognising the likely need for multiple iterations of this and the previous step should be produced in order to help users of the information. Data quality should be assessed and documented at this stage.

85. The above three steps (collect, process and analyse) are the core activities in building the accounts and will be repeated in cycle during each production period. This allows the strength of the accounting approach to be used to confront the various data sources and check for consistency and reasonableness in comparison to other datasets such as the related national accounts values.

86. The first time accounts are estimated for a new program, particular attention needs to be made with regard to adjustments required to the source data to ensure the methods used are appropriate

[8] This is assuming that clean microdata sets are already available.

and sound. Since these accounts deal with physical quantities, care must be taken to fully understand the challenges in converting estimation methods from other domains where the focus has been economic values.

87. It is also recommended to construct bridge tables to show the conceptual difference between the air emission accounts and other air emissions data such as those reported for UNFCCC purposes.

88. It is recommended that in cases where significant basic data come from other agencies that staff of those agencies be asked to participate in the analysis of the estimates. These experts often have in depth knowledge that can allow the identification and resolution of inconstancies.

4.5 Disseminate

89. The dissemination of data should always be accompanied by sufficient documentation and metadata to allow users to fully understand the information being disseminated (e.g. including indicators, methodological notes and statements of data quality). This is particularly important for the initial dissemination of a new program of data where one might want to identify the initial data as 'experimental' or 'preliminary' and make it clear that user input is being sought in order to improve future releases. The metadata should be clearly published.

90. Care should be taken to ensure that differences in the SEEA air emissions accounting figures and other air emissions information previously disseminated are properly clarified, and ensure terms are properly defined and explained.

4.5 Evaluate

91. Data and related methodological and other documentation should be archived. A review of estimates, data sources, methods and systems, including actively seeking user feedback should also be undertaken.

92. These last two steps are very important for all statistical programs but when initiating a new program of data, seeking user feedback is crucial. This in turn depends on the existence of good documentation on the methods and systems so as to properly inform users and assess their feedback.

5. Extensions

93. A number of linkage have already be mentioned to other SEEA accounts such as forestry, energy, MFA and waste, EPEA and Tax and Subsidies. These accounts may provide the basis to either extend the air emissions accounts and/or help to validate the results. Likewise the data sources for the air emissions accounts may be useful in extending or verifying other accounts.

94. The accounts can be extended to highlight the estimates for specific industries of importance for the country or expanded to show separately the emissions for different household activities. Such extensions may be related to the policy initiatives of the country. As policy initiatives to minimize the growth in the emissions of various gaseous and particulate substances grow, administrative data sets may arise that will provide additional basic data for the estimation of these accounts.

95. The estimates can also be extended by the coverage of additional gaseous and particulate substances with particular attention to any that may be of significance for the economy in question.

96. Extensions to air emissions accounts can relate to the spatial disaggregation of data contained in other accounts of the SEEA Central Framework and the national accounts, as well as to the SEEA Experimental Ecosystem Accounting.

97. The accounts described in the SEEA Central Framework largely relate to specific materials, substances and flows recorded for a country as a whole. However, all materials, substances and resources are found in particular locations and, from a policy perspective, knowledge of the location of various flows may be of particular relevance. Indeed, national averages usually hide important local variations and spatially disaggregating data can help to better identify environmental spatial patterns. For example, some regions may produce higher levels of emissions than others.

98. The quality of spatial coding must be assessed carefully. The original purpose and sources may not provide precise locational information in all cases. For example, data for many economic data programs are gathered by enterprise, usually though the head office; head offices are often not located where the majority of material flows occur, particularly in large scale manufacturing or energy operations. For air emissions, the location of where transportation equipment is operating will be important if more precise locational data are to be estimated. It may be necessary to pursue more precise locations for some economic activities to fully exploit such data integration.

99. With the globalization of economic activities production and consumption processes are increasingly geographically spread. The production system of a country specialized on services may emit comparably lower amounts of carbon dioxide or other emissions on their territory since the country will tend to import major portions of their demand for basic material goods such as food, fuels, and metals. Hence, the carbon dioxide emissions on the territory only tell one side of the story (the production side) – whereas the consumption related emissions may be significantly higher when the emissions from imports are considered. Input-Output models extended by Air Emissions Accounts help to quantify the embedded emissions of imported and exported products.

6. References and Links

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