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Air emissions

System of Environmental Economic Accounting

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Outline

- Learning objectives
- Review of basics (5 min.)
- Level 1 What? why? (compilers)
  - Concepts (15 min.)
  - Group exercise and discussion (30 min.)
- Level 2
  - Data sources, country examples and issues (15 min.)
  - Group exercise and discussion (15 min.)
- Closing discussion (10 min.)

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Learning objectives

- Level 1
  - Understand what **Air Emission Accounts** are and why they are important
  - Understand the basic concepts of air emission accounting
  - Understand how air emissions are treated in the SEEA
  - Learn the steps of compiling an Air Emissions Account
- Level 2
  - Understand the common data options and sources
  - Understand the important conceptual issues
  - Be aware of how other countries have approached air emission accounting

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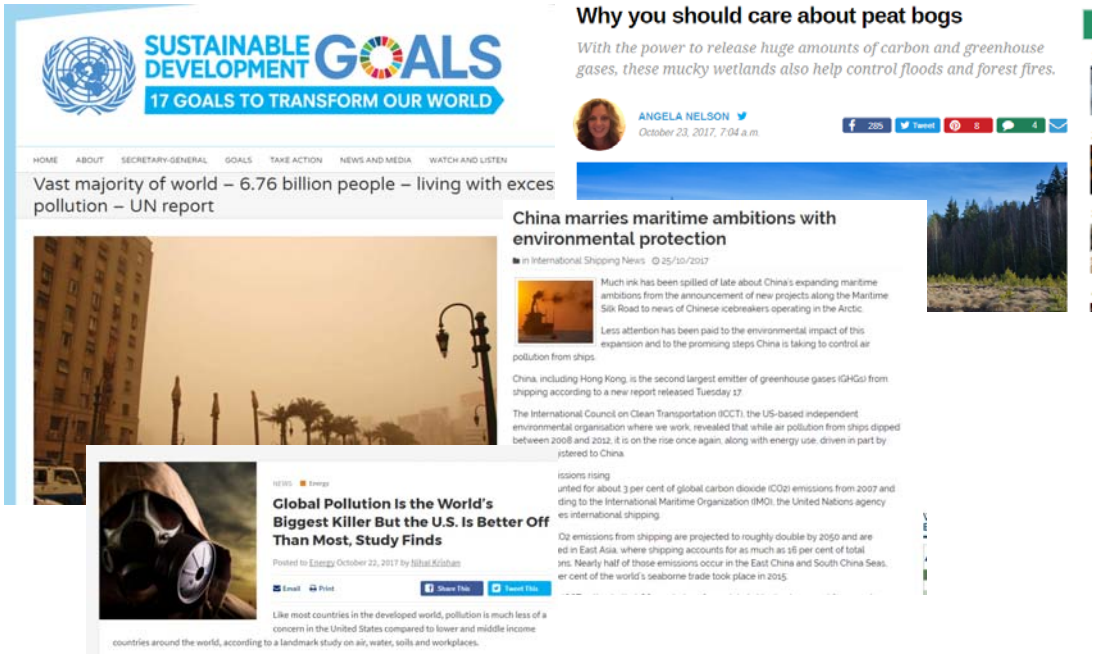
In the news...



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Basic concepts

- Why are air emissions important?
- Flows of air emissions
- Physical supply and use tables
- What's included (and not)

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Why are air emissions important?

- Contribute to to global warming
  - Carbon dioxide (CO_2), Methane (CH_4)
  - Dinitrogen Oxide (or Nitrous Oxide) (N_2O) (also ozone depleting)
  - Sulphur hexaflouride (SF_6)
- Negative effects on ecosystem and human health
  - Sulphur Dioxide (SO_2)
  - Nitrogen Oxides (NO_x)
  - Particulate Matter (PM_{10} and $PM_{2.5}$)
  - Ammonia (NH_3)
- Policies to manage air emissions need reliable data on amounts produced and who releases them (and where).

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Air emissions and SDGs

3. Good Health
- 3.9 Reduce deaths and illnesses from hazardous chemicals and **air**, water and soil pollution and contamination

11. Sustainable cities and communities
- 11.5 …reduce the number of deaths…and economic losses …caused by **disasters**
- 11.6 …reduce…adverse environmental impact of cities, including…**air quality**

12. Responsible consumption
- 12.4 …achieve environmentally sound management of **chemicals and all wastes…**

13. Climate Action
- 13.2 Integrate **climate change measures** into national policies, strategies and planning

14. Life below water
- 14.3 Minimize and address the impacts **of ocean acidification**

15. Life on land
- 15.5 …reduce **degradation** of natural habitats…

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Flows of air emissions

- Emissions to air are **gaseous and particulate** substances released to the atmosphere by establishments and households as a result of **production, consumption and accumulation**
- Air Emissions Account records generation by **resident** economic units and by type of substance

- Why do we calculate emissions of **resident** economic units?

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Supply and use table for air emissions

Who releases them?

Where do they go?

Table 3.7
Air emissions account *(tonnes)*

	Supply table for air emissions										Use table for air emissions	
	Generation of emissions								Accumulation		Flows to the environment	
	Industries—by ISIC					Households						
	Agriculture ISIC A	Mining ISIC B	Manufacturing ISIC C	Transport ISIC H	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
Hydrofluorocarbons			0.3		0.4					0.7	0.7	0.7
Perfluorocarbons												
Sulphur hexafluoride												
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 (including PM10 and 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

Why can't you add them up?

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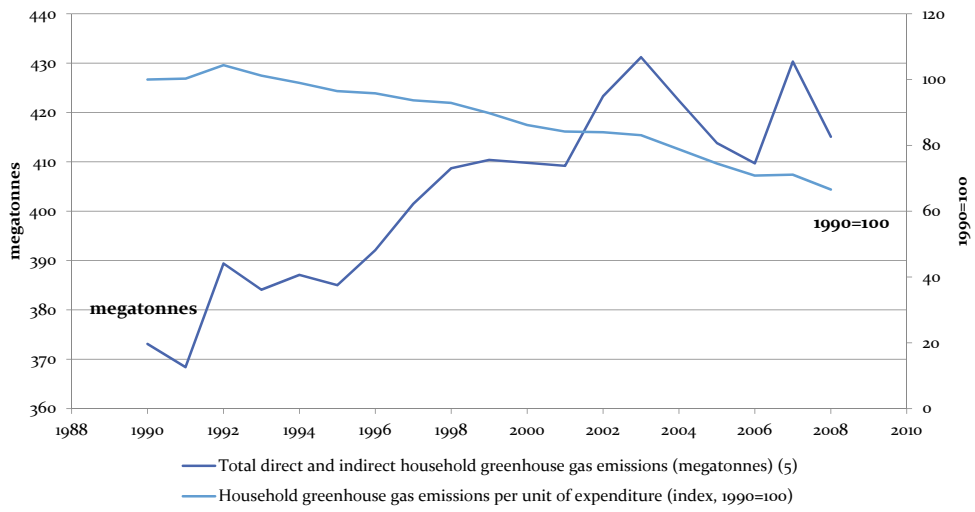
Total household GHG emissions increasing while intensity decreasing



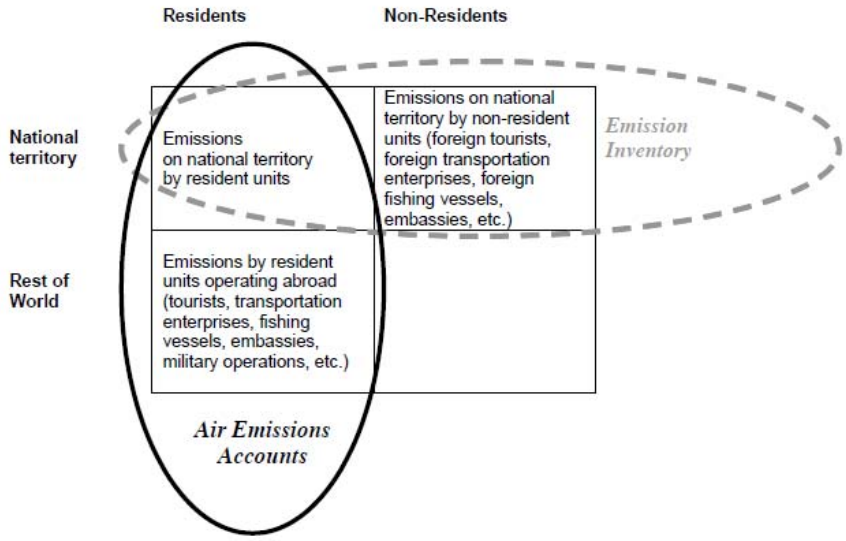
Source: CANSIM table 153-0046

Flows of air emissions: some notes

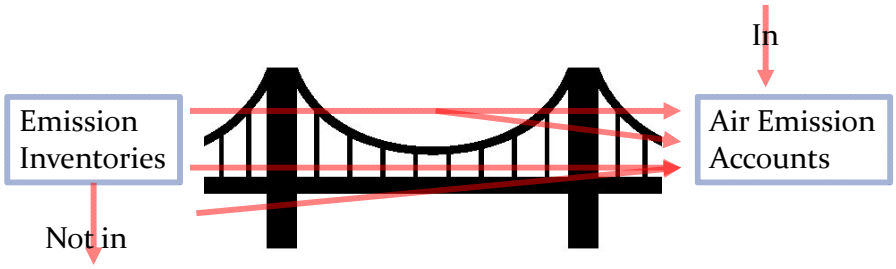
- All actual CO_2 emissions should be **included** in the accounts – also CO_2 emissions from **burning of biomass**
  - What are some examples of burning of biomass?

- However, it is recommended that, where possible, CO_2 emissions resulting from the burning of **fossil fuels** should be distinguished from CO_2 emissions from **biomass**.
  - This is to improve comparison with emission inventories (e.g., IPCC)

Use **residence** principle (not territorial)



Bridge tables needed



- The national economy totals & categories of Air Emissions Accounts **differ** from those in emission inventories.
- These differences are recorded and presented in **bridge tables**
  - Bridge tables convert between classifications and concepts

Example of a bridge table

- Territorial → convert to Residence principle

	1000 tonnes
Total emissions originating from the Danish territory (IPCC-emission inventory)	54 568
+ Emissions caused by Danish operated vehicles abroad	1 905
+ Emissions caused by Danish operated planes abroad	1 105
+ Emissions caused by Danish operated ships abroad	35 084
+ Other differences in emissions from transport and cross border trade	612
= Total Emissions from Danish economic activities (Environmental Accounts)	93 274

Took **territorial** emissions and added Danish vehicles, airplanes and ships (Maersk) operating abroad.

This almost doubled the **residential** emissions.

What else could have been added (or subtracted)?

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What's excluded?

Flows of air emissions **within** the environment are **not** in the scope for the accounts:

- **Transboundary flows** of air emissions
- **Capture of gases by the environment**, for example, carbon captured in forests and soil
- Emissions such as **unintended forest and grassland fires** and human metabolic processes which are not the direct result of economic production
- **Secondary emissions** (when substances combine to create new substances in the environment)

What is an example of a human metabolic process that produces air emissions?

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What is included?

- **Flaring and venting** of e.g. natural gas
- **Emissions from manure** collected and spread on agricultural land (dissipative use)
- **Leakages from accumulations** (durable goods like refrigerators, landfills, etc.) should be recorded **as they occur** and **attributed to the owner** of the good at the time of the leakage

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Implementation of air emission accounts

- The compilation of Air Emissions Accounts **starts from existing data**, namely data on air emissions, energy use and/or other sources.
- These existing data need to be **re-arranged** according to the accounting principles of National Accounts.
- Two general approaches are used:
  - **Energy First**
  - **Inventory First**

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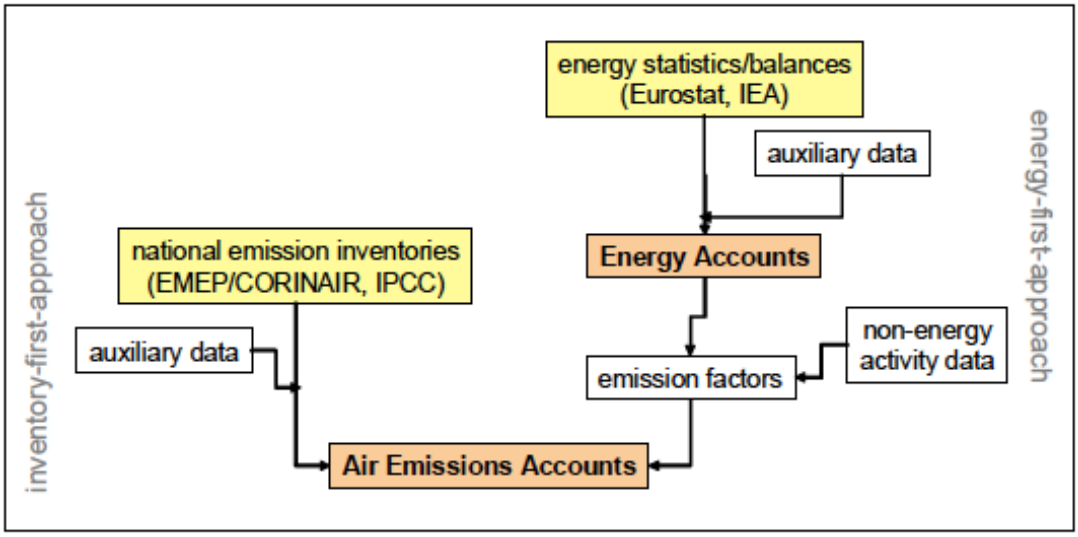
Energy first/inventory first



Source: Eurostat: Manual for Air Emissions Accounts

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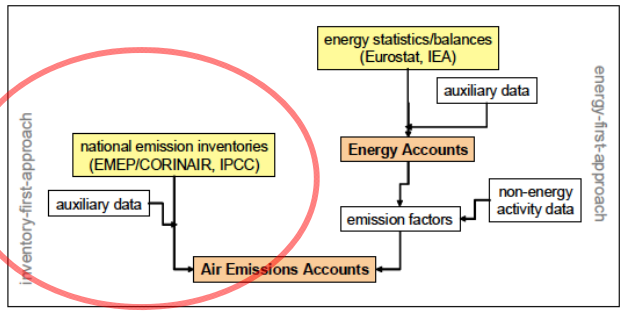
Inventory first appraoch



- The Inventory First approach starts from existing **national emission inventories** (e.g. related to United Nations Framework Convention on Climate Change, cf. IPCC Guidelines for National Greenhouse Gas Inventories)
- It **re-arranges** those data to a format compatible with National Accounts.

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"Inventory first" appraoch

Emission inventory

01	Combustion in Energy and Transformation Industry
01 01	Public Power
01 02	District heating plants
01 03	Petroleum refining plants
01 04	Solid fuel transformation plants
01 05	Coal mining, oil/gas extraction, pipeline compressor

02	Non-industrial Combustion Plants
02 01	Commercial and institutional plants
02 02	Residential plants
02 03	Plants in agriculture, forestry and aquaculture

03	Combustion in Manufacturing Industries
03 01	Comb. in boilers, gas turbines and stationary engines
03 02	Process furnaces without contact (a)
03 03	Processes with contact

Emission accounts

- NACE Rev.1.1 division 40
- NACE Rev.1.1 division23
- NACE Rev.1.1 divisions 10 - 11
- Privat Households (Heating, warm water)
- Services (NACE Rev.1.1 divisions 50 - 99)
- Agriculture etc. (NACE Rev.1.1 divisions 01 - 05)
- remaining manufacturing industries (NACE Rev.1.1 divisions 15 - 22; 24 - 37; 45)
- specific industries (NACE Rev.1.1 2-digit code can easily be identified)

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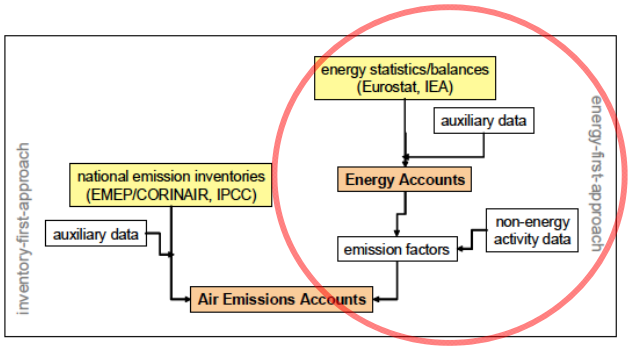
Energy first appraoch



- The Energy First approach starts from **energy statistics/balances** which are re-arranged to create **Energy Accounts,** from which
- **Air Emissions Accounts** are calculated using emission factors.

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Energy first appraoch

Energy Accounts

The same classifications as used in the SNA

From emission inventories:

Emissions **not** connected to combustion of energy:

Industrial processes
Agriculture
etc.

Emission Factors
Specific for each energy product

Air Emission Accounts

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Group exercise

- Situation:
  - Have **Energy Use table** and CO_2 **emissions factors**
  - Also know that "other industries" generate 139,000 tonnes CO_2
  - Need to calculate:
    - CO2 emissions from **use** of energy products
- Objective (Groups of 3-5; Not alone!):
  1. Multiply energy use (PJ) by appropriate emission factor
  2. Calculate total CO_2 emissions from all sources
  3. Report product totals and overall total and discuss results
  4. Which industry and product is the largest contributor to overall emissions?

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Air Emissions accounts: Exercise

Calculate CO_2 emissions from Energy Use Table and CO_2 emissions factors:

1. From **Table 1**, select relevant energy use
2. Multiply by appropriate CO2 emissions factors from **Table 2**.
3. Enter CO2 emissions in **Table 3.** Calculate totals for each product.
4. In **Table 4**, enter **139** as Non-energy-related CO2 emissions for Industrial processes for "Other industries"
5. Calculate total CO2 emissions in **Table 5**. Calculate total for all emissions.

Note: Consumption of electricity does not directly generate CO2

Table 1. USE TABLE for Energy

	UNIT: Petajoule (1015)	Agriculture and forestry	Mining	Electricity supply	Other industries	Households	Inventories	Exports	Environment	Total
Natural inputs	Extraction of coal		200							200
	Electricity form solar panels and wind mills			36						36
	Wood	20								20
Products	Coal			195			3			198
	Gasoline	15	3	1	14	12				45
	Electricity	4	5		77	24		46		156
	Fuel wood					20				20
Residuals	Losses during extraction (coal)								2	2
	Losses during distribution (electricity)								9	9
	Losses during transformation								66	66
	Other losses (due to end use)									
	gasoline								45	45
	electricity								110	110
	fuel wood								20	20
Total use of energy		39	208	232	91	56	3	46	252	927
		Emission relevant to energy use								

Table 2. CO2 EMISSION FACTORS, Tonnes CO2/TJ

		Agriculture and forestry	Mining	Electricity supply	Other industries	Households
Products	Coal	96	96	96	96	96
	Gasoline	70	70	70	70	70
	Electricity	0	0	0	0	0
	Fuel wood	110	110	110	110	110

Table 3. ENERGY RELATED CO2 EMISSIONS ACCOUNT, 1000 tons

		Agriculture and forestry	Mining	Electricity supply	Other industries	Households	Inventories	Exports	Environment	Total
Products	Coal									
	Gasoline									
	Electricity									
	Fuel wood									
Total CO2 Emissions - energy related										

Table 4. NON ENERGY RELATED CO2 EMISSION

		Agriculture and forestry	Mining	Electricity supply	Other industries	Households	Inventories	Exports	Environment	Total
	Industrial processes									

Table 5. CO2 EMISSIONS ACCOUNTS - ALL EMISSIONS

		Agriculture and forestry	Mining	Electricity supply	Other industries	Households	Inventories	Exports	Environment	Total
	CO2 Emissions									

Agriculture and Forestry consume 15 PJ of **Gasoline** (70 tonnes/TJ) = (15 PJ * 70 T/TJ) = **1050** thousand TCO_2

The answers

Table 3. ENERGY RELATED CO2 EMISSIONS ACCOUNT, 1000 tons

		Agriculture and forestry	Mining	Electricity supply	Other industries	Households	Inventories	Exports	Environment	Total
Products	Coal			18 720						18 720
	Gasoline	1 050	210	70	980	840				3 150
	Electricity									
	Fuel wood					2 200				2 200
Total CO2 Emisssions - energy related		1 050	210	18 790	980	3 040				24 070

Table 4. NON ENERGY RELATED CO2 EMISSION

		Agriculture and forestry	Mining	Electricity supply	Other industries	Households	Inventories	Exports	Environment	Total
	Industrial processes				139					139

Table 5. CO2 EMISSIONS ACCOUNTS - ALL EMISSIONS

		Agriculture and forestry	Mining	Electricity supply	Other industries	Households	Inventories	Exports	Environment	Total
	CO2 Emisssions	1 050	210	18 790	1 119	3 040				24 209

Coal use by **Electricity Supply** is the largest contributor.

Level 2: Country examples and data

- Detailed guidance
- Country examples: Denmark, Canada
- Data sources and adjustments
- Compilation challenges

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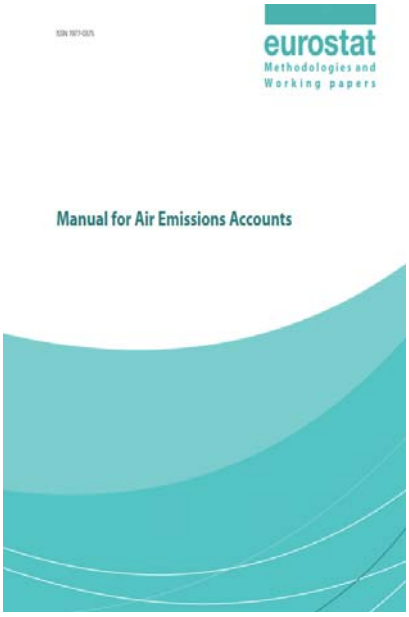
Detailed guidance

EuroStat Manual for Air Emissions Accounts uses SEEA principles

Intergovernmental Panel on Climate Change (IPCC) focuses on **anthropogenic** sources on **national territory**



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EuroStat

- Data collected by Eurostat's questionnaire to Member States

Table 3: Gaseous or particulate substances included in Eurostat's questionnaire for air emissions accounts

Code	Gaseous or particulate substances	Measurement unit
CO_2	Carbon dioxide without emissions from biomass	1000 metric tonnes
biomass CO_2	Carbon dioxide from biomass used as fuel	1000 metric tonnes
N_2O	Nitrous oxide	Metric tonnes
CH_4	Methane	Metric tonnes
HFC	Hydrofluorocarbons	Metric tonnes CO_2-equivalents
PFC	Perfluorocarbons	Metric tonnes CO_2-equivalents
SF_6	Sulphur hexafluoride	Metric tonnes CO_2-equivalents
NO_X	Nitrogen oxides	Metric tonnes NO_2-equivalents
SO_X	Sulphur oxides	Metric tonnes SO_2-equivalents
NH_3	Ammonia	Metric tonnes
NMVOC	Non-methane volatile organic compounds	Metric tonnes
CO	Carbon monoxide	Metric tonnes
PM10	Particulate matter<10 micrometres	Metric tonnes
PM2.5	Particulate matter<2.5 micrometres	Metric tonnes

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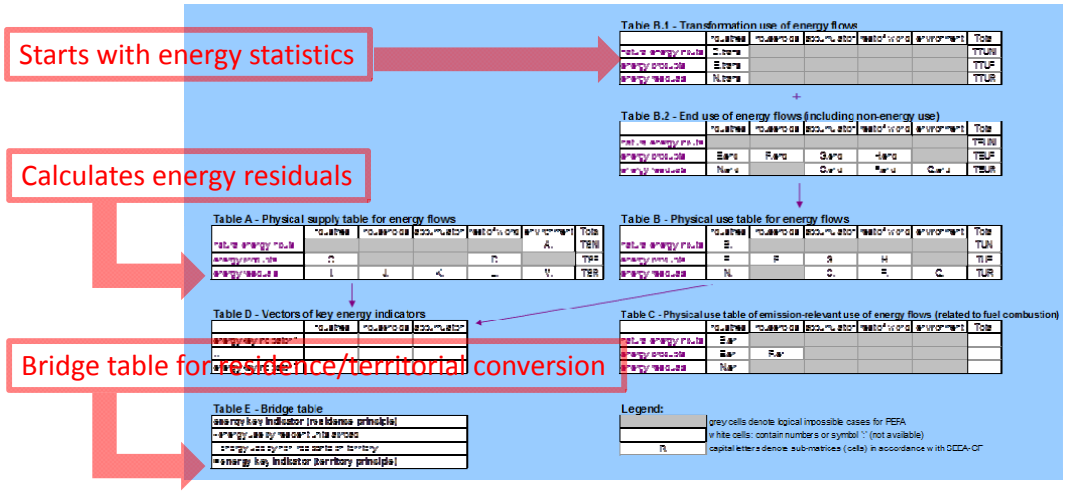
EuroStat – Physical Energy Flow Accounts (PEFA) Builder

- Application to record flows of energy from the environment (natural inputs), within the economy (products), and back to the environment (residuals)



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Country example - Denmark

Air Emission Accounts by industry and type of emission Denmark 2012

	Carbon dioxide incl. biomass (CO2), 1000 tonnes	Carbon dioxide excl. biomass (CO2), 1000 tonnes	Carbon dioxide from biomass (CO2), 1000 tonnes	Suphur dioxide (SO2), tonnes	Nitrogen oxides (NOX), tonnes	Ammonia (NH3), tonnes	Nitrous oxide (N2O), tonnes	Methane (CH4), tonnes	Non-methane volatile organic compounds (NMVOC), tonnes	Particulate matter < 10 µm (PM10), tonnes	Sulphur hexafluoride (SF6), tons CO2-equivalents
Total	93 274	78 117	15 156	233 261	1089 108	76 222	21 557	262 535	108 838	48 188	117 852
Households	12 083	7 903	4 180	1 608	20 164	1 501	319	6 438	29 527	17 391	0
Total industries	81 190	70 214	10 976	231 652	1068 945	74 721	21 238	256 097	79 311	30 796	117 852
A Agriculture, forestry and fishing	2 528	2 264	264	1 336	19 908	73 447	17 515	200 933	4 258	7 176	0
B Mining and quarrying	1 932	1 777	155	180	7 380	0	37	2 663	3 982	116	0
C Manufacturing	6 537	5 801	736	4 999	12 331	379	101	2 606	31 492	811	66 369
D_E Utility services	24 017	14 599	9 419	2 833	15 111	703	917	48 443	1 681	797	11 036
F Construction	1 509	1 444	65	9	7 451	64	52	52	2 711	869	40 447
G_I Trade and transport etc.	42 969	42 793	176	222 148	1001 308	74	2 532	1 220	33 525	20 602	0
J Information and communication	101	96	5	5	304	4	3	11	92	21	0
K Financial and insurance	65	62	3	8	180	3	2	7	29	11	0
LA Real estate activities and renting of non-residential buildings	97	91	6	1	403	3	3	4	47	23	0
LB Dwellings	39	37	2	0	145	1	1	3	18	11	0
M_N Other business services	403	381	22	11	1 430	17	13	29	393	105	0
O_Q Public administration, education and health	846	727	119	98	2 489	19	57	109	863	230	0
R_S Arts, entertainment and other services	148	142	6	23	505	6	5	17	220	25	0

26-10-2017 Statistics Denmark , www.statistikbanken.dk/MRU1

Why are almost half of CO_2 emissions and almost all SO_2 and NOx from Trade & Transport?

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Country example - Canada

- Derived from emission inventory
- Adjusted for residence principle
  - About 4% higher than inventory
- Available by detailed industry
- Many footnotes

Statistics Canada — Canada

Table 153-0114 1, 2, 3, 4, 5, 9, 10, 11, 14
Physical flow account for greenhouse gas emissions
annual (kilotonnes)

Data table | Add/Remove data | Manipulate | Download | Related information | Help

The data below is a part of CANSIM table 153-0114. Use the Add/Remove data tab to customize your table.

Selected items [Add/Remove data]
Geography = Canada

Sector	2011	2012	2013	2014	2015
Total, industries and households	734,844	742,364	758,467	758,845	754,789
Total, industries	590,322	601,493	612,401	612,805	610,695
Total, households	144,522	140,871	146,065	146,040	144,094
Total, United Nations Framework Convention on Climate Change (UNFCCC), Canada's submission [7]	707,435	716,273	729,196	727,146	721,788
Total, Reconciliation with Canada's submission to the United Nations Framework Convention on Climate Change (UNFCCC) [8]	-27,409	-26,091	-29,271	-31,699	-33,000
Reconciliation item: Waste	24,753	24,288	24,397	24,558	24,699
Reconciliation item: Biomass	-51,577	-51,999	-53,506	-53,808	-52,895
Reconciliation item: Motor fuels	-8,679	-7,910	-7,921	-7,632	-7,969
Reconciliation item: Aviation	-10,550	-10,195	-9,768	-11,226	-11,329
Reconciliation item: Synthetic fluorinated gases	10,681	11,314	11,484	11,515	12,403
Reconciliation item: Non-energy Products from Fuels and Solvent Use	3,192	6,439	6,461	5,265	5,104
Reconciliation item: Statistical difference	4,772	1,972	-419	-370	-3,012

Footnotes:

1. Data source: Statistics Canada, Environment, Energy and Transportation Statistics Division.
2. Carbon dioxide equivalent emissions are estimated using global warming potentials for methane and nitrous oxide of 25 and 298 respectively.
3. Emission sources included in these estimates: combustion of fossil fuels and biomass; non-combustion uses of fossil fuels; industrial processes; agricultural soils; livestock manure and enteric fermentation.
4. This table is published at the link: 1961 level of the input-output tables. The input-output tables are built around three classification systems: the Input-Output Industry Classification (IOIC) for industries, the Input-Output Commodity Classification (IOCC) for products (goods and services) and the Input-Output Final Demand Classification (IOFDC) for final demand categories. The Input-Output Industry Classification (IOIC) is based on the North American Industry Classification System (NAICS) and the Input-Output Commodity Classification (IOCC) is based on the North American Products Classification System (NAPCS). The Input-Output Final Demand Classification is based on the Classification of Individual Consumption by Purpose (COICOP) for the personal expenditure categories and the North American Industry Classification (NAICS) for the gross fixed capital formation categories. The classifications of the Input-Output tables can be found at the following link: http://www.statcan.gc.ca/nea-cen/hr-rh/2012-rh2012-data-donnees/appendix-appendice-annexe-eng.htm.
5. The alphanumeric codes appearing in square brackets beside each industry title represent the Input-Output Industry Classification (IOIC) codes. The IOIC identifies both institutional sectors and industries based on the North American Industry Classification System (NAICS). The first two characters of the IOIC alphanumeric codes represent the sector. IOIC codes beginning with a BS represent business sector industries, codes beginning with an NP represent Non-Profit Institutions Serving Household (NPISH) sector industries, and codes beginning with a GS represent government sector industries.
6. As of the December 2014 release of the physical flow accounts, industries BS32520 and BS32540 have been merged into a single industry BS32520 (Miscellaneous chemical product manufacturing).
7. Environment and Climate Change Canada is responsible for producing Canada's National Inventory Report on Greenhouse Gas Sources and Sinks. This inventory fulfills Canada's reporting obligations under the United Nations Framework Convention on Climate Change (UNFCCC), and is the official benchmark for greenhouse gas emissions in Canada.
8. The reporting requirements of the United Nations Framework Convention on Climate Change (UNFCCC) differ from the methodological guidelines of the United Nations System of Environmental-Economic Accounting used to create this account. As such there are differences between the totals reported in the Greenhouse Gas Account and Canada's National Inventory Report on Greenhouse Gas Sources and Sinks. These reconciliation items are included with the Greenhouse Gas Account to demonstrate these differences, which are described in EHDB 9215.
9. This table replaces CANSIM table 153-0026.
10. Totals may not add due to rounding.
11. Data for 2009 to 2014 were revised in September 2017.
13. Data for 2009 are based on input-output tables, while data for 2010 onwards are based on the supply and use tables: comparisons with the 2009 data should be done with caution.
14. For more information on the concepts, sources and methods, please consult the greenhouse gas emissions account section of the Methodological guide: Canadian System of Environmental-Economic Accounting (13-500-x).

Source: Statistics Canada, Table 153-0114 - Physical flow account for greenhouse gas emissions, annual (kilotonnes), CANSIM (database), (accessed:)
Back to search

- = in account, not in UNFCCC
+ = in UNFCCC not in account

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Country example - Canada

Used household survey to estimate fuelwood consumption

➔ major contributor to $PM_{2.5}$ and CO

5.1.7 Air emissions from residential wood consumption

A number of pollutants can be generated from burning wood including particulate matter, nitrogen oxides, carbon monoxide, volatile organic compounds, dioxins and furans, and polycyclic aromatic hydrocarbons.[11]

In 2009, residential fuel wood combustion was responsible for 9% of emissions of $PM_{2.5}$, the largest contributor after open sources (Table 5.1). Residential fuel wood combustion was also the source of 7% of carbon monoxide emissions in 2009.

The efficiency of wood heating depends greatly on the type of wood fireplace or stove used. Fireplaces tend to use wood inefficiently. Fireplace inserts and airtight wood stoves and heaters are more efficient. In 2007, wood and wood pellets accounted for 13% of total energy used by Canadian households (Table 5.2).

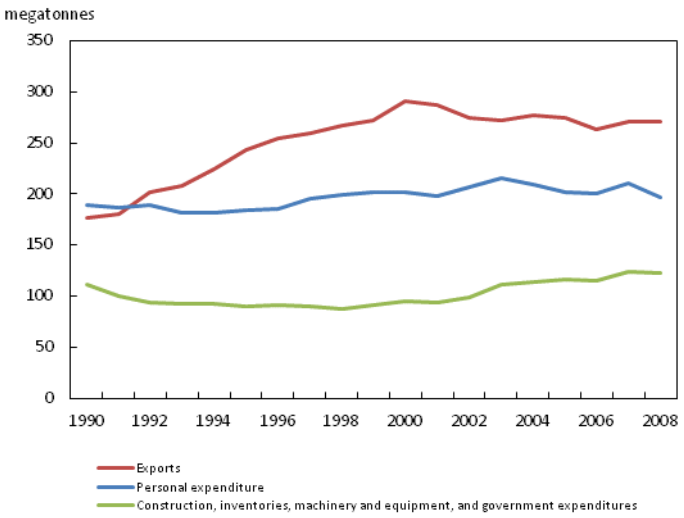
11. Environment Canada, 2011, *Residential Wood Heating, www.ec.gc.ca/residentiel-residential/default.asp?lang=En&n=E9FE1750-1* (accessed December 12, 2011).

Table 5.2
Household wood consumption, by province, 2007

	Wood and wood pellets	
	terajoules of energy used	percent of total energy use
Canada	**176,107**	**13**
Newfoundland and Labrador	5,746 E	25 E
Prince Edward Island	1,890 E	28 E
Nova Scotia	12,864	29
New Brunswick	10,729	31
Quebec	84,996	27
Ontario	35,411	7
Manitoba	3,370 E	7 E
Saskatchewan	F	F
Alberta	5,738 E	3 E
British Columbia	13,750	8

Source(s): Statistics Canada, 2010, *Households and the Environment Survey: Energy Use, 2007*, Catalogue no. 11-526-S.

Producing exports accounts for 46% of Canada's greenhouse gas emissions



This requires calculating emissions on residence principle and using I-O modelling to calculate "demand side".

For example, electricity companies generate power so we can light, heat and cool our homes. All industrial production is "intermediate" for the benefit of final consumers.

Source: Statistics Canada, The Daily, April 11, 2012

Material and energy flow accounts

The residence principle is required to calculate intensity measures.

Intensity measures are useful for targeting efficiency measures (note decrease in intensity of Oil & Gas Extraction & Coal Mining)

Table 153-0033[1,2,3,4,5,6,7]
Direct plus indirect greenhouse gas emissions intensity, by industry
annual

Data table | Add/Remove data | Manipulate | Download | Related information | Help

The data below is a part of CANSIM table 153-0033. Use the Add/Remove data tab to customize your table.

Selected items [Add/Remove data]
Geography=Canada

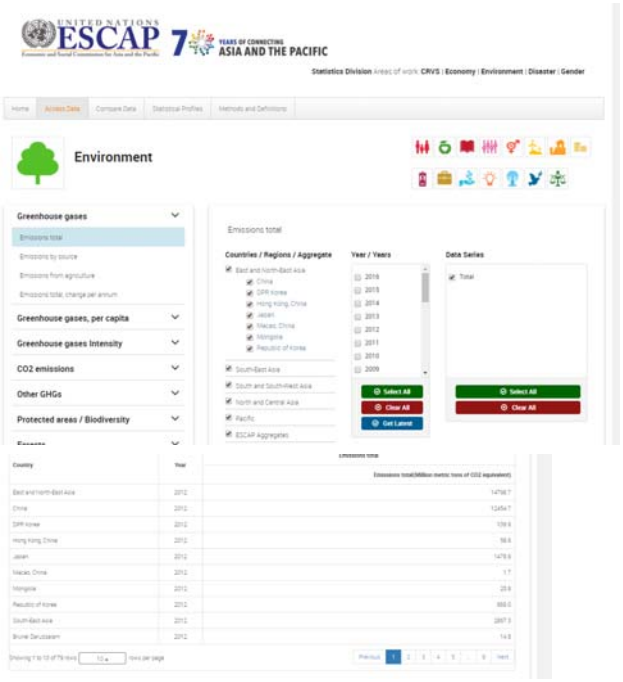
Intensity measure	Industry, L-level aggregation	2004	2005	2006	2007	2008
tonnes per thousand current dollars of production	Crop and animal production	2.91	2.94	2.88	2.59	2.12
	Forestry and logging	0.68	0.69	0.64	0.61	0.64
	Fishing, hunting and trapping	0.89	0.78	0.75	0.72	0.73
	Support activities for agriculture and forestry	0.77	0.79	0.73	0.75	0.77
	Oil and gas extraction	1.43	1.14	1.08	1.09	0.83
	Coal mining	1.50	0.76	0.73	0.93	0.55
	Metal ore mining	0.67	0.56	0.40	0.34	0.37
	Non-metallic mineral mining and quarrying	0.66	0.58	0.65	0.60	0.44
	Support activities for mining and oil and gas extraction	0.61	0.59	0.52	0.48	0.43
	Electric power generation, transmission and distribution	3.68	3.33	3.10	3.15	2.88
	Natural gas distribution, water and other systems	0.74	0.72	0.70	0.68	0.65
	Residential building construction	0.48	0.45	0.41	0.40	0.37
	Non-residential building construction	0.44	0.40	0.37	0.35	0.34
	Transportation engineering construction	0.93	0.81	0.75	0.72	0.62
	Oil and gas engineering construction	0.59	0.46	0.40	0.36	0.34

Data sources

- Existing energy accounts, energy balances and statistics
- Existing emissions inventories (e.g., IPCC reporting)
- If none, create an energy account, first!
- Surveys
  - Only if necessary (e.g., to fill in gaps on household consumption of fuelwood)
  - Exploit financial and administrative data first!
- Administrative data
  - Expenditures on fuel (by type), consumption of fuel
  - Energy utilities
- Conversion factors (by type of fuel)
  - Use "best" national factors

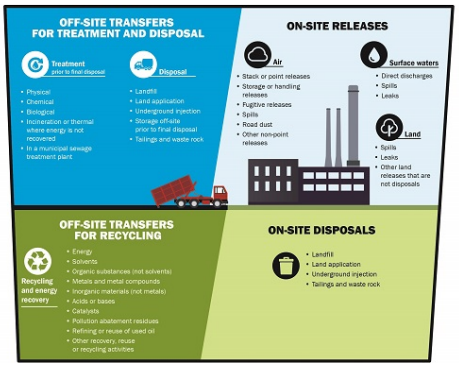
Data sources – ESCAP Statistical Database

- Derived from international sources
- By source and type



PRTR: Pollutant Release and Transfer Registers

- OECD: International guidelines & data clearinghouse
- Usually **large** emitters of **large** quantities
- Canada: National Pollutant Release Inventory (NPRI)
  - Collected via mandatory questionnaire
  - Only specific substances
  - Publicly accessible → maps, data
  - But…some substances, small emitters, mobile sources not covered



Source: https://www.ec.gc.ca/inrp-npri/

Data sources and adjustments

Area needing adjustment:	Countries that may consider corrections for these areas
International water transport	Countries with large ocean transport fleets such as: Norway, Greece, Denmark, the Netherlands, United Kingdom, South Korea, Japan
International air transport	Most countries but especially those with airport "hubs": Netherlands, UK, Germany, Italy, France, Denmark
International road transport	Countries where companies operate transport services abroad (mostly lorries and coaches registered abroad)
Fishing vessels	Countries whose fishing vessels are active in areas far from national fishing areas such as: Portugal, Spain, Norway, Ireland, Iceland, Russia
Tourism (private car driving) (non-resident units on national territory)	Countries that are attractive destinations for relatively large numbers of foreign tourists such as: Malta, Cyprus, Spain, France, Italy, Switzerland, Austria, UK
Tourism (private car driving) (resident units operating abroad)	Countries whose resident often leave the national territory on holidays using their own vehicles: Belgium, Luxembourg, The Netherlands, Slovenia
Emissions from land transport that do not involve fuel purchases	Geographic location as a "transit country" – driven through without purchasing fuel: Switzerland, Slovenia, Belgium, Germany
Fuel "tourism" (often induced by differences in tax levels between adjacent countries)	Countries where non-resident travel across borders to purchase petrol and diesel: Luxembourg, Sweden and Denmark (from Norway)
Transportation in pipelines	When pipelines are located in international territories – such as the sea floor there may be some issues related to residence and how the energy use in the pipelines is recorded. The energy use in the non-resident pipelines should be coordinated with how this is treated in the National Accounts. Relevant for Norway, the Netherlands, and potentially Denmark and Iceland in the future
Embassies, consulates and other extraterritorial enclaves	Nearly all countries have embassies within the national boundaries. In the National Accounts the economic activities of these areas are considered as non-resident units on the national territory. For Air Emissions Accounts this activity is of minor importance and is not included in corrections although technically it should be included.
Military establishments and military "actions" on national territory	For countries that host large military bases for other countries, corrections for this activity as non-resident units on the national territory should be considered although often a lack of data often due to the confidentiality of the data do not allow for corrections to be made. The same applies to military actions/wars on national territories.

Source: Eurostat: Manual for Air Emissions Accounts

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Compilation challenges

- Adjusting for residence principle
  - Requires detailed data, maybe bridge tables
- Smaller emitters may not be included in inventories
  - Larger companies have engineers, who can estimate emissions
  - In Canada, tested Survey of Industrial Processes to obtain data
- Some emissions are difficult to measure directly
  - For example, CFCs (Chlorofluorocarbons)
  - Measure "apparent consumption"
    - Domestic production + imports + opening stocks – exports – closing stocks
- Conversion factors may depend on type of fuel (use nationally-accepted ones)
- Location of releases would be useful for some emissions
  - Some emission inventories include maps

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Group exercise - Discussion

- Which air emissions are a concern in your country?
- Does your country produce:
  - Energy Accounts?
  - Emissions inventory?
  - Air emission accounts?
- What is the main data challenge in producing an air emissions account?

Take home points

- Air Emission Accounts are a useful addition to emissions inventories to calculate **intensities** and align with SNA
  - They can serve to validate emissions inventories
  - Need to adjust emission inventories to "residence principle"
- Some elements can be easily calculated from **Energy Accounts**
  - Energy Accounts can be compiled from energy balances and statistics

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