

## Dataset Information:

Title	Emissions by sector
<b>Abstract</b>	The <b>Emissions by sector</b> domain of the FAOSTAT Agri-Environmental Indicators section contains data on emissions of greenhouse gases (GHG) by gas, economic sector, country and year. It also displays the shares of each sector in the total emissions of each gas (e.g. share of agriculture in total CH <sub>4</sub> emissions) and the shares of each gas in the emissions from each sector (e.g. share of CH <sub>4</sub> in the emissions from Agriculture). The data provided are based on FAOSTAT (FAO, 2016) for Agriculture total, Land Use sources and Forest, and on the EDGAR Database (JRC/PBL, 2016) for the other sectors. The aim of this domain is to provide a global database of reference data to support countries in addressing statistical data gaps and exploring policy-relevant emissions indicators.
<b>Supplemental</b>	Emissions are displayed for all GHG aggregated, and also separately for: carbon dioxide (CO <sub>2</sub> ), methane (CH <sub>4</sub> ), nitrous oxide (N <sub>2</sub> O) and F-gases. The latter category comprises perfluorocarbons (PFCs), hydrofluorocarbons (HFCs), nitrogen trifluoride (NF <sub>3</sub> ) and sulfur hexafluoride (SF <sub>6</sub> ). All emissions are expressed in gigagrams of CO <sub>2</sub> equivalent (Gg CO <sub>2</sub> eq).  The classification of economic sectors is based on the reporting tables of the 2006 IPCC Guidelines (IPCC 2006, vol.1, ch.8).
<b>Creation Date</b>	2016
<b>Last Update</b>	2016
<b>Data Type</b>	Climate Change - Greenhouse Gases
<b>Category</b>	Environment
<b>Time Period</b>	1990–2010
<b>Periodicity</b>	Annual
<b>Geographical Coverage</b>	World
<b>Spatial Unit</b>	Country
<b>Language</b>	Multilingual (EN, FR, ES)

## Methodology and Quality Information:

<b>Methods and processing</b>	<p><b>Data sources</b></p> <p>This ‘Emissions by sector’ domain of the FAOSTAT Agri-Environmental Indicators section contains data on emissions of greenhouse gases (GHG) by gas, economic sector, country and year. The sources for these data are:</p> <ul style="list-style-type: none"><li>• <b>FAOSTAT</b> emissions domains (Emissions - Agriculture and Emissions - Land Use) (FAO, 2016) for the sectors: ‘Agriculture total’, ‘Land Use sources’ and ‘Forest’.</li><li>• <b>EDGAR</b> (Emissions Database for Global Atmospheric Research) (JRC/PBL, 2016) for the sectors: ‘Energy (energy industries, manufacturing and fugitive emissions)’, ‘Transport’, ‘Residential, commercial, institutional and AFF (Agriculture/Forestry/Fishing)’, ‘Industrial processes and product use’, ‘Waste’, ‘Other sources’ and ‘International Bunkers’.</li></ul> <p>In the EDGAR database, developed by the Joint Research Centre of the European Commission and the Netherlands Environmental Assessment Agency (JRC/PBL, 2016), the annual data on GHG emissions are available by country, source/sink category, gas and year. The source/sink categories follow the guidelines from IPCC (1997) <i>Revised 1996 IPCC Guidelines for National GHG Inventories</i> (Olivier et al., 2011, p.8).</p> <p>In this FAOSTAT ‘Emissions by sector’ domain, the source/sink categories from EDGAR have been aggregated into seven sectors, as shown in table 1 below. EDGAR data under IPCC categories 4 and 5 (‘Total Agriculture’ and ‘Total Land-Use Change and Forestry’) have not been included, as these data have been taken from FAOSTAT. EDGAR data for ‘International aviation’ and ‘International navigation/shipping’ are available only at the world level.</p>
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**Table 1. Allocation of EDGAR categories into FAOSTAT items**

EDGAR	EDGAR name	Item Code	Item Name
1A1a	Public electricity and heat production	6814	Energy (energy, manufacturing and construction industries and fugitive emissions)
1A1bc	Other energy industries		
1B1	Fugitive emissions from solid fuels		
1B2	Fugitive emissions from oil and gas		
1A2	Manufacturing industries and construction		
1A2b			
1A3a	Domestic aviation	6815	Transport
1A3b	Road transportation		
1A3c	Rail transportation		
1A3d	Domestic navigation		
1A3e	Other transportation		
1A4	Residential and other sectors	6816	Residential, commercial, institutional and AFF
2A	Production of minerals	6817	Industrial processes and product use
2A1			
2A2			
2A7			
2B	Production of chemicals		
2C	Production of metals		
2C3			
2C4a			
2C4b			
2D	Production of pulp/paper/food/drink		
2E	Production of halocarbons and SF6		
2F1	Refrigeration and air conditioning		
2F1a			
2F2	Foam blowing		
2F3	Fire extinguishers		
2F4	Aerosols		
2F5	F-gas as solvent		
2F7	Semiconductor/electronics manufacture		
2F7a			
2F7b			
2F7c			
2F8	Electrical equipment		
2F8b			
2F9	Other F-gas use		
2F9a			
2F9b			
2F9c			
2F9d			
2F9e			
2F9f			
2G	Non-energy use of lubricants/waxes (CO2)		
3A	Solvent and other product use		
3B			
3C			
3D			
6A	Solid waste disposal on land	6818	Waste
6B	Wastewater handling		
6C	Waste incineration		
6D	Other waste handling		
7A	Fossil fuel fires	6819	Other sources
7B	Indirect N2O from non-agricultural NOx		
7C	Indirect N2O from non-agricultural NH3		
7D	Other anthropogenic sources		
1C1	Memo: International aviation	6820	International Bunkers
1C2	Memo: International navigation/shipping		

The common period for which data from both FAOSTAT and EDGAR are available is 1990–2010. In EDGAR data, this period is split into two release versions: version 4.2, covering 1970–2008 (<http://edgar.jrc.ec.europa.eu/overview.php?v=42>) and version 4.2 FT2010, for 2000–2010 (<http://edgar.jrc.ec.europa.eu/overview.php?v=42FT2010>).

To combine the time series from the two EDGAR versions the most recent version, v4.2 FT2010, has been considered the most updated and accurate source. Therefore the data from the previous version, v4.2, have been adjusted to align them with v4.2 FT2010, based on the values for 2000–2008 (the common period for both EDGAR versions). The adjustment ratio  $\bar{R}_{A,I,G}$  was calculated by estimating the average of the ratios v4.2 FT2010 / v4.2 (by gas, sector and country).

$$\bar{R}_{A,I,G} = \left( \sum_{Y=2000}^{2008} \frac{v4.2FT2010_{A,I,G,Y}}{v4.2_{A,I,G,Y}} \right) / N_{A,I,G}$$

where:

$v4.2FT2010_{A,I,G,Y}$  Emissions of gas  $G$  from sector  $I$  in country  $A$  and year  $Y$ , as reported in EDGAR v4.2 FT2010

$v4.2_{A,I,G,Y}$  Emissions of gas  $G$  from sector  $I$  in country  $A$  and year  $Y$ , as reported in EDGAR v4.2

$N_{A,I,G}$  Number of years in the period 2000–2008 with emissions data simultaneously available in both versions of EDGAR (for gas  $G$ , sector  $I$  and country  $A$ )

$A$  Country

$I$  Sector

$G$  GHG gas (CO<sub>2</sub>, N<sub>2</sub>O, CH<sub>4</sub> or F-gases)

$Y$  Year

The ratio  $\bar{R}_{A,I,G}$  has been used as multiplier to estimate an adjusted EDGAR v4.2 time series ( $\widehat{v4.2}_{A,I,G}$ ) for the period 1990–1999:

$$\widehat{v4.2}_{A,I,G,Y} = v4.2_{A,I,G,Y} \cdot \bar{R}_{A,I,G}$$

There are some territories that are covered by one of the datasets (EDGAR or FAOSTAT) but not by the other. This is the case of: Andorra, Liechtenstein, San Marino, Channel Islands, Isle of Man, Occupied Palestinian Territory, Svalbard and Jan Mayen Islands, Monaco, Holy See, British Indian Ocean Territory, Antarctica, Christmas Island and Cocos (Keeling) Islands. No data are displayed for these countries in this domain, although any available data have been included in the estimation of the regional and world values.

A similar approach has been applied in the case of Serbia and Montenegro. In FAOSTAT emissions domains data for Serbia and Montenegro are reported separately from 2005 onwards, whereas in EDGAR data are reported aggregated for the entire time series. In consequence, in this ‘Emissions by sector’ domain no data are provided for these countries for the period 2005–2010, while the available data have been included in the estimation of the regional and world aggregates.

### ***Items (sectors) and items aggregated***

The classification of economic sectors provided in this domain is based on the reporting tables in the 2006 IPCC Guidelines (IPCC 2006, vol.1, ch.8). Table 2 shows the list of individual sectors reported, as well as the composition of the four aggregated items included.

**Table 2. List of items and composition of the four aggregated items included in this domain**

Items	Items aggregated			
	Energy total	Land Use total	Sources total	Sources total excl. AFOLU
Energy (energy, manufacturing and construction industries and fugitive emissions)	✓		✓	✓
Transport	✓		✓	✓
Residential, commercial, institutional and AFF (Agriculture/Forestry/Fishing)	✓		✓	✓
Industrial processes and product use			✓	✓
Agriculture total			✓	
Land Use sources		✓	✓	
Forest		✓		
Waste			✓	✓
Other sources			✓	✓
International Bunkers			✓	✓

As mentioned before, data for the sectors 'Agriculture total', 'Land Use sources' and 'Forest' are taken from the emissions domains in FAOSTAT.

In particular, **Agriculture total** is item 1711 from the 'Agriculture Total' domain, under Emissions-Agriculture. It includes CH<sub>4</sub> and N<sub>2</sub>O emissions from: Enteric Fermentation, Manure Management, Rice Cultivation, Synthetic Fertilizers, Manure applied to Soils, Manure left on Pasture, Crop Residues, Burning-Crop residues, Burning-Savanna and Cultivation of Organic Soils.

**Forest** is item 6661 from the 'Forest Land' domain, under Emissions-Land Use.

**Land Use sources** contains the sum of the remaining categories from Emissions - Land Use: Net Forest conversion (item 6750 from the 'Forest Land' domain), Cropland, Grassland and Burning-Biomass (items 5070, 6794 and 5069, respectively, from the 'Land Use total' domain). 'Land Use sources' contains CO<sub>2</sub> emissions (from Net Forest conversion, Cropland, Grassland and Burning-Biomass) as well as CH<sub>4</sub> and N<sub>2</sub>O emissions (from Burning-Biomass).

The sum of 'Forest' and 'Land Use sources' from this 'Emissions by sector' domain is equivalent to the value of 'Land Use Total' in the 'Land Use Total' domain.

### ***Emissions data and estimation of shares***

Removals (recorded as negative emission values) have not been included in the estimation of shares in this domain. Therefore the item Forest, which contains the net value resulting from emissions (sources) minus removals (sinks), has not been included in the estimation of shares, and the shares by sector are calculated with respect to the value of **Sources total**.

The domain contains emissions for all GHG aggregated and also separately for: carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O) and F-gases. The latter category (F-gases) comprises perfluorocarbons (PFCs), hydrofluorocarbons (HFCs), nitrogen trifluoride (NF<sub>3</sub>) and sulfur hexafluoride (SF<sub>6</sub>).

All emissions are expressed in gigagrams of CO<sub>2</sub> equivalent (Gg CO<sub>2</sub>eq). The EDGAR Database (JRC/PBL, 2016) provides emission values in gigagrams of each gas, and these values have been converted into CO<sub>2</sub>eq by multiplying by the corresponding global warming potential in table 3.

Data are available by country, by region, and also for the groupings 'Annex I' and 'Non-Annex I' Parties to the United Nations Framework Convention on Climate Change.

Two types of shares are estimated (please see equations below). The shares of each sector are available for the same categories of gases as the emissions (total GHG, CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O and F-gases), whereas the shares of each gas are available for CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O and F-gases (not for total GHG, which would always be 100%).

### *Share of each sector in the total emissions of each gas*

This share represents the contribution of each sector to the total emissions, for all GHG or separately for each gas (e.g. share of agriculture in total CH<sub>4</sub> emissions).

$$\text{Share of sector}_{(A,I,G,Y)} = \left( \text{Emiss. CO}_2\text{eq}_{(A,I,G,Y)} / \text{Emiss. CO}_2\text{eq}_{(A,ST,G,Y)} \right) \cdot 100$$

where:

$\text{Share of sector}_{(A,I,G,Y)}$	Share of sector <i>I</i> (%) in total emissions of gas <i>G</i> , for country <i>A</i> and year <i>Y</i>
$\text{Emiss. CO}_2\text{eq}_{(A,I,G,Y)}$	Emissions of gas <i>G</i> (Gg CO <sub>2</sub> eq) from sector <i>I</i> , for country <i>A</i> and year <i>Y</i>
$\text{Emiss. CO}_2\text{eq}_{(ST,G)}$	Emissions of gas <i>G</i> (Gg CO <sub>2</sub> eq) from 'Sources Total', for country <i>A</i> & year <i>Y</i>
<i>A, I, G, Y</i>	Country, sector, gas and year, respectively

### *Share of each gas in the emissions from each sector*

This share represents the contribution of each gas to the emissions from one specific sector (i.e. share of CH<sub>4</sub> in the emissions from Agriculture).

$$\text{Share of gas}_{(A,I,G,Y)} = \left( \text{Emiss. CO}_2\text{eq}_{(A,I,G,Y)} / \text{Emiss. CO}_2\text{eq}_{(A,I,All\ GHG,Y)} \right) \cdot 100$$

where:

$\text{Share of gas}_{(A,I,G,Y)}$	Share of gas <i>G</i> (%) in emissions from sector <i>I</i> , for country <i>A</i> and year <i>Y</i>
$\text{Emiss. CO}_2\text{eq}_{(A,I,G,Y)}$	Emissions of gas <i>G</i> (Gg CO <sub>2</sub> eq) from sector <i>I</i> , for country <i>A</i> and year <i>Y</i>
$\text{Emiss. CO}_2\text{eq}_{(A,I,All\ GHG,Y)}$	Emissions of all GHG (Gg CO <sub>2</sub> eq) from sector <i>I</i> , for country <i>A</i> and year <i>Y</i>
<i>A, I, G, Y</i>	Country, sector, gas and year, respectively

**Table 3. Global Warming Potentials (GWP) (dimensionless)**

Greenhouse gas	Global Warming Potential (GWP)	Reference
N <sub>2</sub> O	310	IPCC (1996)
CO <sub>2</sub>	1	IPCC (1996)
CH <sub>4</sub>	21	IPCC (1996)
SF <sub>6</sub>	23900	IPCC (1996)
c-C <sub>4</sub> F <sub>8</sub>	8700	IPCC (1996)
C <sub>2</sub> F <sub>6</sub>	9200	IPCC (1996)
C <sub>3</sub> F <sub>8</sub>	7000	IPCC (1996)
C <sub>4</sub> F <sub>10</sub>	7000	IPCC (1996)
C <sub>5</sub> F <sub>12</sub>	7500	IPCC (1996)
C <sub>6</sub> F <sub>14</sub>	7400	IPCC (1996)
C <sub>7</sub> F <sub>16</sub>	7930	Ivy D. J. et al (2012)
CF <sub>4</sub>	6500	IPCC (1996)
HFC-125	2800	IPCC (1996)
HFC-134a	1300	IPCC (1996)
HFC-143a	3800	IPCC (1996)
HFC-152a	140	IPCC (1996)
HFC-227ea	2900	IPCC (1996)
HFC-23	11700	IPCC (1996)
HFC-236fa	6300	IPCC (1996)
HFC-245fa	560	IPCC (1996)
HFC-32	675	IPCC (1996)
HFC-365mfc	794	UNFCCC (2014)
HFC-43-10-mee	1300	IPCC (1996)
NF <sub>3</sub>	17200	UNFCCC (2014)

The aim of this domain is to provide a global database of reference data to support countries in addressing statistical data gaps and exploring policy-relevant emissions indicators.

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**Data** Computed

**Collection**

**Method**

**Completeness** 100%

**s**

**Useful links** <http://edgar.jrc.ec.europa.eu/>  
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<http://www.fao.org/in-action/micca/en/>  
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