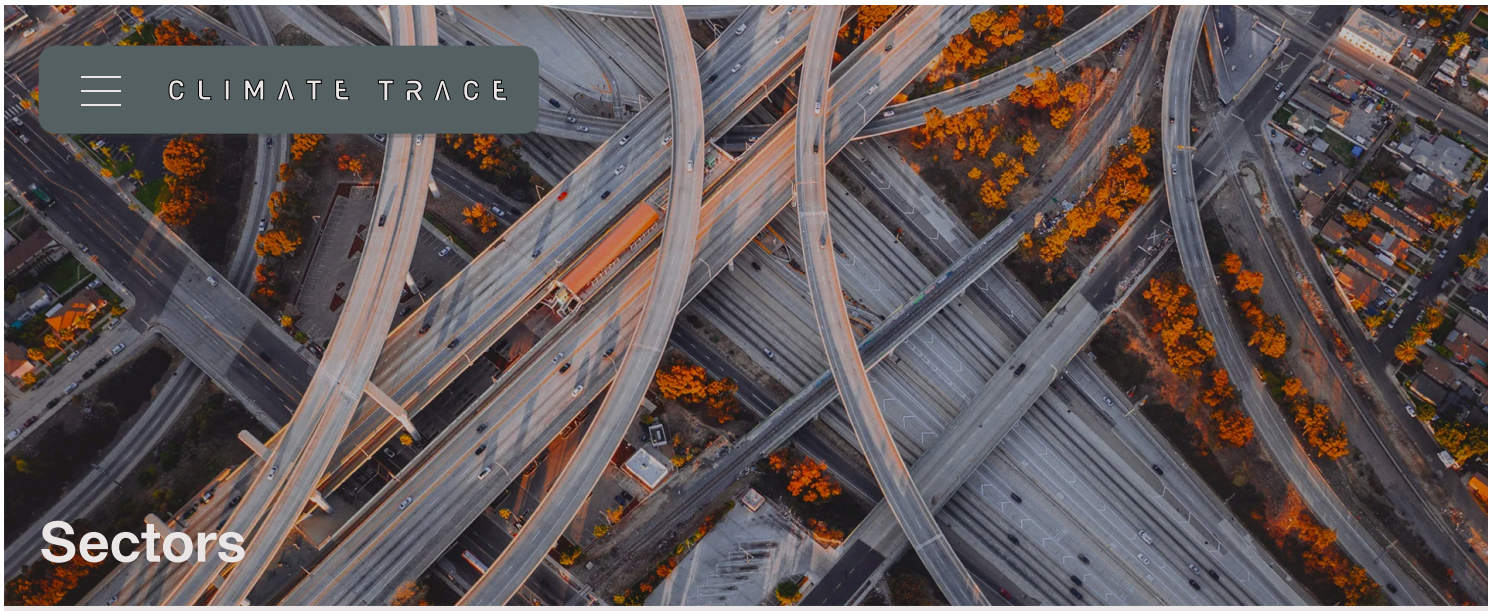
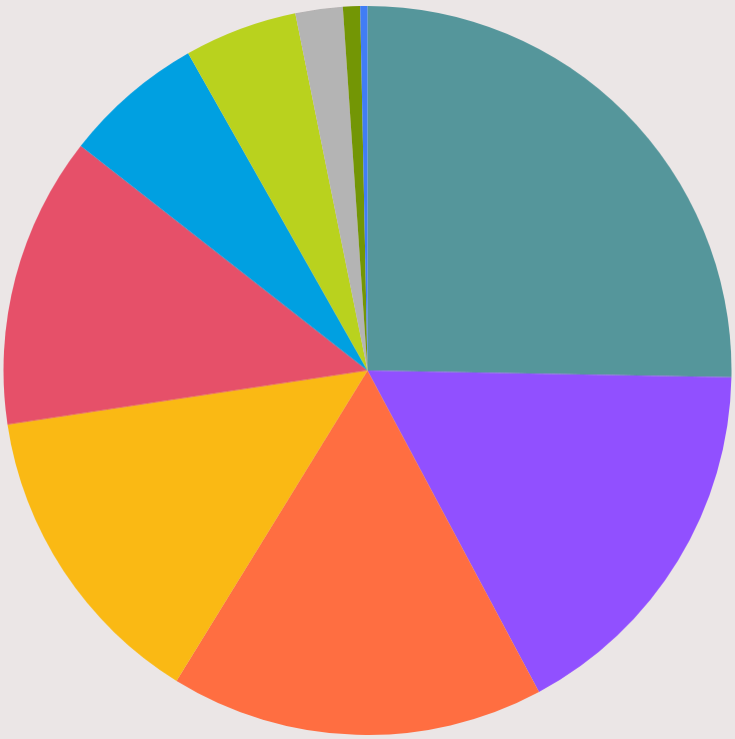


Faster, more-effective decarbonization starts with detailed knowledge of emissions sources.

Pie Chart | Bar Chart



450.75

Billion Tonnes CO2e

January 2015 - December 2022

CLIMATE TRACE

Climate TRACE is a detailed database of human-caused emissions from all major sources—from power plants and oil refineries to rice cultivation, cement production, and shipping. This emissions inventory combines direct observations of emissions sources, remote sensing, and troves of industry data to estimate emissions, unlocking more opportunities for meaningful action to decarbonize.

Sectors **Download data schema (PDF)**

Power

Greenhouse gas emissions from electricity generation.

1st
Leading Contributor

114.04
Billion Tonnes CO2e

25%
Of Total Global Emissions

Subsectors

CLIMATE TRACE

Electricity generation

Power

Definition

Greenhouse gas emissions from thermal power plants from all major fuel sources including coal, natural gas, fuel oil, diesel, and incinerated waste. Data available for download: Country-level emission totals from electricity generation Emissions and ownership estimates for individual power plants

Co2e Emmisions

98.36

Billion Tonnes

21.82%

of total global emmisions

Methodology

Power sector emissions are estimated by first assembling a global geolocated inventory of power plants, generation, and metered emissions data. Machine learning models then predict power plant generation from satellite images. These predictions are aggregated and combined with available generation data and carbon intensity factors to derive emissions estimates.

Methodology

Data Frequency

Updated every year

Source

Satellite imagery
Ground Truth
Alternative

Subsector

Other energy use

Power

Definition

Greenhouse gas emissions arising from fuel combustion that are not included in any other subsector. Data available for download: Country-level emission totals from other energy use

Co2e Emmisions

15.68

Billion Tonnes

3.48%

of total global emmisions

Methodology

EDGAR energy subsectors were subtracted from Climate TRACE electricity generation to derive "other energy use" for years 2015 to 2022.

Methodology

Data Frequency

Source

Updated every year, delayed

Alternative

CLIMATE TRACE

Manufacturing

Greenhouse gas emissions from cement, aluminum, steel, and other manufacturing processes.

2nd
Leading Contributor

76.12
Billion Tonnes CO2e

17%
Of Total Global Emissions

Subsectors

Subsector	Definition
Aluminum Manufacturing	Direct greenhouse gas emissions released from alumina refining and aluminum smelting processes. Indirect emissions from electricity usage are provided separately. Data available for download: Country-level emission totals from aluminum manufacture Emissions estimates and ownership for individual alumina refinery and smelting plants
Co2e Emmisions	Methodology
2.70 Billion Tonnes **0.60%** of total global emmisions	Aluminum emissions were estimated by determining each individual plant's contribution to the national aluminum capacity, which was used to estimate the plant's share of country aluminum production. Relevant emissions factors for the plant were applied to derive emissions for a given year. Methodology
Data Frequency	Source
Updated every year	**Satellite imagery** **Ground Truth** **Alternative**
Subsector	Definition
Cement	Greenhouse gas emissions released during the manufacture of cement, including both the emissions

Manufacturing

CLIMATE TRACE

released during the chemical reaction to create the main component of cement (clinker), as well as the emissions from the combustion of fossil fuels. Data available for download: Country-level emission totals from cement manufacture Emissions and ownership estimates for individual cement plants

Co2e Emmisions

19.91

Billion Tonnes

4.42%

of total global emmisions

Methodology

Cement emissions from clinker production are estimated by combining modeling with satellite imagery and plant-level capacity to generate asset-level cement production. The facility-level cement production values are calibrated against country-level production. Finally, plant-level emission factors are applied to derive total emissions. Country level emissions are estimated by aggregated all assets within the country and scaled to account for missing assets.

Methodology

Data Frequency

Updated every year

Source

Satellite imagery
Alternative

Subsector

Chemicals

Manufacturing

Definition

Direct greenhouse gas emissions from the manufacture of soda ash, methanol and ammonia. Data available for download: Country-level emission totals from chemicals manufacture Emissions estimates and ownership from individual soda ash, methanol and ammonia plants

Co2e Emmisions

4.55

Billion Tonnes

1.01%

of total global emmisions

Methodology

Emissions from the manufacture of soda ash, methanol and ammonia were estimated by using, first, a disagregation model to characterize the production levels for each plant. Then the production quantity for the plant was multiplied by the proper emissions factors in order to generate emissions estimates.

Methodology

Data Frequency

Source

CLIMATE TRACE

Ground Truth
Alternative

Subsector

Other manufacturing

Manufacturing

Definition

Greenhouse gas emissions from other manufacturing industries such as glass, lime, and electronics. Data available for download: Country-level emission totals from other manufacturing industries

Co2e Emmisions

28.81

Billion Tonnes

6.39%

of total global emmisions

Methodology

Self reported plant-level emissions data were gathered from various governments sites for few selected countries (Canada, USA, Israel, Europe). Country level emissions from 2015 to 2022 are from EDGAR.

Methodology

Data Frequency

Updated every year, delayed

Source

Alternative

Subsector

Petrochemicals

Manufacturing

Definition

Fugitive and exhaust emissions from combustion-related processes of petrochemical steam cracking of oil and gas products, the main global manufacturing process for producing olefins (ethylene, propylene, butadiene). Data available for download: Country-level emission totals from ethlylene manufacture Emissions estimates and ownership for individual steam cracking ethylene plants

Co2e Emmisions

2.06

Billion Tonnes

0.46%

of total global emmisions

Methodology

Plant-level petrochemical emissions were calculated by employing tailored emissions factors, estimated feedstock compositions, and projected outputs for select individual asset and major countries. Specifically, for plants situated in the United States, Europe, and China, this method leverages data on asset-level ethylene capacity, utilization rates, and regional emissions factors to derive more precise estimates. Country level emissions for the rest of the world were calculated based on ethylene capacity data.

Methodology

Source

Alternative

Subsector

Pulp and paper

Manufacturing

Definition

Direct greenhouse gas emissions from the manufacture of chemical and semi-chemical pulp manufacture. Data available for download: Country-level emission totals from pulp and paper manufacture Emissions estimates and ownership for individual chemical and semi-chemical pulp plants

Co2e Emmisions

0.64

Billion Tonnes

0.14%

of total global emmisions

Methodology

Emissions from the production of chemical, semi-chemical and mechanical pulp were estimated by determining each individual plant's contribution to the national pulp capacity, which was used to estimate the plant's share of national production. Relevant emissions factors were applied to derive emissions for a given year.

Methodology

Data Frequency

Updated every year

Source

Satellite imagery
Ground Truth
Alternative

Subsector

Steel

Manufacturing

Definition

Greenhouse gas emissions released during the manufacturing of crude steel from fuel combustion and industrial processes. Indirect emissions from electricity usage are provided separately. Data available for download: Country-level emission totals from steel manufacture Emissions and ownership estimates for individual steel plants

Co2e Emmisions

Methodology

17.44

CLIMATE TRACE

3.87%

of total global emmisions

Steel emission estimates are modeled separately for two subgroups: (1) Blast furnace, basic oxygenation furnace, and open hearth furnace plants that are modeled with satellite imagery and plant-level capacity to generate facility-level production calibrated against country-level production; and (2) electric furnace plants use a disaggregation model to compute their national capacity share. Country level emissions are estimated by aggregated all assets within the country and scaled to account for missing assets.

Methodology

Data Frequency

Updated every year

Source

Satellite imagery
Ground Truth
Alternative

Fossil Fuel Operations

3rd

Leading Contributor

74.83

Billion Tonnes CO2e

17%

Of Total Global Emissions

Greenhouse gas emissions from oil and gas production, refining, and coal mining.

Subsectors

Subsector

Coal mining

Fossil fuel operations

Definition

Fugitive methane emissions from coal mining, and post-mining activities of commercially operating mines and carbon dioxide emissions from on-site fuel combustion for coal extraction, handling, and logistics.

Co2e Emmisions

10.48

Billion Tonnes

2.33%

of total global emmisions

Methodology

At the country level, a statistical model was constructed using historic data going back 10 years from 2007-2018 based on verified production statistics and forecasting forward to derive 2021 data, before apply relevant emissions factors. Asset-level estimates from Global Energy Monitor.

CLIMATE TRACE

Methodology

Source

Updated every year

Satellite imagery
Alternative

Subsector

Oil and gas production and transport

Fossil fuel operations

Definition

Combustion and fugitive emissions from pumping, separating, flaring, and venting during oil and gas extraction, processing, refining, compression, liquefaction, regasification, and transport of crude oil and natural gas. Data available for download: Country-level emissions totals from all oil and gas extraction processes within the country Emissions estimates and ownership for individual oil basins Emissions estimates for sub-basins (available in a few locations only)

Co2e Emmisions

44.88

Billion Tonnes

9.96%

of total global emmisions

Methodology

Oil and gas field- and basin-level carbon dioxide and methane emissions are estimated with the Oil Production Greenhouse Gas Emissions Estimator (OPGEE) Model. Oil refining carbon dioxide and methane emissions are estimated with the Petroleum Refinery Life Cycle Inventory Model (PRELIM) Model. Inputs include a number of oil and gas field characteristics, including production volumes, gas content and compositions, oil assays, and satellite-derived flaring volumes. Field-level estimates are summed and scaled to country-level on an annual basis.

Methodology

Data Frequency

Source

Satellite imagery
Ground Truth
Alternative

Subsector

Oil and gas refining

Fossil fuel operations

Definition

Fugitive and exhaust emissions from combustion-related processes of crude oil refining. Data available for download: Country-level emission totals from oil

CLIMATE TRACE

refining within a country Emissions estimates and ownership for individual oil refining plants

Co2e Emmisions

7.83

Billion Tonnes

1.74%

of total global emmisions

Methodology

Oil refining emissions are estimated with the Petroleum Refinery Life-Cycle Inventory Model (PRELIM). PRELIM estimates energy use and greenhouse gas emissions associated with processing various crude oil types for different refinery configurations. Inputs include refinery locations, configurations, and crude refining throughputs to generate GHG intensities and absolute emissions by country.

Methodology

Data Frequency

Updated every year

Source

Ground Truth
Alternative

Subsector

Other fossil fuel operations

Fossil fuel operations

Definition

Fugitive and exhaust emissions from all remaining fossil fuel operation activities. Data available for download: Country-level emission totals from all other fossil fuel operations within a country

Co2e Emmisions

6.00

Billion Tonnes

1.33%

of total global emmisions

Methodology

EDGAR energy subsectors were subtracted from Climate TRACE fossil fuel operations to derive "other energy use" for annual emissions from 2015 to 2022.

Methodology

Data Frequency

Updated every year, delayed

Source

Alternative

Subsector

Solid fuel transformation

Fossil fuel operations

Definition

Fugitive methane and carbon dioxide emissions from the manufacture of secondary and tertiary products from solid fuels. Data available for download: Country-

CLIMATE TRACE

level emission totals from solid fuel transformation within a country

Co2e Emmisions

5.65

Billion Tonnes

1.25%

of total global emmisions

Methodology

Data from EDGAR. Estimates available from 2015 to 2022.

Methodology

Data Frequency

Updated every year, delayed

Source

Transportation

Greenhouse gas emissions from on-road vehicles, aviation, shipping, railways and other modes of transportation.

4th

Leading Contributor

62.38

Billion Tonnes CO2e

14%

Of Total Global Emissions

Subsectors

Subsector

Domestic aviation

Transportation

Definition

Greenhouse gas emissions from the combustion of fuels in domestic commercial, cargo, private flights, and general aviation. Onsite emissions from airport ground operations are not included. Data available for download: Country-level emission totals from all flights between international airports Emissions and ownership from trips between domestic airports aggregated to arriving and departing airports

Co2e Emmisions

2.37

Billion Tonnes

0.52%

of total global emmisions

Methodology

Historical flight status data from OAG for all passenger and freight flights were combined with the International Civil Aviation Organisation (ICAO)'s methodology to estimate emissions from flights within one country between 2015 to 2022. Emissions are then assigned and aggregated to the

Methodology

Data Frequency

Updated every year

Source

Ground Truth
Alternative

Subsector

Domestic shipping

Transportation

Definition

Greenhouse gas emissions from the combustion of fuels in domestic voyages of vessels greater than 500 gross tons. Onsite emissions from port operations are not included. Data available for download: Country-level emission totals from all voyages between domestic ports Emissions from voyages between domestic ports aggregated to arriving and departing ports

Co2e Emmisions

1.41

Billion Tonnes

0.31%

of total global emmisions

Methodology

Shipping estimates are estimated using Automatic Identification Systems (AIS) transmissions from vessels, which is combined with vessel characteristics. The estimation method is based on audited emissions reported to the European Union. Emissions then are assigned and aggregated to the corresponding port based on the port of departure and port of arrival of ship, half the emissions for a voyage are assigned to the arrival and departure ports respectively.

Methodology

Data Frequency

Updated every year

Source

Satellite imagery
Ground Truth
Alternative

Subsector

International aviation

Transportation

Definition

Greenhouse gas emissions from the combustion of fuels in international commercial, cargo, private flights, and general aviation. Onsite emissions from airport ground operations are not included. Data available for download: Country-level emission totals from all flights between domestic airports Emissions and ownership

CLIMATE TRACE

Co2e Emmisions

3.83

Billion Tonnes

0.85%

of total global emmisions

Data Frequency

Updated every year

from trips between domestic airports aggregated to arriving and departing airports

Methodology

Historical flight status data from OAG for all passenger and freight flights is combined with the International Civil Aviation Organisation (ICAO)'s methodology to estimate emissions from flights within one country between 2015 to 2022.

Methodology

Source

Ground Truth
Alternative

CLIMATE TRACE

International shipping

Transportation

Definition

Greenhouse gas emissions from the combustion of fuels in international voyages of vessels greater than 500 gross tonnes. Onsite emissions from airport ground operations are not included. Data available for download: Country-level emission totals from all voyages between international ports Emissions from voyages between domestic ports aggregated to arriving and departing ports

Co2e Emmisions

3.70

Billion Tonnes

0.82%

of total global emmisions

Methodology

Shipping estimates are estimated using Automatic Identification Systems (AIS) transmissions from vessels, which is combined with vessel characteristics. The estimation method is based on audited emissions reported to the European Union. Emissions then are assigned and aggregated to the corresponding port based on the port of departure and port of arrival of ship, half the emissions for a voyage are assigned to the arrival and departure ports respectively.

Methodology

Data Frequency

Updated every year

Source

Satellite imagery
Ground Truth
Alternative

Subsector

Other transport

Transportation

Definition

Greenhouse gas emissions from all remaining transport activities. Data available for download: Country-level emissions totals from all other remaining transport activities within a country

Co2e Emmisions

1.33

Billion Tonnes

0.30%

of total global emmisions

Methodology

EDGAR transportation subsector emissions were subtracted from Climate TRACE road transportation, railways, shipping, and aviation emissions to derive "other transport" for annual emissions from 2015 to 2022.

Methodology

CLIMATE TRACE

Source

Updated every year, delayed

Alternative

Subsector

Railways

Transportation

Definition

Greenhouse gas emissions from the combustion of fuels in both freight and passenger trains. Data available for download: Country-level emissions totals from the railways within a country

Co2e Emmisions

0.82

Billion Tonnes

0.18%

of total global emmisions

Methodology

Data from EDGAR. Estimates available from 2015 to 2022.

Methodology

Data Frequency

Updated every year, delayed

Source

Alternative

Subsector

Road transportation

Transportation

Definition

Greenhouse gas emissions from the combustion of fuels in all road vehicles within an urban area. Data available for download: Country-level emissions totals from all road transport Emissions from road transport aggregated to urban areas Road segment-level emissions available on request.

Co2e Emmisions

48.91

Billion Tonnes

10.85%

of total global emmisions

Methodology

Country level data derived from EDGAR; estimates available from 2015 to 2022. Asset-level estimates derived from a hybrid machine-learning based model that combines satellite and road network driven activity with region-specific emissions factors.

Methodology

CLIMATE TRACE

Source

Updated every year, delayed

Satellite imagery
Ground Truth
Alternative

Agriculture

Greenhouse gas emissions from the growing of crops and livestock for food and raw materials for non-food consumption.

5th
Leading Contributor

58.30
Billion Tonnes CO2e

13%
Of Total Global Emissions

Subsectors

Subsector

Cropland fires

Agriculture

Definition

Greenhouse gas emissions from the combustion of agricultural residue burned on site. Emissions are gross (not net) as they do not include the carbon sink associated with vegetation regrowth.

Co2e Emmisions

9.25
Billion Tonnes

2.05%
of total global emmisions

Methodology

Data compiled from EDGAR inventory.

Methodology

Data Frequency

Updated every year

Source

Alternative

Subsector

Enteric fermentation cattle feedlot

Agriculture

Definition

Methane emissions from digestive systems of cattle located in feedlots. Data available for download: Country-level emission totals from enteric fermentation

CLIMATE TRACE

from cattle in feedlots within a country Emissions estimates and ownership for individual cattle feedlots available in select countries

Co2e Emmisions

7.95

Billion Tonnes

1.76%

of total global emmisions

Methodology

Methane emissions were estimated by identifying individual cattle operations using remote sesning data and AI. Once identified, the cattle operation's area size was used to predict total head of cattle and converted to emissions for years 2015 to 2022. For country-level methane emissions, FAOSTAT data was used for years 2015-2021; 2022 was forward-filled using 2021 FAOSTAT data.

Methodology

Data Frequency

Updated every year

Source

Satellite imagery
Ground Truth
Alternative

Subsector

Enteric fermentation cattle pasture

Agriculture

Definition

Methane emissions from digestive systems of cattle located in pasture lands. Data available for download: Country-level emission totals from enteric fermentation from cattle in pastures within a country County or district level emissions from enteric fermentation from cattle in pastures

Co2e Emmisions

8.55

Billion Tonnes

1.90%

of total global emmisions

Methodology

Methane emissions were estimated using spatially gridded pasture data and FAOSTAT cattle data for years 2015 to 2021, with 2022 forward filled with 2021 FAOSTAT data. Country-level emissions were generated by aggregating pasture emissions within a region.

Methodology

Data Frequency

Source

Satellite imagery
Alternative

CLIMATE TRACE

Enteric fermentation other

Agriculture

Definition

Methane emissions from digestive systems of other livestock animals. Data available for download: Country-level emission totals from enteric fermentation from all other livestock animals within a country

Co2e Emmisions

6.22

Billion Tonnes

1.38%

of total global emmisions

Methodology

Methane emissions for other non-cattle animals was estimated using FAOSTAT data for years 2015 to 2020, with 2021 and 2022 forward filled.

Methodology

Data Frequency

Source

Alternative

CLIMATE TRACE

Manure left on pasture cattle

Agriculture

Definition

Methane emissions from cattle manure decomposition in pasture lands. Data available for download: Country-level emission totals from manure management of cattle in pastures within a country County or district level emissions from manure management of cattle in pastures

Co2e Emmisions

2.91

Billion Tonnes

0.65%

of total global emmisions

Methodology

Methane and nitrous oxide emissions were estimated using spatially gridded pasture data and FAOSTAT cattle data for years 2015 to 2021 for each country, with 2022 forward filled with 2021 FAOSTAT data. Country-level emissions were generated by aggregating cattle on pasture and converting to emissions. Nitrous oxide emissions are reported under the "other agricultural soils" category.

Methodology

Data Frequency

Source

Satellite imagery
Alternative

Subsector

Manure management cattle feedlot

Agriculture

Definition

Methane and nitrous oxide emissions from cattle manure decomposition in feedlots. Data available for download: Country-level emission totals from cattle manure management in feedlots within a country Emissions and ownership estimates for individual cattle feedlots available in select countries

Co2e Emmisions

0.70

Billion Tonnes

0.16%

of total global emmisions

Methodology

Methane and nitrous oxide emissions were estimated by identifying individual cattle operations using remote sensing data and AI. Once identified, the cattle operation's area size was used to predict total head of cattle and combined with the predicted manure mangement practices to estimate emissions for years 2015 to 2022. For country-level methane emissions, FAOSTAT data was used for years 2015-2021; 2022 was forward-filled using 2021 FAOSTAT data.

CLIMATE TRACE

Methodology

Source

Updated every year

Satellite imagery
Ground Truth
Alternative

Subsector

Manure management other

Agriculture

Definition

Methane and nitrous oxide emissions from other animal manure management. Data available for download: Country-level emission totals from manure management of all other livestock animals within a country

Co2e Emmisions

1.78

Billion Tonnes

0.40%

of total global emmisions

Methodology

Methane and nitrous oxide emissions for other non-cattle animals was estimated using FAOSTAT data for years 2015 to 2020, with 2021 and 2022 forward filled using 2020 data.

Methodology

Data Frequency

Source

Alternative

CLIMATE TRACE

Definition

Other agriculture

Agriculture

Co2e Emmisions

Methodology

Billion Tonnes

%

of total global emmisions

Data Frequency

Source

Subsector

Definition

Other agricultural soil emissions

Agriculture

Greenhouse gas emissions from crop residues, animal manure applied to soils or left in pastures (N2O), and drained organic soils. Data available for download: Country-level emission totals from agricultural soils within a country

Co2e Emmisions

Methodology

11.89

Billion Tonnes

2.64%

of total global emmisions

Data compiled from FAOSTAT for emissions from manure left on pasture, crop residues, and drained organic soils. FAOSTAT data available from 2015-2020. Remaining years were forward filled using 2020 data.

Methodology

Data Frequency

Source

Alternative

Subsector

Definition

Rice cultivation

Agriculture

Methane emissions from the anaerobic decomposition of organic matter in paddy fields. Data available for download: Country-level emission totals from rice cultivation within a country County or district level

CLIMATE TRACE

emissions from rice cultivation in 25 countries 500x500m and 10mx10m resolution gridded data available on request

Co2e Emmisions

5.71

Billion Tonnes

1.27%

of total global emmisions

Methodology

Methane emissions for 25 countries was estimated by identifying rice fields and practices using satellite-based mapping; estimates available from 2015 to 2022. For the remaining countries, methane emissions were generated from FAOSTAT rice production for years 2015-2021; 2022 was forward-filled using 2021 FAOSTAT data.

Methodology

Data Frequency

Updated every year

Source

Satellite imagery
Ground Truth
Alternative

Subsector

Synthetic fertilizer application

Agriculture

Definition

Direct nitrous oxide emissions from the application of synthetic fertilizers in agricultural soils. Data available for download: Country-level emission totals from synthetic fertilizer application within a country County or district level emissions from synthetic fertilizer application in over 100 countries. Ownership data for selected regions available. 4x4km resolution gridded data available on request

Co2e Emmisions

3.32

Billion Tonnes

0.74%

of total global emmisions

Methodology

Direct N2O emissions from synthetic nitrogen (N) fertilizer applied to crops are calculated based on crop area, crop yields and estimated crop-specific Nitrogen Use Efficiency (NUE). NUE is used as proxy for N fertilizer applied to different crops. The estimated synthetic nitrogen applied to crops is converted to total N2O emissions at country scale using machine learning-derived emission factors. Emissions values for 2022 were forward filled from estimates of 2021.

Methodology

Data Frequency

Source

Updated every year

CLIMATE TRACE

Satellite imagery
Alternative

Buildings

Greenhouse gas emissions from onsite fuel combustion in residential, commercial and institutional buildings.

6th
Leading Contributor

28.11
Billion Tonnes CO2e

6.2%
Of Total Global Emissions

Subsectors

Subsector	Definition
Other onsite fuel usage Buildings	Greenhouse gas emissions from fuel combustion in stationary and mobile sources not otherwise specified. Data available for download: Country-level emission totals from other onsite fuel usage within a country
Co2e Emmisions	Methodology
1.66 Billion Tonnes **0.37%** of total global emmisions	Data from EDGAR's category "Non-Specified". Estimates available from 2015 to 2022. Methodology
Data Frequency	Source
	Alternative

Subsector	Definition
Residential and commercial onsite fuel usage Buildings	Greenhouse gas emissions from fuel combustion in residential, commercial, and institutional buildings. Indirect emissions from buildings (i.e., electricity) are not included. Data available for download: Country-level emission totals from onsite building fuel usage within a country

CLIMATE TRACE

26.46

Billion Tonnes

5.87%

of total global emmisions

Methodology

Data from EDGAR. Estimates available from 2015 to 2022.

Methodology

Data Frequency

Updated every year, delayed

Source

Alternative

Waste

Greenhouse gas emissions from solid waste disposal on land, wastewater, waste incineration and any other waste management activity.

7th

Leading Contributor

22.61

Billion Tonnes CO2e

5.0%

Of Total Global Emissions

Subsectors

Subsector

Biological treatment of solid waste

Waste

Definition

Greenhouse gas emissions from composting and anaerobic digestion of organic waste, such as food waste, garden (yard) and park waste, and sludge. Data available for download: Country-level emission totals from biological treatment of waste within a country

Co2e Emmisions

0.19

Billion Tonnes

0.04%

of total global emmisions

Methodology

Data from EDGAR. Estimates available from 2015 to 2022.

Methodology

Data Frequency

Source

Updated every year, delayed

Alternative

CLIMATE TRACE

Subsector

Incineration and open burning of waste

Waste

Definition

Greenhouse gas emissions from the combustion of solid and liquid waste in controlled incineration facilities, as well as in nature (open-air) or in open dumps. Data available for download: Country-level emission totals from incineration and open burning of waste within a country

Co2e Emmisions

0.48

Billion Tonnes

0.11%

of total global emmisions

Methodology

Data from EDGAR. Estimates available from 2015 to 2022.

Methodology

Data Frequency

Updated every year, delayed

Source

Alternative

Subsector

Solid waste disposal

Waste

Definition

Greenhouse gas emissions from the treatment and disposal of municipal, industrial, and other solid waste in landfills and dumpsites. Electricity generation facilities are excluded from this subsector. Data available for download: Country-level emission totals from solid waste disposal within a country Emissions estimates for individual landfills and dumpsites

Co2e Emmisions

11.11

Billion Tonnes

2.47%

of total global emmisions

Methodology

Solid waste disposal methane emissions are directly republished from self-reported facility-level datasets where available. Where unavailable, methane emissions are estimated through a Bayesian hierarchical regression model using waste quantities as its predictor if known, or using land area to predict both incoming waste and consequent emissions if waste data are unavailable. Country level emissions from EDGAR, except in cases where the combined total of the landfill-level emissions exceeded the EDGAR-estimate.

Methodology

CLIMATE TRACE

Data Frequency

Updated every year, delayed

Source

Satellite imagery
Ground Truth
Alternative

Subsector

Wastewater treatment and discharge

Waste

Definition

Methane emissions from the treatment and disposal of wastewater from domestic, commercial, and industrial sources. Data available for download: Country-level emission totals from wastewater treatment within a country Emissions estimates for individual wastewater treatment plants

Co2e Emmisions

10.83

Billion Tonnes

2.40%

of total global emmisions

Methodology

Wastewater treatment plants (WWTPs) emissions were estimated by combining reported data from the Hydrowaste database with WWTPs identified using a satellite imagery and machine learning algorithms. Once identified, emissions were estimated based on the IPCC national greenhouse gas inventory guidelines. Country level emissions from EDGAR, except in cases where the combined total of the WWTPs exceeded the EDGAR-estimate.

Methodology

Data Frequency

Source

Satellite imagery
Alternative

Fluorinated Gases

Greenhouse gas emissions from the release of fluorinated gases used in refrigeration, air-conditioning, transport, and industry.

8th

Leading Contributor

9.45

Billion Tonnes CO2e

2.1%

Of Total Global Emissions

> **Subsectors**

CLIMATE TRACE

Subsector

Fluorinated gases

Fluorinated gases

Definition

Greenhouse gas emissions from the use of fluorinated greenhouse gases in mobile and stationary air conditioning systems and other industries. Data available for download: Country-level emission totals from fluorinated gases within a country

Co2e Emmisions

9.45

Billion Tonnes

2.10%

of total global emmisions

Methodology

Data from EDGAR. Estimates available from 2015 to 2021, and 2022 data generated by forward filling 2021 estimates.

Methodology

Data Frequency

Updated every year, delayed

Source

Alternative

Forestry And Land Use

Greenhouse gas emissions and removals from change in living biomass due to clearing, degradation and fires in forests, grasslands and wetlands.

9th

Leading Contributor

3.45

Billion Tonnes CO2e

0.8%

Of Total Global Emissions

> **Subsectors**

Subsector

Net Forest & Mangrove Carbon Stock Change - living biomass

Forestry and Land Use

Definition

Emissions and removals of CO2 from living biomass in forest and mangrove lands. Positive emissions are considered committed (source) emissions to the atmosphere and negative emissions corresponds to carbon sequestration (sink) from the living biomass.

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2.92

Billion Tonnes

0.65%

of total global emmisions

Methodology

Net emissions from the forestry sector was derived by first estimating annual total live carbon biomass (TLB, Mg CO2e) in forest vegetation from above ground biomass (AGB) and below ground biomass (BGB). AGB was estimated in machine learning models using a combination of LIDAR, SAR, and, multispectral remote sensing datasets, which was used to derive BGB using allometric models. These approaches were applied to years 2015 to 2021. Then net changes (emissions) in carbon stock between years was calculated by subtracting current year's TLB from the previous year's TLB.

Data Frequency

Updated every year

Source

Satellite imagery
Ground Truth
Alternative

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Net Grassland Carbon Stock Change - living biomass

Forestry and Land Use

Definition

Emissions and removals of CO2 from living biomass in wetlands. Positive emissions are considered committed (source) emissions to the atmosphere and negative emissions corresponds to carbon sequestration (sink) from the living biomass.

Co2e Emmisions

0.11

Billion Tonnes

0.03%

of total global emmisions

Methodology

Net emissions from the wetland sector was derived by first estimating annual total live carbon biomass (TLB, Mg CO2e) in wetland vegetation from above ground biomass (AGB) and below ground biomass (BGB). AGB was estimated in machine learning models using a combination of LIDAR, SAR, and, multispectral remote sensing datasets, which was used to derive BGB using allometric models. These approaches were applied to years 2015 to 2021. Then net changes (emissions) in carbon stock between years was calculated by subtracting current year's TLB from the previous year's TLB.

Data Frequency

Updated every year

Source

Satellite imagery
Ground Truth
Alternative

Subsector

Net Wetland Net Carbon Stock Change - living biomass

Forestry and Land Use

Definition

Emissions and removals of CO2 from living biomass in wetlands. Positive emissions are considered commited (source) emissions to the atmosphere and negative emissions corresponds to carbon sequestration (sink) from the living biomass.

Co2e Emmisions

-0.31

Billion Tonnes

-0.07%

of total global emmisions

Methodology

Net emissions from the wetland sector was derived by first estimating annual total live carbon biomass (TLB, Mg CO2e) in wetland vegetation from above ground biomass (AGB) and below ground biomass (BGB). AGB was estimated in machine learning models using a combination of LIDAR, SAR, and, multispectral remote sensing datasets, which was used to derive BGB using allometric models. These approaches were applied to years 2015 to 2021. Then net changes (emissions) in carbon stock between years was calculated by

subtracting current year's TLB from the previous year's TLB.

Data Frequency

Updated every year

Source

Satellite imagery
Ground Truth
Alternative

Subsector

Water reservoirs

Forestry and Land Use

Definition

Greenhouse gas emissions from human-made or human-expanded water bodies. Data available for download: Country-level emission totals from water reservoirs within a country Emissions estimates for individual water reservoirs

Co2e Emmisions

0.73

Billion Tonnes

0.16%

of total global emmisions

Methodology

Water reservoir emissions were estimated by combining data from reservoir databases such as HydroLAKES and GraND, along with other attributes on climatic zone, weather and elevation. Emissions factors were taken from the IPCC National Greenhouse Gas Inventory guidelines.

Methodology

Data Frequency

Updated every year

Source

Alternative

Mineral Extraction

Greenhouse gas emissions from mining and quarrying of minerals and ores.

10th

Leading Contributor

1.46

Billion Tonnes CO2e

0.3%

Of Total Global Emissions

> **Subsectors**

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Bauxite mining

Mineral Extraction

Definition

Emissions from energy usage in bauxite mining activities. Data available for download: Country-level emission totals from bauxite mining within a country Emissions estimates and ownership for individual bauxite mines

Co2e Emmisions

0.09

Billion Tonnes

0.02%

of total global emmisions

Methodology

Bauxite mining emissions are derived from annual country-level production (2010-2019) and forecasted through 2022. Where available asset level data, data is aggregated from 2020 to 2022. InSAR analysis was used for some assets where production data wasn't available, by developing scaling factors from assets where we had both InSAR and reported production values. Emission factors were calculated from reported CO2 emissions and production statistics, then averaged by country or region. Finally, emissions factors are combined with activity data to estimate total emission.

Methodology

Data Frequency

Updated every year

Source

Satellite imagery
Alternative

Subsector

Copper mining

Mineral Extraction

Definition

Emissions from energy usage in copper mining activities. Data available for download: Country-level emission totals from copper mining within a country Emissions and ownership estimates for individual copper mines

Co2e Emmisions

0.63

Billion Tonnes

0.14%

of total global emmisions

Methodology

Copper-mining emissions are derived from annual country-level production (2010-2019) and forecasted through 2022. Where available asset level data, data is aggregated from 2020 to 2022. InSAR analysis was used for some assets where production data wasn't available, by developing scaling factors from assets where we had both InSAR and reported production values. Emission factors were calculated from reported CO2 emissions and production statistics, then

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averaged by country or region. Finally, emissions factors are combined with activity data to estimate total emission.

Methodology

Data Frequency

Updated every year

Source

Satellite imagery
Alternative

Subsector

Iron mining

Mineral Extraction

Definition

Greenhouse gas emissions from energy usage in iron mining activities. Data available for download: Country-level emission totals from iron mining within a country Emissions estimates and ownership for individual iron mines

Co2e Emmisions

0.73

Billion Tonnes

0.16%

of total global emmisions

Methodology

Iron mining emissions are derived from annual country-level production (2010-2019) and forecasted through 2022. Where available asset level data, data is aggregated from 2020 to 2022. InSAR analysis was used for some assets where production data wasn't available, by developing scaling factors from assets where we had both InSAR and reported production values. Emission factors were calculated from reported CO2 emissions and production statistics, then averaged by country or region. Finally, emissions factors are combined with activity data to estimate total emission.

Methodology

Data Frequency

Updated every year

Source

Satellite imagery
Alternative

Subsector

Rock quarrying

Mineral Extraction

Definition

Greenhouse gas emissions from energy usage for mining limestone, granite, and marble. Data available for download: Country-level emission totals from rock quarrying within a country

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0.01

Billion Tonnes

0.00%

of total global emmisions

Methodology

Rock-quarry emissions are derived from total production inventories at yearly, country-level scale using a minimum of 9 years of production data (2010-2018). Data availability varies between countries and it is forecasted through 2022.

Methodology

Data Frequency

Updated every year

Source

Alternative

Subsector

Sand quarrying

Mineral Extraction

Definition

Greenhouse gas emissions from the extraction of sand and gravel and used in the construction industry. Data available for download: Country-level emission totals from sand quarrying within a country

Co2e Emmisions

0.00

Billion Tonnes

0.00%

of total global emmisions

Methodology

Sand-quarry emissions are derived from total production inventories at yearly, country-level scale using a minimum of 9 years of production data (2010-2018). Data availability varies between countries and it is forecasted through 2022.

Methodology

Data Frequency

Updated every year

Source

Alternative

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