Discover valuable insights on climate data and get familiar with real-time emissions tracking.

How to use the Emissions Map

What Do The Different Units Used On The Climate TRACE Website Mean?

CO2e - Carbon dioxide equivalent. You can view this in 100-year or 20-year CO2 equivalent. For more on what this means, check out our blog post here.

BT or B Tonnes - Billion metric tonnes

MT or M Tonnes - Million metric tonnes

tCO2 - tonnes of carbon dioxide

What Does The 100 Yr Versus 20 Yr On The "Emissions Map" Mean?

Each greenhouse gas has a different impact on the climate – some remain in the atmosphere for a shorter time, but trap more heat.

Global warming potential (GWP) is a metric developed to make it easier to compare the climate change effects of different GHGs. Carbon dioxide — the most abundant GHG — is the reference gas, so its GWP is always 1 on all time scales. Other gases such as methane and nitrous oxide trap significantly more heat than CO2. Their GWPs over timescales of 100 years and 20 years are

expressed in “carbon dioxide equivalents (CO2e)”. This is important because even though methane [illegible]maller in quantity than CO2, their impact on the climate is [illegible]to their GWP; using CO2e as the unit ensures that their impact is not minimized in decision-making. You can read more about global warming potential and the 20 versus 100 year timescales in this blog post.

What Do “Source Type”, “Capacity” And “Activity” On The Emissions Map Mean? →

Source type: This refers to the type of source you are looking at. For example, a coal or gas power plant, a blast furnace or electric arc furnace steel plant. You can find more about this in the sector specific methodology documentation.

Capacity: This is a measure of the size of the source, primarily useful when validating and comparing emissions estimates. It is measured different ways in different sectors, but is often something that measures or helps approximate the maximum potential emissions this source could cause if it ran flat out. For example, power plants are measured in their maximum potential production of electricity per hour. Whereas road transport emissions are measured by the total length of roads within a particular urban area.

Activity: This refers to the amount of total emitting activity that occurred at a source in a given year, and can be a measure of total production or use. For example, a petrochemical plant with an activity of “420,000” produced those many metric tonnes of ethylene in the selected year.

Descriptions of what these mean for specific sectors and their units are included in the data download. You can also find more information about how these are calculated in the sector-specific methodology documentation.

Do You Calculate Emissions From [Sector]? →

Take a look at our Sectors page to see how we measure different sectors and what’s included in them.

Climate TRACE has gathered emissions estimates for all major emitting sectors to provide a comprehensive global database of emissions. But for some smaller sectors we are not yet fully independent or granular, and are simply republishing high-level estimates from elsewhere. For example, we don’t yet produce granular, source-level estimates for most food processing plants, textile processing plants, battery manufacture and rare earth mining. If you are interested in such estimates or know experts in these areas, we encourage you to get in touch!

A Specific Plant/ Landfill/ Mine From My Country Or City Is Missing From The Emissions Map, What Should I Do? →

Let us know! Although our database is getting closer and closer to being globally complete, it’s not quite there yet. If you know of any source of anthropogenic (human-caused) emissions we don’t

know about yet, anywhere on the planet, we'd love to know about it so we can add it! Please reach
share anything you know about the missing source. We'll
put it on our to-do list to add.

I Believe Your Data May Be Incorrect For A Specific Plant/ Landfill/ Mine. What Should I Do? →

Let us know! Climate TRACE methods have varying levels of uncertainty. You can see from the "confidence" value whether it is a source we have been able to verify against multiple high-quality methods (higher confidence) or are still particularly interested in feedback (lower confidence). If you know of any information that can be used to measure this source more accurately, we'd love to know. You can share feedback with us by using the "share feedback" link that is available on all the cards that pop up when you click on an emissions source. Please note that to prevent misinformation, we can only rely on information we are able to independently verify. So anything you can provide about why you believe the emissions are different, and your sources, would be very helpful in our ability to investigate this claim and consider editing the database.

I Have Downloaded The Raw Data But I Am Struggling To Map These Sources/Plants To Specific Companies. Could You Clarify The Best Way Of Mapping The Data? →

When you download each sector's folder and unzip the folder, you will find a CSV file titled "emissions-source_[subsector]_ownership.csv". This file contains the company ownership information. We have tried our best to provide ownership data where available but in many cases it is not available/not updated.

Each emissions source in the ownership file has a unique identifying number. You can use that number to find the same emissions source in the file that contains emissions estimates.

I Need Help Analyzing These Data. Do You Offer Technical Support? →

Due to the large volume of requests, Climate TRACE is not always able to provide individualized technical support. However, we do have a small team which offers free technical support and additional analysis for as many governments, companies, researchers, and others as we can. We explicitly prioritize providing technical support to projects that have a reasonably high chance of reducing significant amounts of emissions. If you would like technical or analytical support using Climate TRACE data to reduce emissions, please contact us.

About the Inventory

How Does Climate TRACE Calculate Emissions? →

Climate TRACE identifies the most significant gaps in emissions reporting within current [illegible]evelops models to estimate those emissions gaps. Climate [illegible]d on a sector-by-sector basis by the relevant Climate TRACE sector lead (listed here) and additional contributed organizations they collaborate with.

Each Climate TRACE sector uses a methodology that is specialized and relevant to each particular sector to estimate emissions. The most common method is using computer vision models to combine one predictor variable (such as satellite imagery) and one high-quality source of ground truth data (such as verified, calibrated sensors located at individual facilities). Computer vision models are a form of artificial intelligence that, unlike generative AI, is relatively easy to verify and not prone to hallucination.

More and more Climate TRACE teams are also moving towards comparing cross-verifying results from modeling different experts, using multiple different methods, to ensure maxim accuracy. In artificial intelligence, this is called an “ensemble model”.

We’ve published detailed documentation on our methodologies, peer reviewed research that underlies those methodologies, and the key datasets and assumptions for the Climate TRACE inventory. You can find those on our data downloads page.

How Many Years Of Data Do You Have? →

Climate TRACE provides emissions data covering global emissions from 2015-2022.

All years of data are available via our downloads page. You can also view country-level totals from 2015-2022 by using our country inventory tool. Our source-level emissions map includes data for 2021 and 2022.

Does Climate TRACE Calculate Emissions From Individual Sources? →

Yes! Climate TRACE provides extremely detailed emissions data for nearly every major emitting source, down to the individual power plant, ship, oil rig, and manufacturing facility.

For some industries and sectors, this is easier than others. For example, with remote sensing, it’s much easier to monitor a stationary source like a power plant than it is to monitor something that constantly moves, like a ship.

This year, our emissions inventory grew from 80 thousand emitting assets to 352 million emitting assets. We have summarized the results into human-readable format here on our emissions map and can download data by sector and country or contact us for more granular information.

Can You Share More Specifically How Climate TRACE Uses Satellite Data And AI To Measure →

At a high level, machine learning (ML) is defined as a branch of artificial intelligence (AI) and computer science that enables software applications to more accurately predict outcomes using in situ historical data. In general, ML works by trying many, many different algorithms that can use data one actually has access to ("features") to predict data you would like to have access to ("target variables"). It then selects the algorithm that does so most accurately. The definition of an accurate algorithm is the one that can most accurately predict target variables it hasn't "seen", only by looking at the features. To measure this, you must have access to accurate, high-quality data on many examples of the target variable ("training data").

In the case of Climate TRACE, the target variable we are estimating is emissions. To estimate it, we combine many features, but particularly satellite imagery. And to gauge the accuracy of different algorithms, we use training data which are verified, high-quality, on-site measurements of many individual facilities. We then weed out any algorithms which did not pass quality control–for example if they were inaccurate, or had a high risk of potential bias. We then run any algorithms that do pass quality control globally, and publish the results including data about our confidence and certainty that a given result is accurate.

One surprising finding of Climate TRACE is that, while we do use data from satellites that directly spot CO2 and methane emissions to predict the level of CO2 and methane coming out of individual assets, we often discover that some other method or "feature" is actually even more accurate. Often this is because emissions disperse in the wind, whereas sometimes other signals can be pinpointed to an exact location with higher certainty. Thus, we have learned to not assume in advance which features will be most accurate, but instead to combine many different features and use whatever actually produces the most accurate results in practice.

Today that includes a long and growing list of features, from extremely high temperatures at steel plants, to fan blades spinning on a power plant, to lidar imagery of trees, to automated identification systems (AIS) tracking the movement of ships, to visual markers of flaring data in oil and gas extraction.

Other than independence, the primary value of using ML to estimate emissions is that direct monitoring systems are cost-prohibitive for most countries and operators. An important element of such models is, therefore, obtaining globally representative ground truth data to avoid causing out-of-sample bias. Thus, in addition to collecting existing emissions measurements, Climate TRACE has invested heavily in gathering high-quality ground truth data in a globally representative mix of countries, biomes, weather conditions, times of day, and equipment types.

We are always collecting more ground truth data and features. If you know of data that can be used to help predict emissions and validate those predictions, we'd love to hear from you!

How Can I Contribute To Climate TRACE Data And Analysis? →

Climate TRACE was built on collaboration. If you like the idea of working together to make the want to hear from you! Whether you're a researcher who would ; a decision-maker interested in diving deeper into our data; or a journalist looking to shine a light on emissions trends; or a potential funder of our nonprofit work, we'd love to talk! Please reach out to us here.

Using Climate TRACE Data

How Does Climate TRACE Compare To Other Emissions Inventories? →

There is general consensus about the big picture when it comes to greenhouse gas estimates. The total amount of greenhouse gas emissions in the atmosphere is well measured and not in question. Climate TRACE estimates of the global total emitted from all human activities also broadly agree with existing global data sources like EDGAR, Global Carbon Project, and Carbon Monitor. In most cases, Climate TRACE data also broadly match both national inventory data and (where available) corporate inventory data. However, when digging into the details — specific emissions sectors in specific countries, or gases other than CO2, there are differences.

There are many reasons why:

(a) Many national inventories have not been updated in a long time. When comparing the latest national inventories to Climate TRACE data *from the same year*, they are often similar.

(b) Many inventories are not comprehensive. For example, many national inventories exclude some entire sectors. Climate TRACE makes every effort to measure all sectors for all countries. When Climate TRACE can clearly verify through satellite imagery or other means that a "missing" industry is in reality present in a country, we are more confident in our results.

(c) Many inventories use a sampling approach. For example, we are particularly impressed by Carbon Monitor and EDGAR's extensive work in obtaining detailed data for some facilities or industries, and use it to extrapolate reasonable estimates about others worldwide. But when Climate TRACE has the opportunity to directly monitor a facility or country instead of assuming, we prioritize this over extrapolation-based estimates.

(d) Varying definitions of where in an inventory to put different emission sources. (For example, some inventories include heat or co-generation plants under 'electricity' and others under 'industry'.) One reason Climate TRACE makes every effort to monitor each individual facility is that it's making it easier to reconcile different inventories, by separating differences of definitions from genuine different views on what's happening.

(d) Different emission factors. Like nearly all inventories, in many cases Climate TRACE often measures emitting activity and multiplies by emissions factors to estimate emissions. Currently Climate TRACE is using IPCC standard emissions factors except in a few cases where we have specific highly reliable verification that other factors are more accurate. But there is some uncertainty of these emissions factors, as displayed in our uncertain and confidence data.

ver be as accurate as an on-site, high-quality, properly calibrated the source of emissions. At the individual facility level, if verified data are available from direct on-site sensors, measured by reputable third parties, they will often be more reliable than Climate TRACE estimates. The biggest value of Climate TRACE is that the vast majority of emitting facilities worldwide do not have such sensors, and/or do not make it available to the public.

You can find comparisons to other data sources in the methodology documentation for each emissions sector, under the "results" section.

Does Climate TRACE Provide Scopes 1, 2 And 3 Data For All Emissions Sources? →

No, Climate TRACE primarily focuses on emissions that can be physically observed in the real world, i.e. Scope 1 emissions (i.e. direct emissions occurring at a source).

However, we do provide some information. First, for some sectors such as heavy industries, Scope 2 emissions (indirect emissions from the consumption of electricity) have been provided in the "other" data columns.

Further, while Climate TRACE does not provide Scope 3 emissions for downstream industries, data users can use the source-level emissions data to calculate their own Scope 3 supply chain emissions.

Take a look at this blog to see how source-level data can provide visibility on supply chain emissions, and how some of Climate TRACE's partners are already using the data to decarbonize supply chains. If you are a government or company that could use scope 2 or scope 3 emissions data in a project with a high chance of significantly reducing emissions, we may be able to support you with additional custom analysis. If so, you can contact us here.

How Accurate Is Your Data? →

Individual methodologies and related research papers publish accuracy metrics for cases where reliable ground truth data are available from which to calculate accuracy. But summarizing "how accurate is Climate TRACE data overall?" is actually much harder than it sounds. Why? Because to quantitatively measure how accurate a dataset is, you need to know exactly what the true answer is. And if there *were* any data source that knew the exact accurate emissions of every emitting facility on the entire planet, there would be no need for Climate TRACE.

However, in practice we know that some parts of the dataset are the *same* accuracy as existing methods (for example, when we re-use IPCC emissions factors), others are *more* accurate (for example, when we can see power plants turning on more often than is reported), and still others are *much more* accurate (for example, when existing inventories exclude a facility or whole sector entirely, but we can clearly see it from space).

examples of Climate TRACE data being *less* accurate than s a coalition, any time we find evidence that any relevant dataset produced by anyone is measuring anything more accurately than Climate TRACE already is, our default workflow is to try to incorporate those better data into the coalition, rather than sticking with a less accurate method. Like all AI projects, the more we incorporate additional data sources and methods in this way, the more our accuracy will continue to increase over time.

But our confidence still varies, and is generally lower in fields where *no* highly certain methods have yet been found (such as underground soil carbon in agriculture). So we make transparent everything we know about the confidence and uncertainty of our estimates for each asset, including detailed metadata on our confidence about different component parts of the estimate. Our confidence and uncertainty metrics are largely patterned off the approaches used by the International Panel on Climate Change (IPCC) with minor modifications. We also encourage you to read through our methodology to understand the underlying data sources we use, the models, and their relative advantages and limitations.

Who Can Use Climate TRACE Data? →

Anyone. Climate TRACE is a free tool that anyone can use. Our data are available to all under a Creative Commons 4.0 License, which means all users are free to copy, modify and distribute Climate TRACE data in any format for any purpose including commercial use, as long as you acknowledge Climate TRACE. Please read our terms of use for more information.

Climate TRACE data are already being used by policymakers for verification of self-reported emissions and data-driven climate action planning, by multinational companies to make supply-chain procurement decisions, by researchers for building decarbonization pathway models, and by climate start-ups and consulting firms to help their clients meet decarbonization targets. You can read about some of these use cases. We also welcome feedback from people who are already using our data, please use the survey form located at the bottom of this page to tell us how you're using the data.

Does Climate TRACE Also Include Emissions From Individuals? →

No. Climate TRACE does not track emissions from individuals nor do we provide any personal data such as individuals' names, addresses or other information that relates to an identifiable person. Our focus is on large emission sources such as manufacturing units, power plants, mines, and cargo ships. While we do track emissions from cars and buildings, these are aggregated up to the level of a city or county, so an individual's privacy is never at any risk of violation. And we have no plans to change this, ever. We are people too and take seriously that there is no need to invade people's privacy to fight climate change.

We also protect your privacy while you visit and use our site. All website browsing activities are anonymized and we do not use any tracking cookies. The only information we collect about you is when you sign up for our newsletter or get in touch with us. You can read our privacy policy here.

What Insights Did We Learn From Climate TRACE Data In 2022? →

ng new insights the Climate TRACE data have uncovered. In the meantime, here are some intriguing insights the initial asset-level data release uncovered last year:

- In oil and gas production and refining, among the world's top countries that submit regular inventories, emissions from oil and gas may collectively be more than double (1 billion tons higher than) recent reports. Further, it is likely that over 1 billion additional tons CO2e per year—more than the annual emissions of the 100 lowest-ranking emitting countries combined—have gone uncounted by countries that aren't required to report their oil and gas emissions regularly.

- Steel production globally resulted in 13.1 billion tons of CO2e between 2015 and 2020, equivalent to the total emissions of Japan and the United Kingdom combined over that same period. In 2020, steel emissions fell in nearly every country except for China. Further, this year China's steel industry is on track for an estimated emissions increase of 158 Mt CO2e, roughly equal to the entire annual emissions of Colombia.

- Shipping and aviation together emitted nearly 9.6 billion tons of CO2e between 2015 and 2020, totals that would make these two sectors combined the 5th largest emitter in the world, if they were a country. Shipping emissions increased about 10% per year from 2018-2020 despite the COVID-19 pandemic, considerably faster than expected. Yet emissions from both sectors are exempted from countries' mitigation commitments under the Paris Agreement.

- Forest fire emissions have more than doubled in Russia and the United States since 2015, which together now emit more from fires than Brazil.

- Rice emissions are higher than previously thought in several countries, and in India's case may be nearly three times the official inventory. Perhaps even higher: Climate TRACE data also detects substantial cropland fires, which are mostly rice stubble, further increasing rice's total emissions impact.

- Road transport emissions are higher than previously estimated in several countries, in Russia's case by potentially as much as 70 percent.

But there is so much more to learn from the data! Visit our News & Insights page for the latest highlights from the Climate TRACE inventory.

FEB 26, 2024

As Arctic Ice Thaws, Questions Around Arctic Shipping Heat Up

Ocean shipping could climb significantly in the years ahead, with maritime trade expected to triple by 2050. But there are concerns that the changing climate will open up previously unnavigable or unviable trade routes — especially in the Arctic.

DEC 27, 2023

Conversations With The Coalition: Nick Wise

We recently caught up with Nick Wise, CEO & Founder of OceanMind, about emissions estimates for the shipping industry.

DEC 02, 2023

Climate TRACE Unveils Open Emissions Database Of More Than 352 Million Assets

The Climate TRACE inventory includes every country and territory in the world, every major sector of the global economy, and nearly every major source of greenhouse gas emissions. Tesla, Polestar, Boeing, and others have already moved swiftly to leverage the new dataset to pinpoint decarbonization opportunities in their supply chains.

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