CLIMATE TRACE

Climate TRACE - Tracking Real time Atmospheric Carbon Emissions: How remote sensing, cloud computing, machine learning and artificial intelligence are changing how we approach the climate crisis

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The Climate TRACE coalition

Climate TRACE is a joint initiative founded by collaborating universities, environmental nonprofits, tech startups, and environmental leaders; plus dozens of other institutions that have contributed additional data and analysis.

The purpose of the coalition is to pool the collective technical resources and domain knowledge of all these organizations to bring transparency, recency, and actionability to global greenhouse gas (GHG) emissions inventories.

Climate TRACE founding members

Johns Hopkins University Applied Physics Lab

EARTHRISE ALLIANCE

OCEAN MIND

Former VP Al Gore

TransitionZero

WattTime

Hypervine.io

RMI ENERGY. TRANSFORMED.

Blue Sky Analytics

Emissions Data for Decision-Making

Independent

- Direct measurements of emissions-causing activities from remote sensing data and multiple other datasets

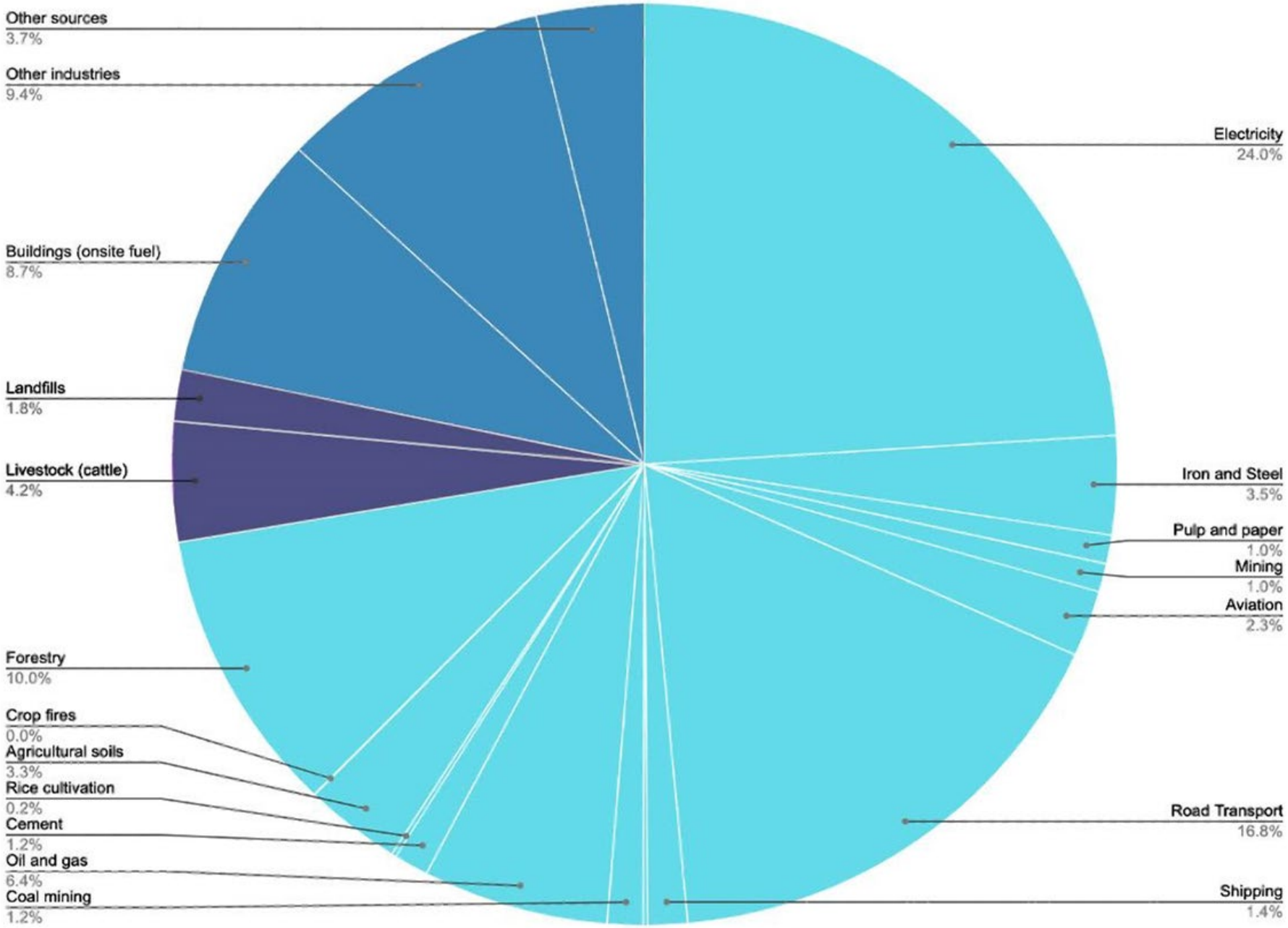
Timely

- Annual data for every country 2015-2020
- Coming November 2022: 2021 emissions data

Comprehensive

- All major emissions sectors
- All countries
- Coming soon: Facility-level emissions estimates for the largest plants across all sectors

Emissions sectors covered



- Direct measurements by CT
- Included in next update (Q4 2022)
- From existing datasets (EDGAR, FAOSTAT)

Climate TRACE roadmap

2021

COUNTRY-LEVEL LAUNCH

- sector
- country

2022

ASSET LEVEL LAUNCH

- top 500 assets in key sectors
- metadata on locations, type, capacity, etc

2023

COMPLETE ASSET LEVEL

- *all* major emitting sources globally

2024

MONTHLY REPORTING

- weekly
- monthly
- biannual

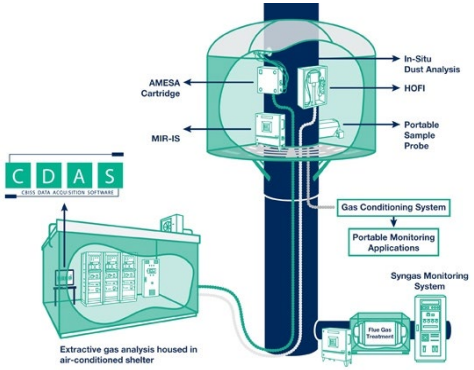
How are Greenhouse Gases Monitored?

Satellites

Measure atmospheric concentrations of GHGs

Used in global atmospheric models but cannot be used to pinpoint emissions to specific sources

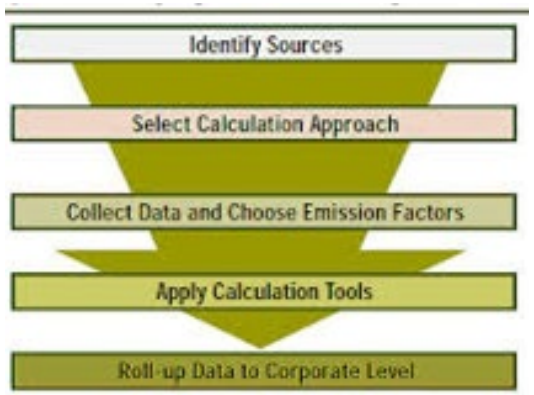
Ground sensors



Measure stack emissions from industrial facilities like power plants and large factories

Not available in many countries, are expensive to install, and require daily calibration

Model-based tools



Estimate GHGs by combining emission causing activities with standard emissions factors

Can have uncertainties due to the use of Tier 1 EFs

Resource intensive and time consuming to prepare

Our Approach

OBSERVE ACTIVITY: satellite imagery and data identifies emissions-causing activities

TRAIN THE MODELS: training data (e.g., CEMS, sensors, reported emissions) complements activity observations

ESTIMATE ACTIVITY: AI, ML, and statistical models estimate activity data

COMPLEMENT ACTIVITY DATA: Other datasets to estimate facility size, technology, and emissions factors

EMISSIONS ESTIMATES

Example 1: Power plants

AI algorithms are trained using ground truth data to recognize observable signals (e.g. steam plumes) that are highly correlated with the release of emissions.

Inferring a power plant's operational status employed Landsat-8, Sentinel-2A/B, and PlanetScope imagery.

Example 2: Steel plants

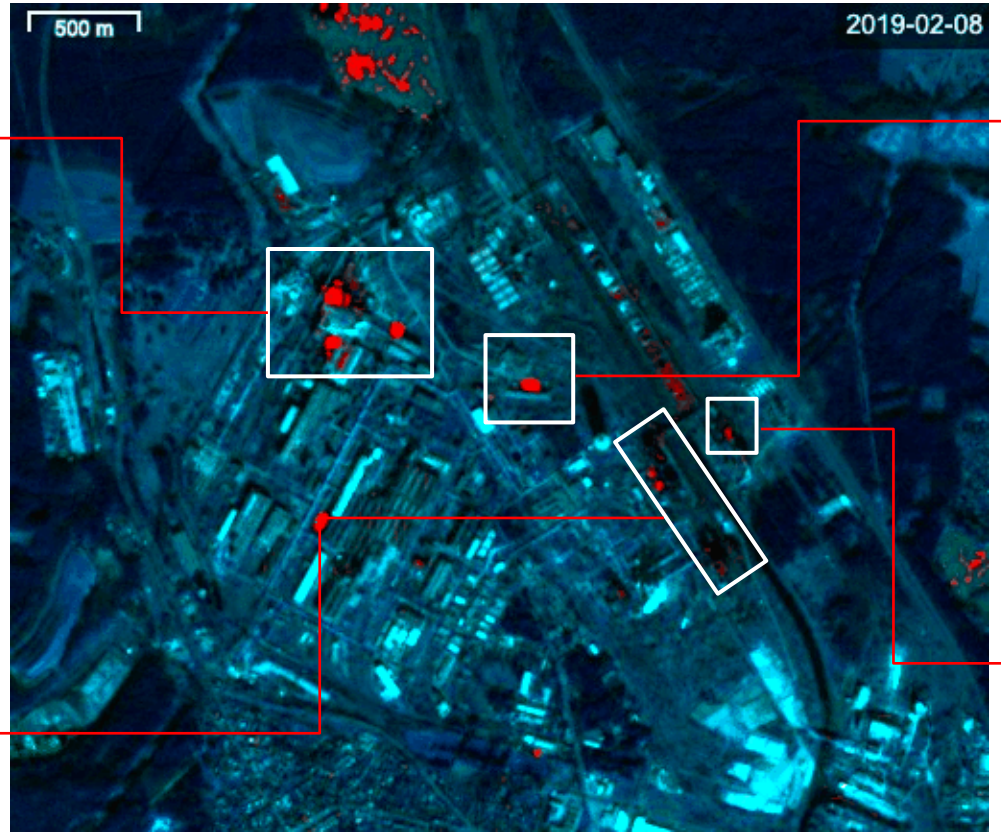
Modified Sentinel-2 imagery of Eisenhuettenstadt mill

Basic Oxygen Furnace

Off-gas emerges from the reaction at about 1650℃.

Blast Furnaces Row

A mixture of sinter and coke is heated to create pig iron at up to 1300℃.



Slag pit

Hot process impurities are dumped into a slag pot then transported back to large pits dug into the ground to be allowed to cool.

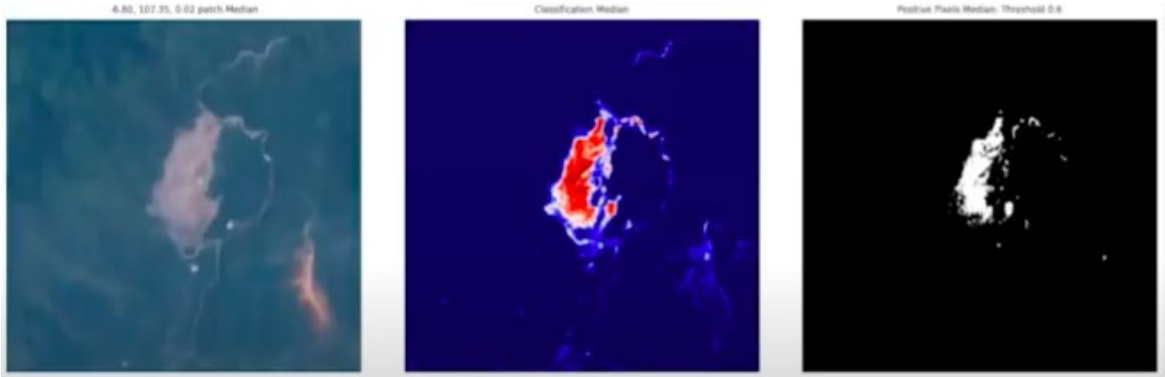
Sinter Plant

The temperature maintained between 1150 - 1250℃.

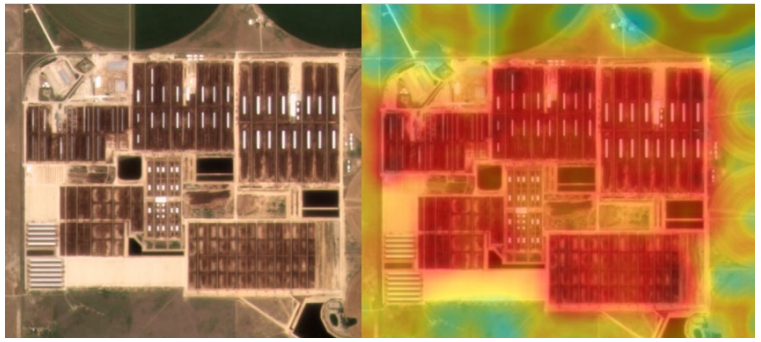
Satellite based steel production estimates used Landsat-8/9 and Sentinel-2A/B SWIR bands.

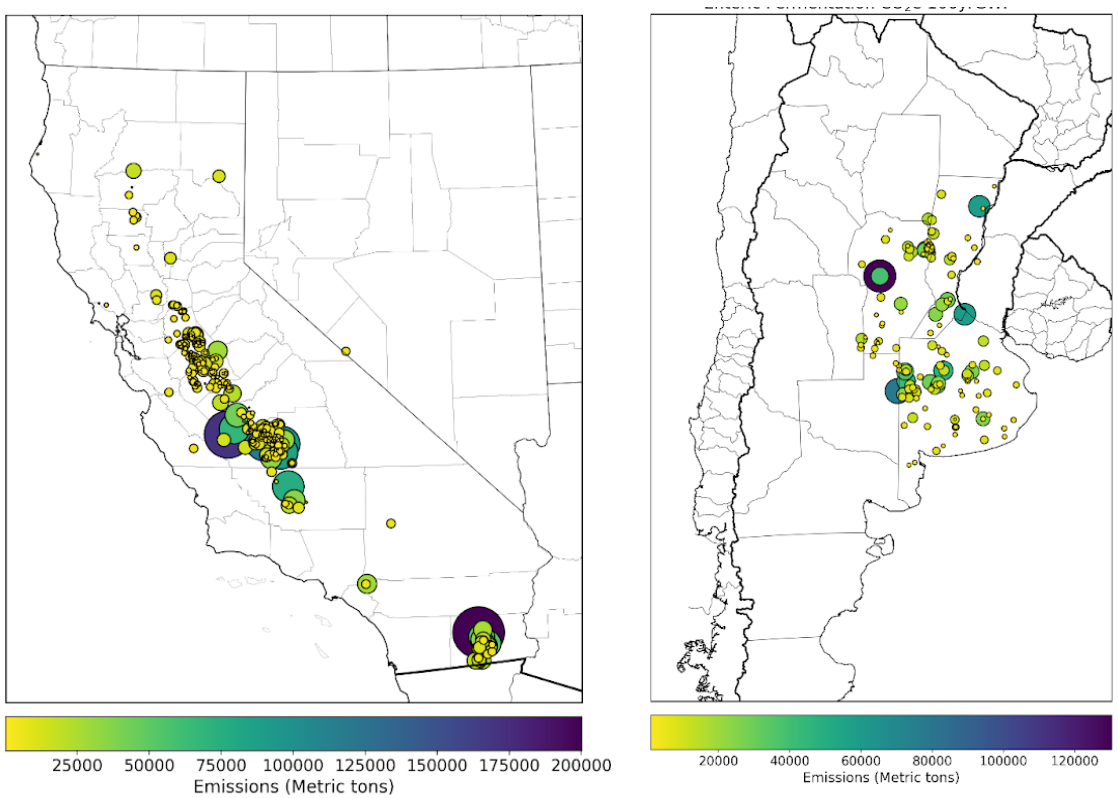
Source: Google data, Copernicus data, TransitionZero analysis

Example 3: Landfill & feedlot detection



Plastic has a unique spectral signature that can be measured with remote sensing. Sentinel-2 imagery and AI algorithms were used to identify plastic containing landfills in South-East Asia and will be expanded globally by Climate TRACE collaborator, Global Plastic Watch.





AI algorithm (top) 'learns' what feedlots looks like and pinpoints their location in NAIP and PlanetScope imagery. Below, beef feedlot enteric fermentation emissions for California and portions of Argentina.

Summary

Utilizing machine learning, artificial intelligence, and cloud computing with remote sensing data, and in situ data Climate TRACE has created an independent GHG database.

With our current GHG emissions inventory, Climate TRACE aims to improve and refine GHG emission estimates using state of the art technology and incorporate more remote sensing data as they become available.

Climate TRACE is looking for collaborators

1. Provide reviewer and end-user feedback on our data.
2. Provide access to unique or non-public data that can be used to train models
3. Work with us to develop a pilot study.
4. Provide expertise in a sector not covered or help refine a current sector by Climate TRACE.
5. Access to additional satellite data and processing tools.

Contact us

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Visit the Climate TRACE website

www.climatetrace.org

How Climate TRACE is harnessing satellite and AI

https://climatetrace.org/news-and-insights

Joint report: GEO, Climate TRACE, & WGIC

GHG Monitoring from Space: A mapping of capabilities across public, private and hybrid satellite missions

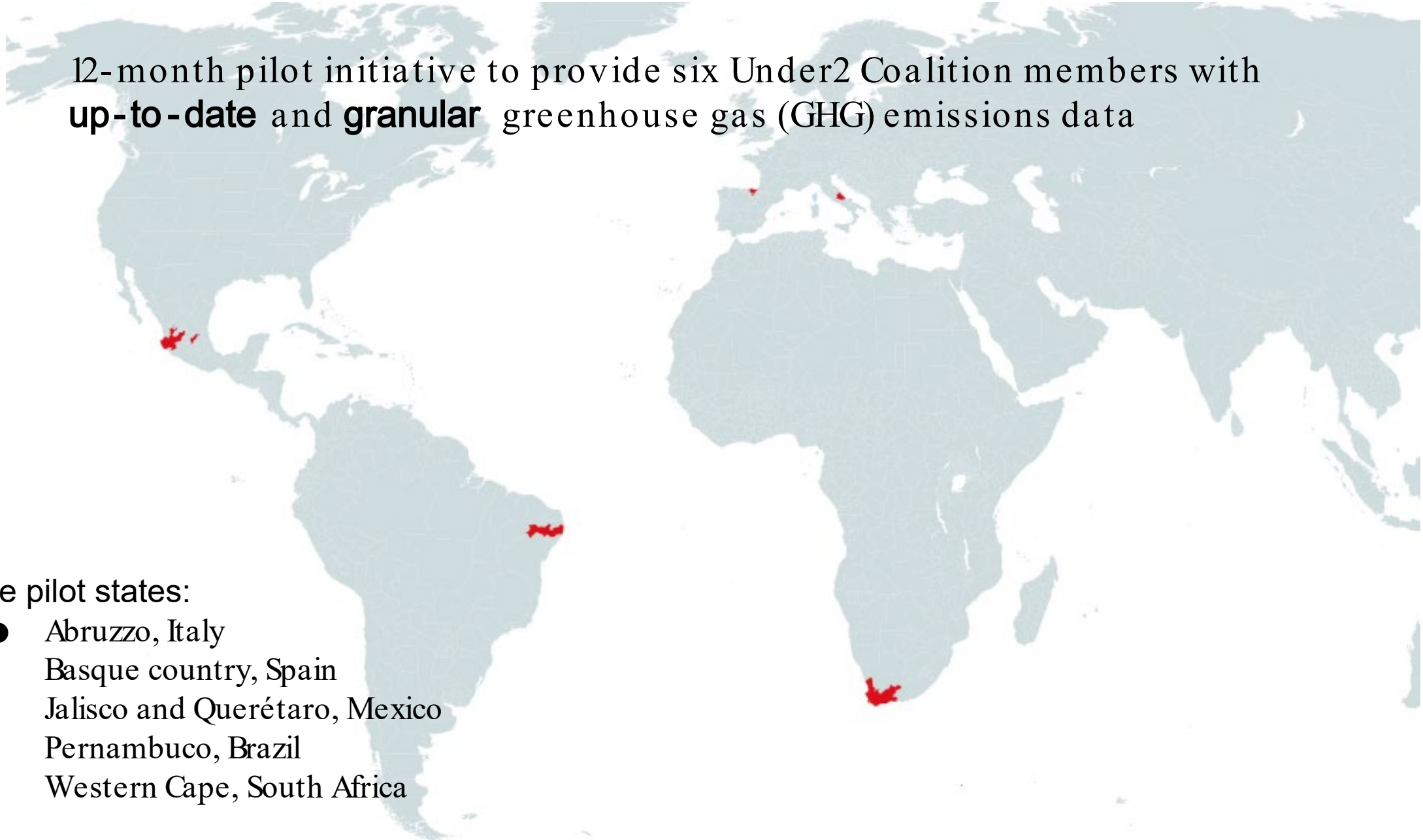
Extra slides

Use cases for Climate TRACE data

01	Compare existing GHG inventories	Countries' official inventory can be compared with Climate TRACE's independent data to identify areas for improvement
02	Filling in gaps where data does not exist & updating outdated inventories	Several countries/regions have no recent data available or have very high-level information. Climate TRACE data can fill those gaps, identify emission trends and provide insights.
03	Evaluate the impact of policies/events on GHG emissions	Ex.: emissions impact of COVID lockdowns or other policies on emissions at the facility-level.
04	Estimate Scope 3 emissions	Facility level emissions of upstream industries (ex. steel and cement manufacture) and travel and logistics (ex. shipping) can be used to quantify Scope 3 emissions
05	Identify emission reduction opportunities	Ex.: identify emission reduction opportunities based on facility-level emissions intensity of upstream industries, locations for renewable energy siting.

The STARRS Project

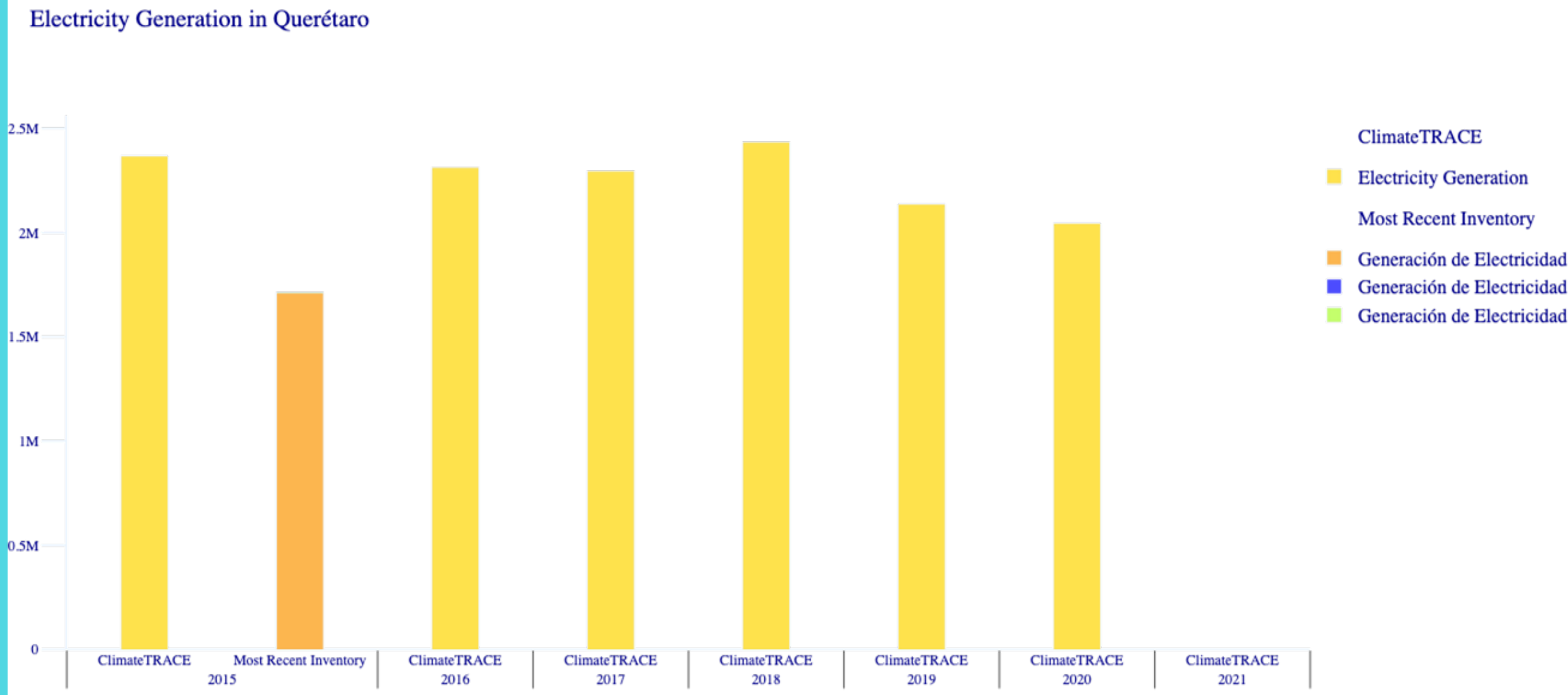
12-month pilot initiative to provide six Under2 Coalition members with **up-to-date** and **granular** greenhouse gas (GHG) emissions data



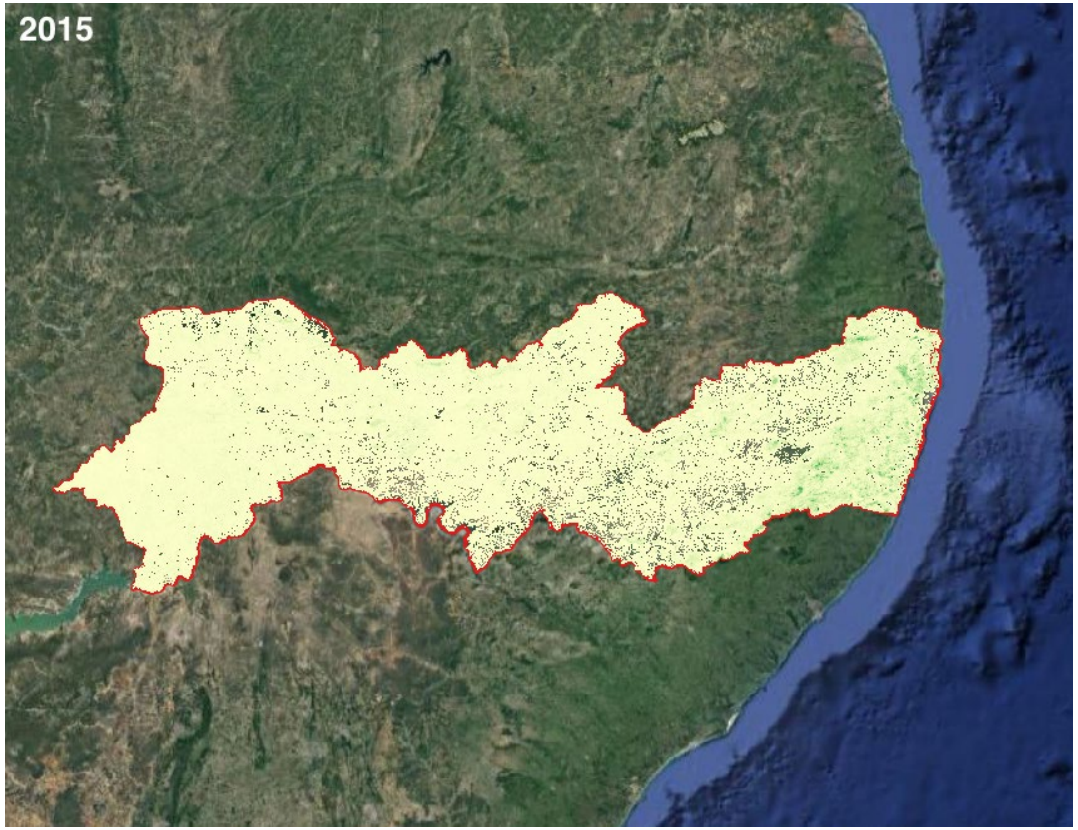
The pilot states:

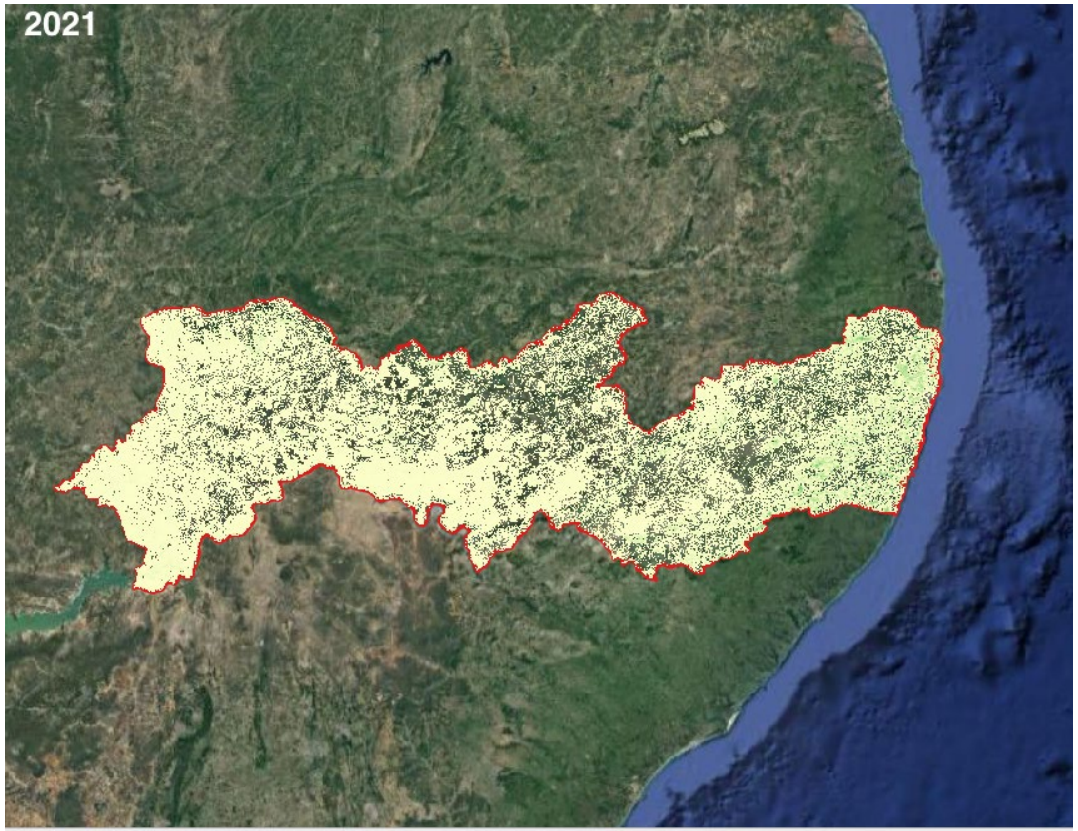
- Abruzzo, Italy
- Basque country, Spain
- Jalisco and Querétaro, Mexico
- Pernambuco, Brazil
- Western Cape, South Africa

Comparing Climate TRACE and last available official inventory



Pernambuco: Change in forest biomass



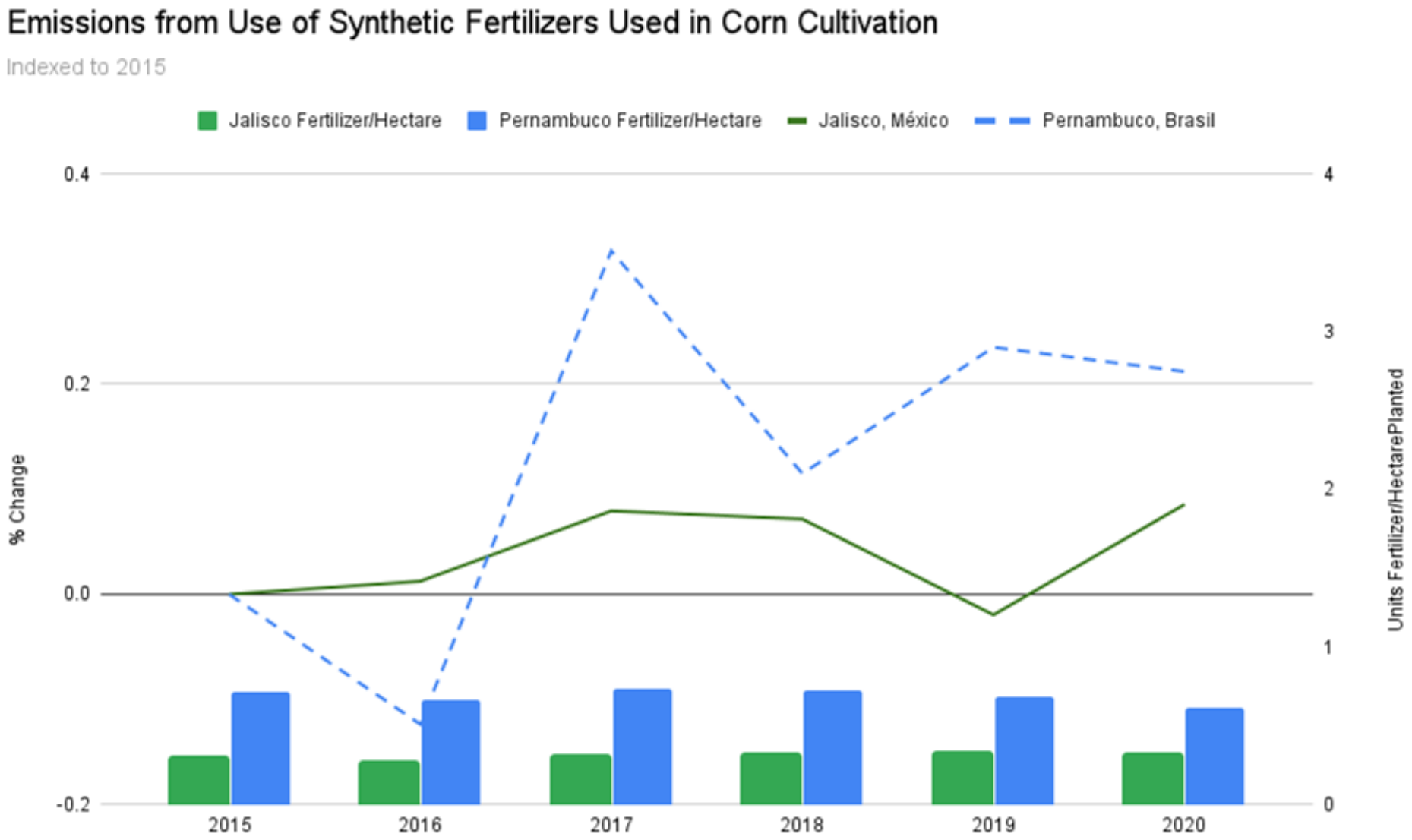


2015 = 725,519 Mg of total Biomass

2021 = 471,858 Mg of total Biomass

Net change =-253,661 Mg of total biomass, ~54% net loss from 2015 to 2021

Impact of agricultural policies on fertilizer emissions



In 2017, corn production outside the United States grew in response to the trade war with China. But, the use of fertilizers did not grow in the same proportion in all the corn-producing regions.