

# Carbon Footprint of Scientific Missions at APC (2021-2025)

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# The Scope

1. Provide a baseline / tool describing / monitoring the **current environmental footprint** of APC professional travel.
2. Enable the Conseil de Laboratoire (**CdL**) to formulate potential **CO<sub>2</sub> reduction scenarios**.
3. Quantitatively **assess the impact of these scenarios** on APC scientific activities using historical mission data

This presentation focuses on Step 1: the methodology developed to reconstruct travel-related emissions and the resulting baseline indicators.

# Background

## APC Ecology Group (2024-2025) ⇒ [link](#)

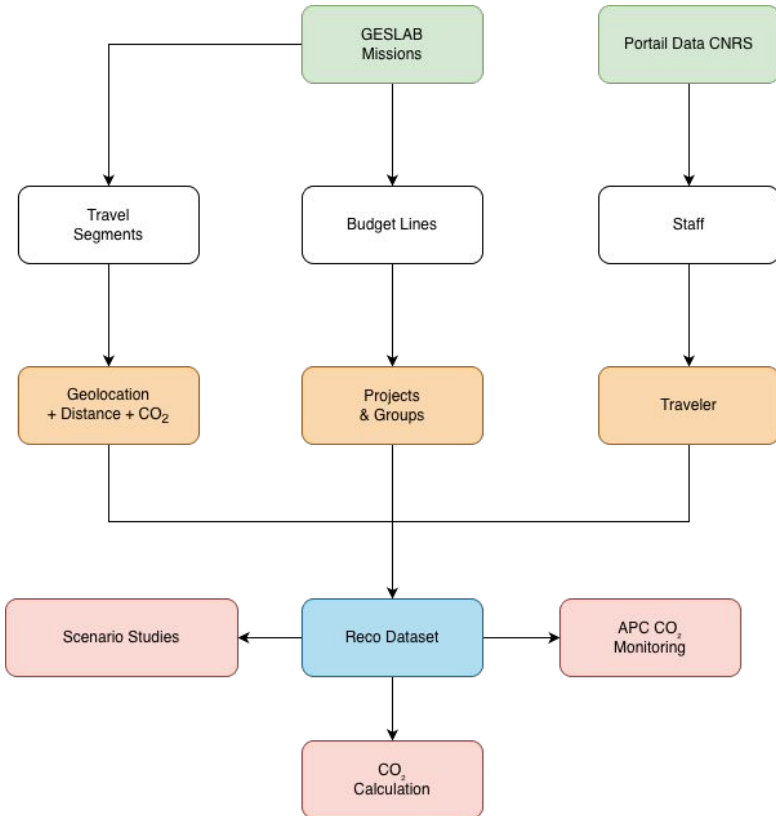
- APC travel CO<sub>2</sub> assessment based on **Labos1point5** methodology.
- Identified **data-quality limitations** in the standard Geslab datasets.
- **Manual validation** and correction of 2024 missions.

## This study (2026) ⇒ [link](#)

- Developed an automated and reproducible **mission reconstruction pipeline** from Geslab records
- Extended the analysis to the full **2021–2025** period.
- Implemented CO<sub>2</sub> calculations calibrated against the **Labos1point5** travel simulator.

## Validation

- Compatible global CO<sub>2</sub> estimates for the **2024 dataset**.



## Accounting perimeter

**Emissions are attributed to APC when budget administered by APC**

⇒ APC-funded invitations are included.

⇒ Missions by APC members non-funded by APC are excluded.

**University-funded missions are not included in this dataset**

⇒ In 2025, university-funded missions are estimated to represent about 6% of the APC mission CO<sub>2</sub> budget

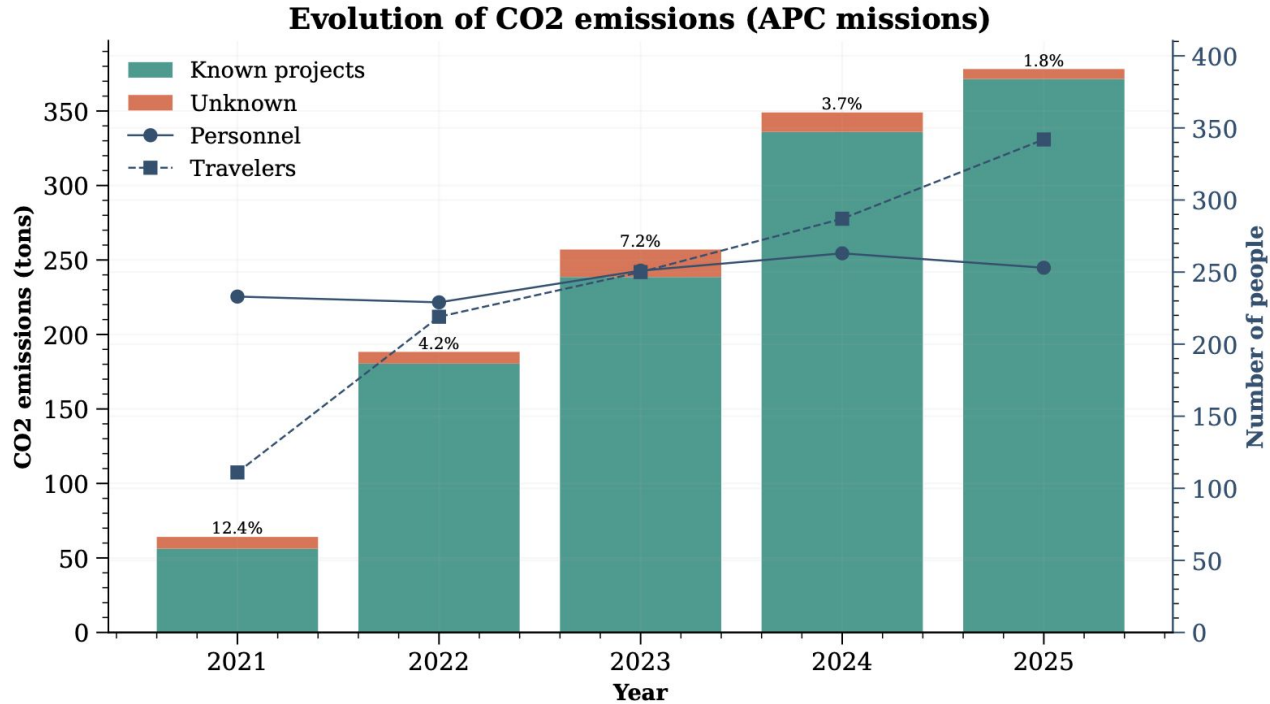
## Metrics and normalization

1. **CO<sub>2</sub> per personnel:** measures the footprint of the lab as a whole
2. **CO<sub>2</sub> per traveler:** measures the carbon intensity of travel activity

**We opted for the 2nd:**

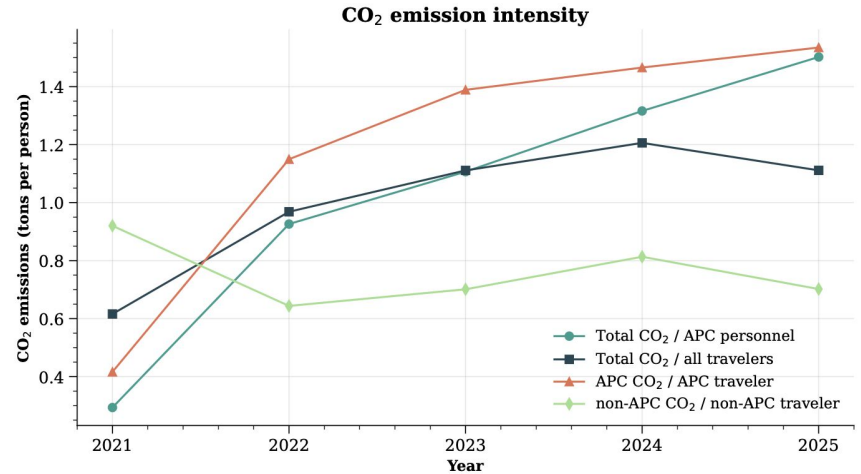
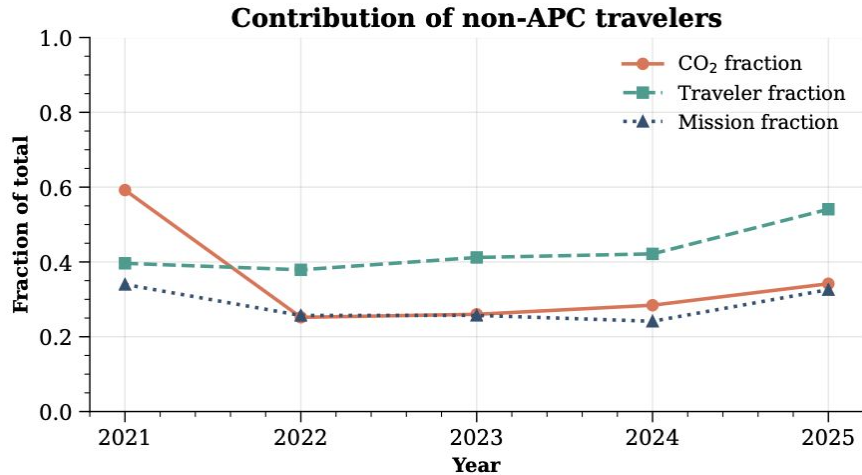
- less sensitive to changes in laboratory size;
- more meaningful for comparisons across groups and years;
- better suited to account for non-APC travelers.

# APC travel emissions: evolution



# APC vs non-APC travelers

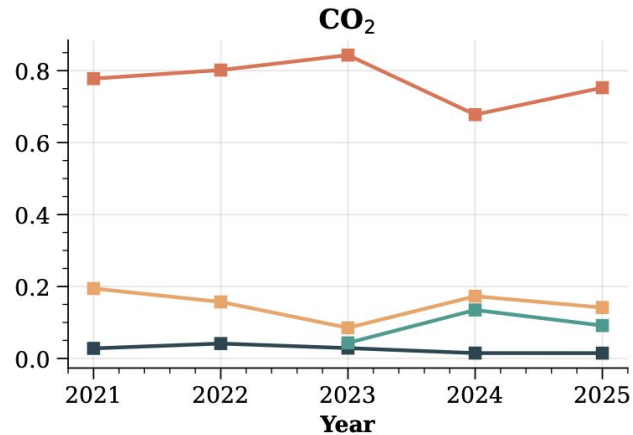
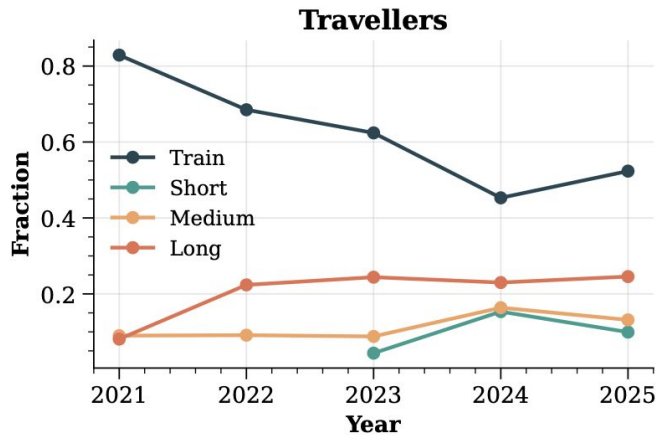
Around 30% of APC-funded travel emissions originate from non-APC travelers



# Where do emissions come from?

Long-haul flight travelers (20-25%) account for 70–80% of emissions because of long-haul travel

**Travel intensity vs CO<sub>2</sub> contribution**



Traveler categories

- Train: no air travel
- Short flight < 1000 km
- Medium flight 1000–3500 km
- Long flight > 3500 km

Travelers are classified according to the most distant trip performed during a given year

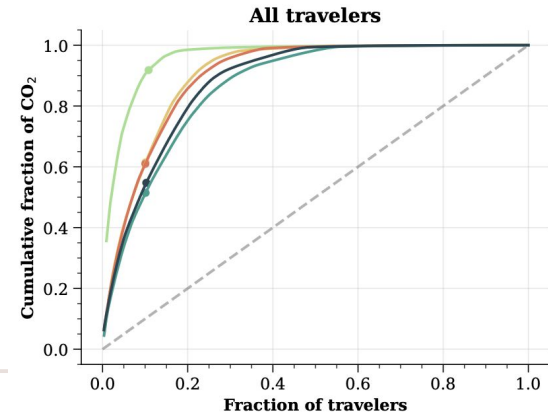
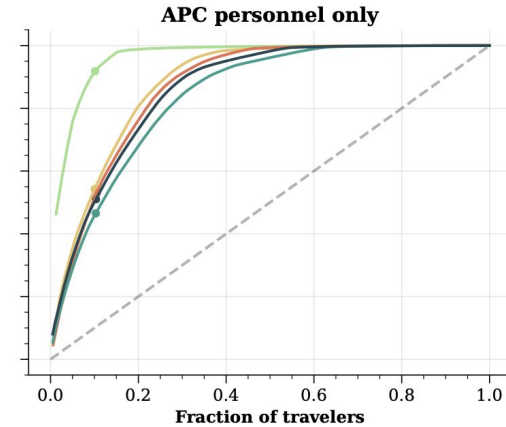
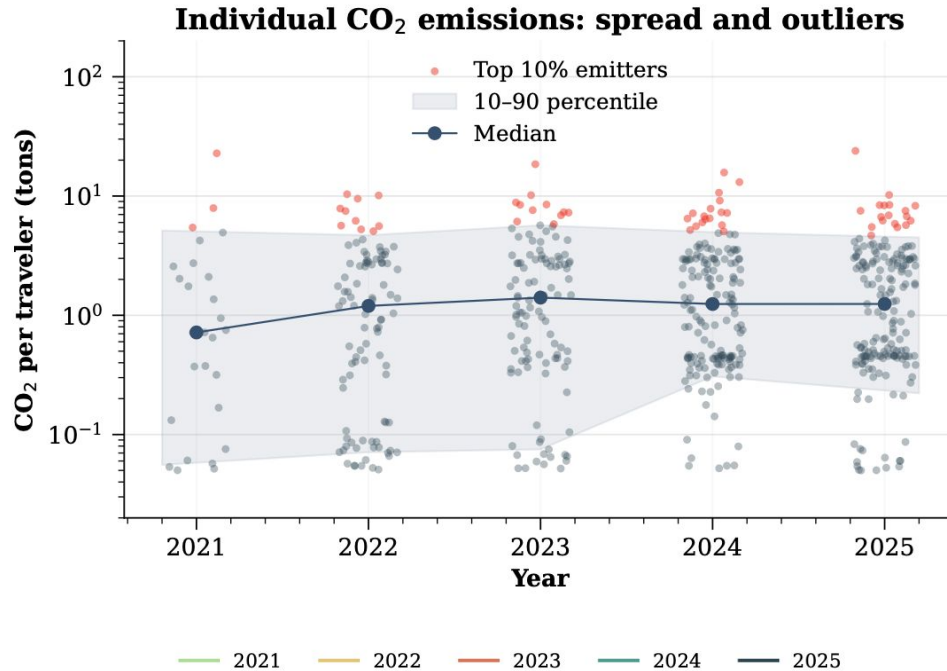
# Short-haul flights: visible, but not the main driver

- Short-haul flights contribute about 10% of total CO<sub>2</sub> emissions in 2024-2025.
- About 65% of short-haul flight segments are connecting flights within longer itineraries.
- After removing connecting segments, stand-alone short-haul flights represent only about 4% of total CO<sub>2</sub> emissions.

Most frequent stand-alone short-haul destinations (2021–2025)

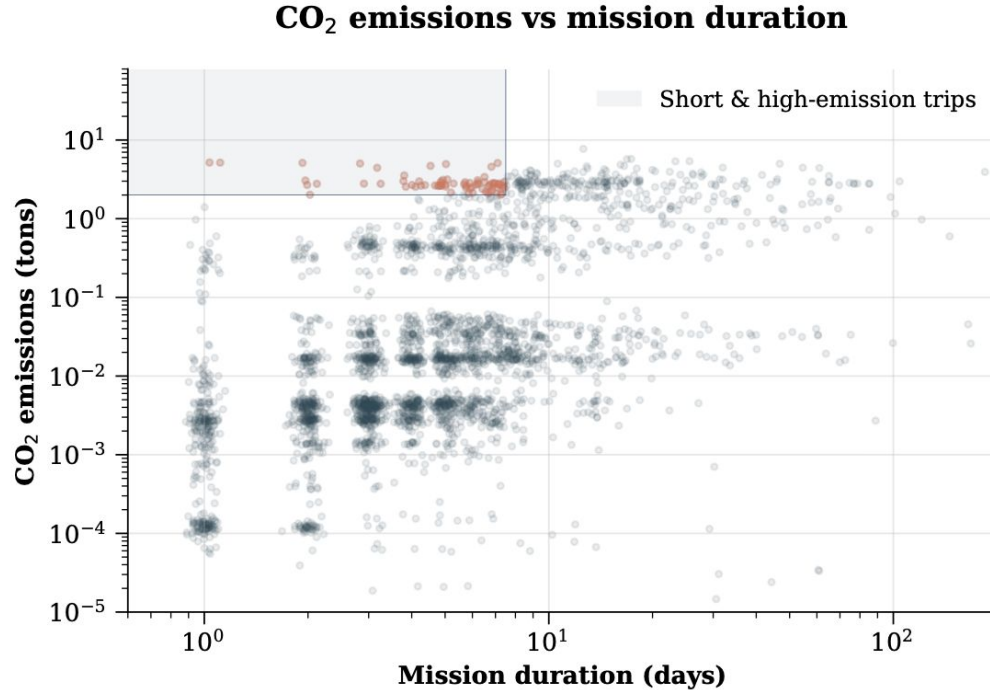
Destination	Trips
Milan	30
Pisa	27
Florence	17
Bologna	16
Venice	15
Berlin	12
Dublin	11
Hamburg	10
Toulouse	8
Edinburgh	6

# Are emissions concentrated among a few individuals?



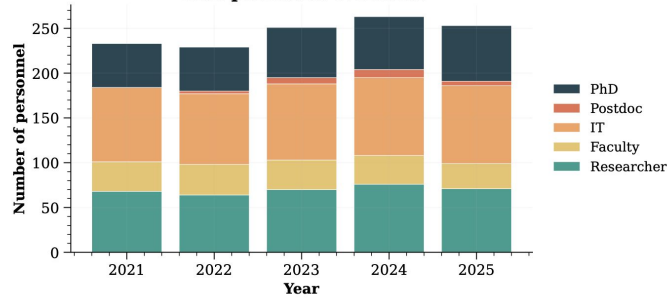
# Are emissions related to mission duration?

Short and far-away trips are responsible for ~1.5% of total emissions

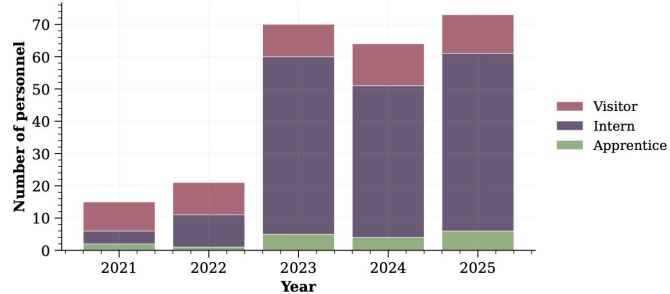


# Personnel categories

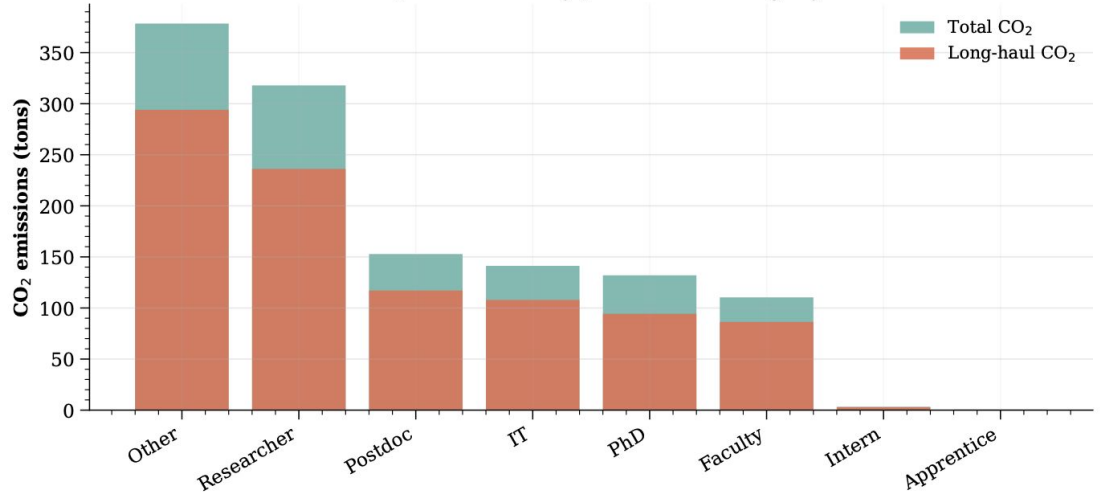
### Core personnel evolution



### Non-core personnel evolution

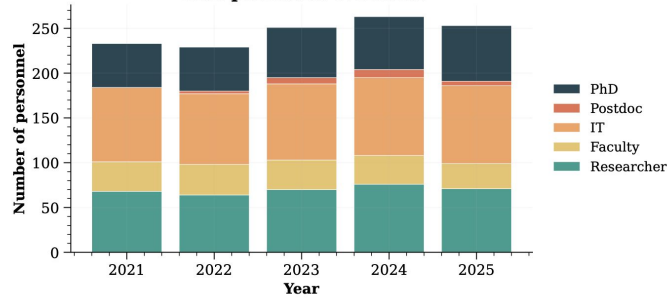


### CO<sub>2</sub> emissions by personnel category

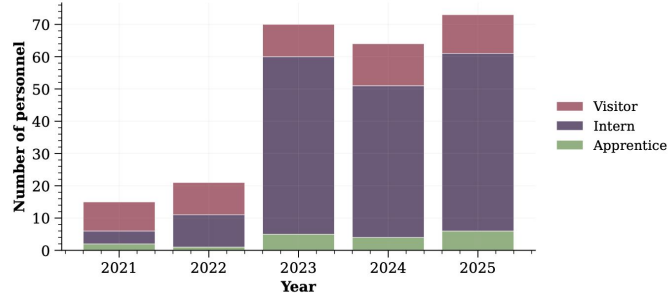


# Personnel categories

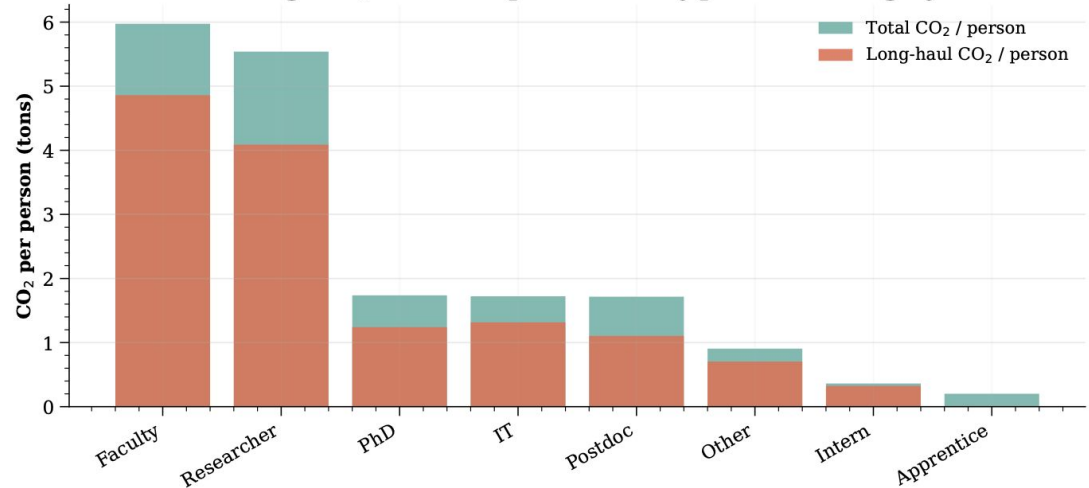
### Core personnel evolution



### Non-core personnel evolution

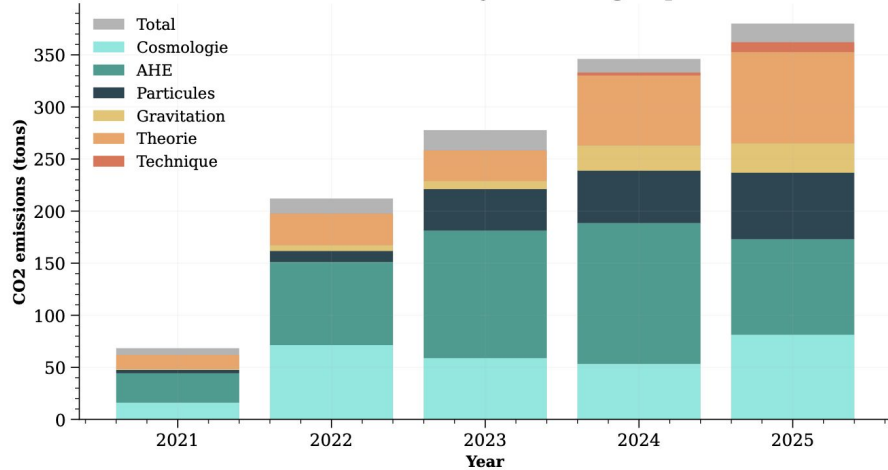


### Average CO<sub>2</sub> emissions per traveler by personnel category

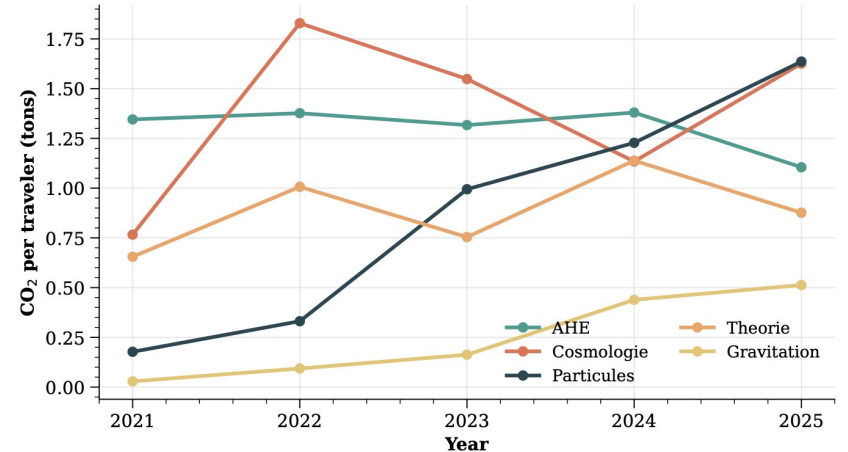


# Evolution by scientific group

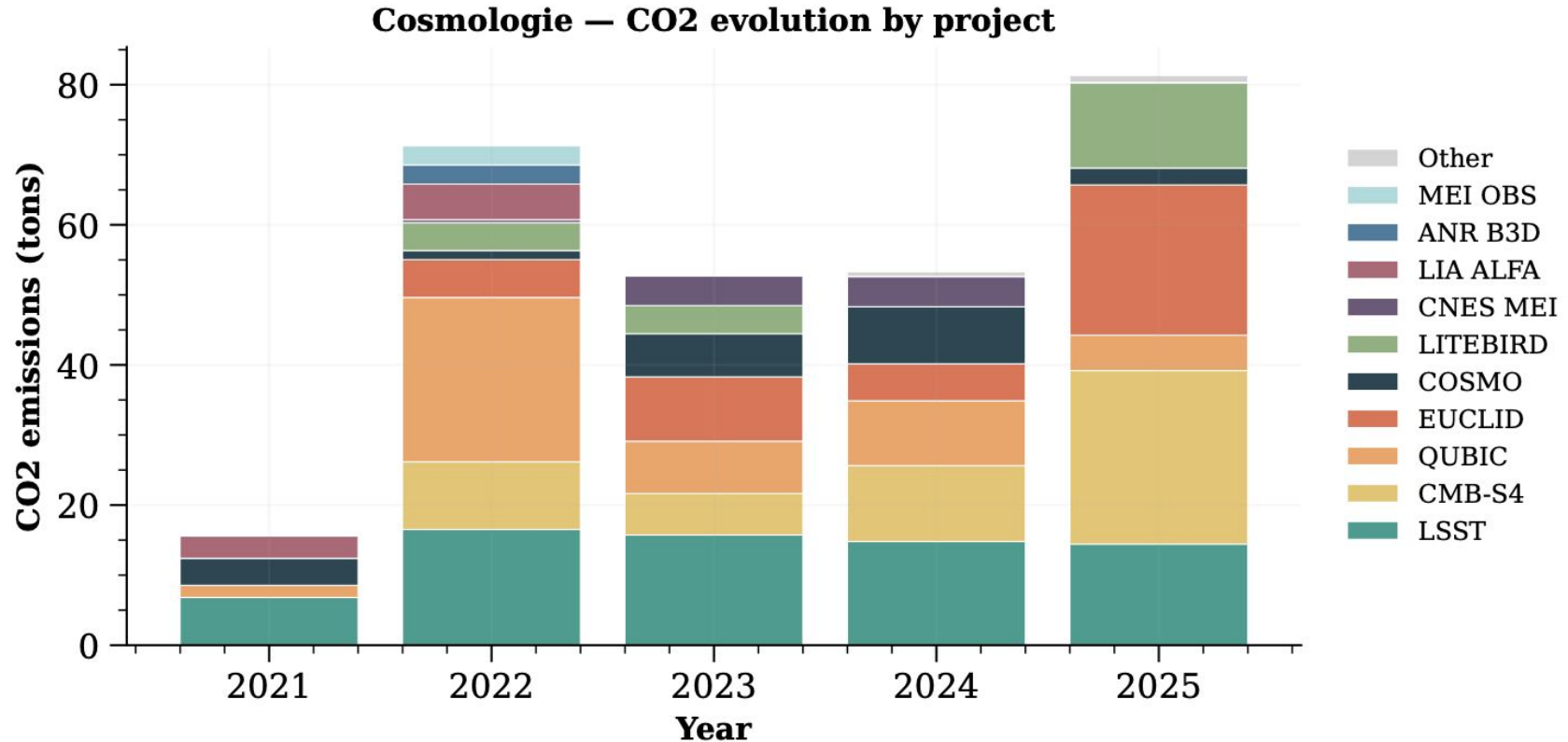
## CO2 emissions by scientific group



## Evolution of CO2 emissions per traveler by group

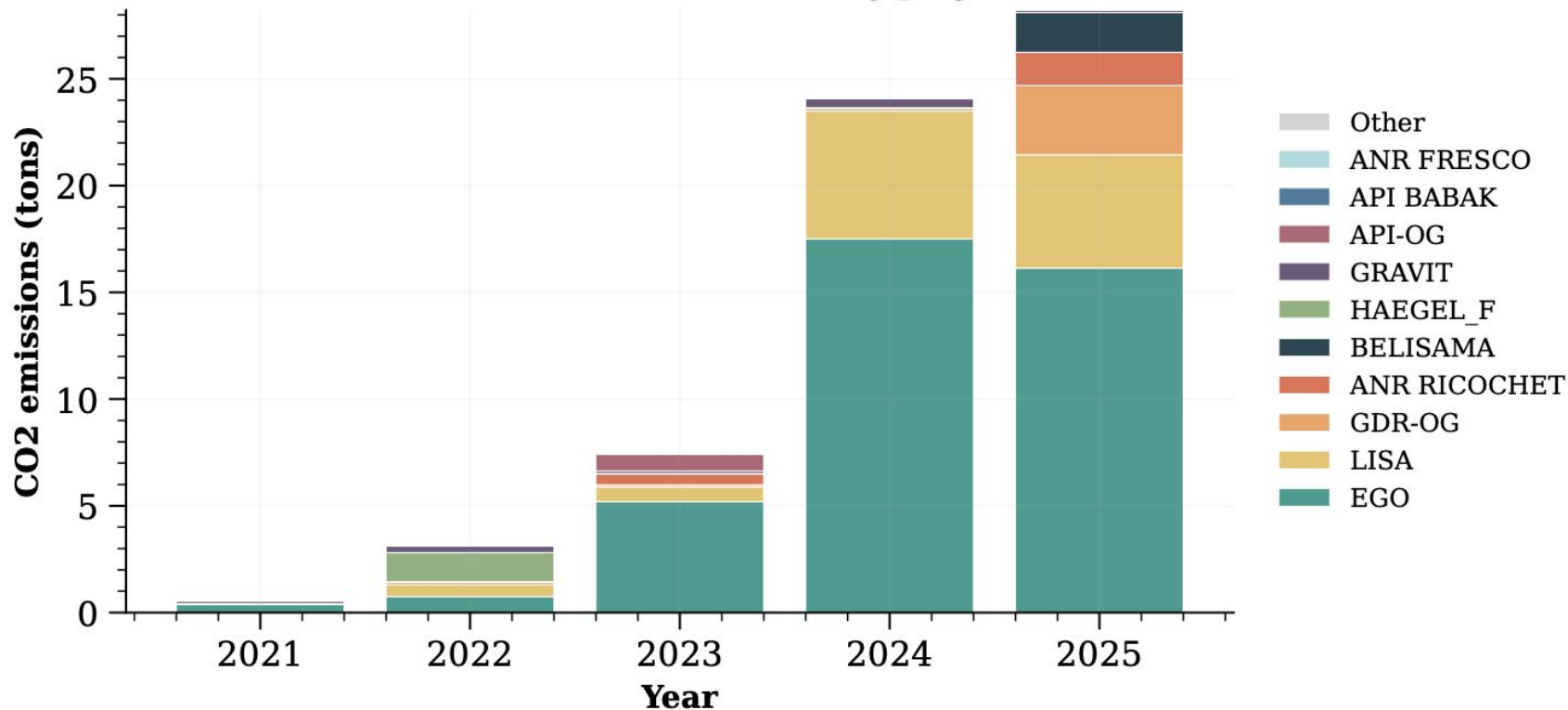


# Evolution by scientific group: Cosmologie



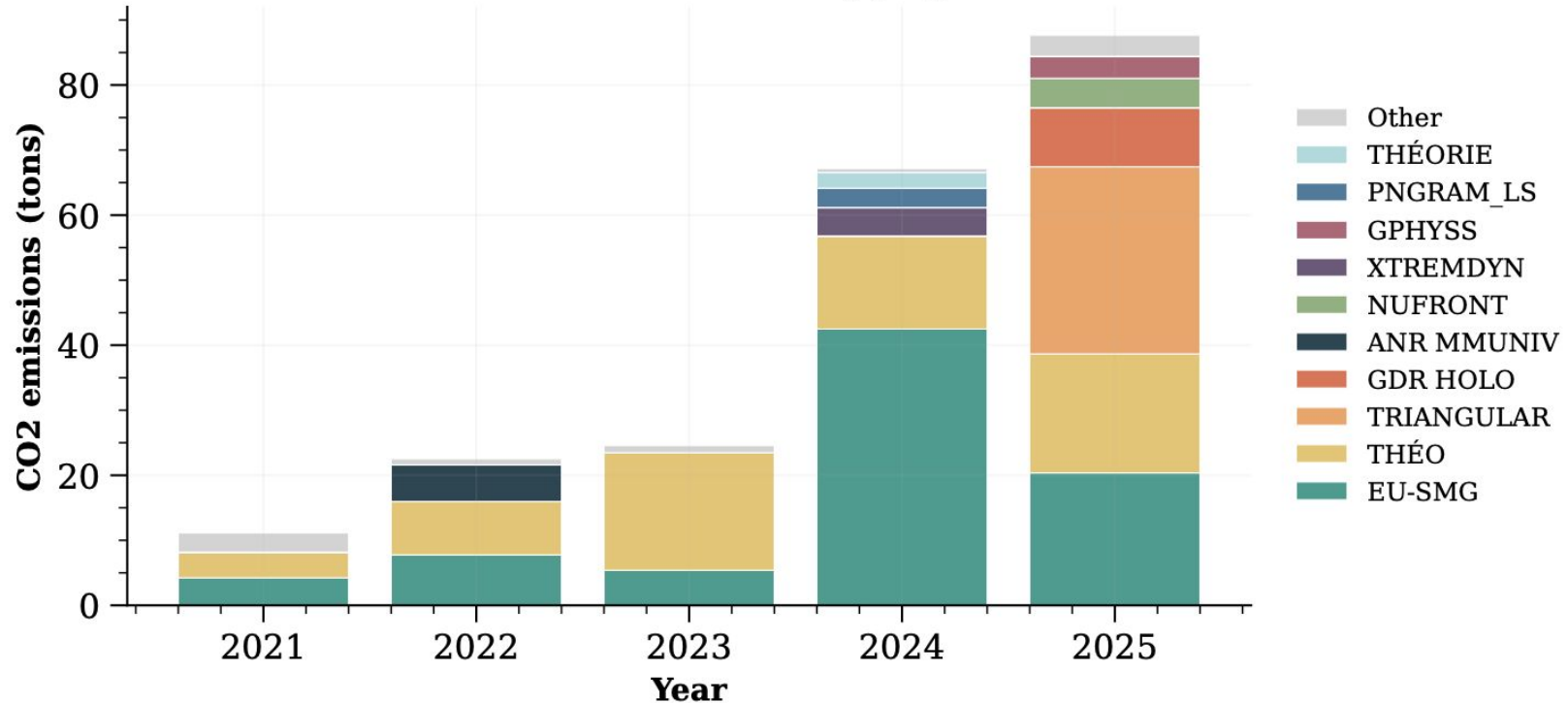
# Evolution by scientific group: Gravitation

**Gravitation — CO2 evolution by project**



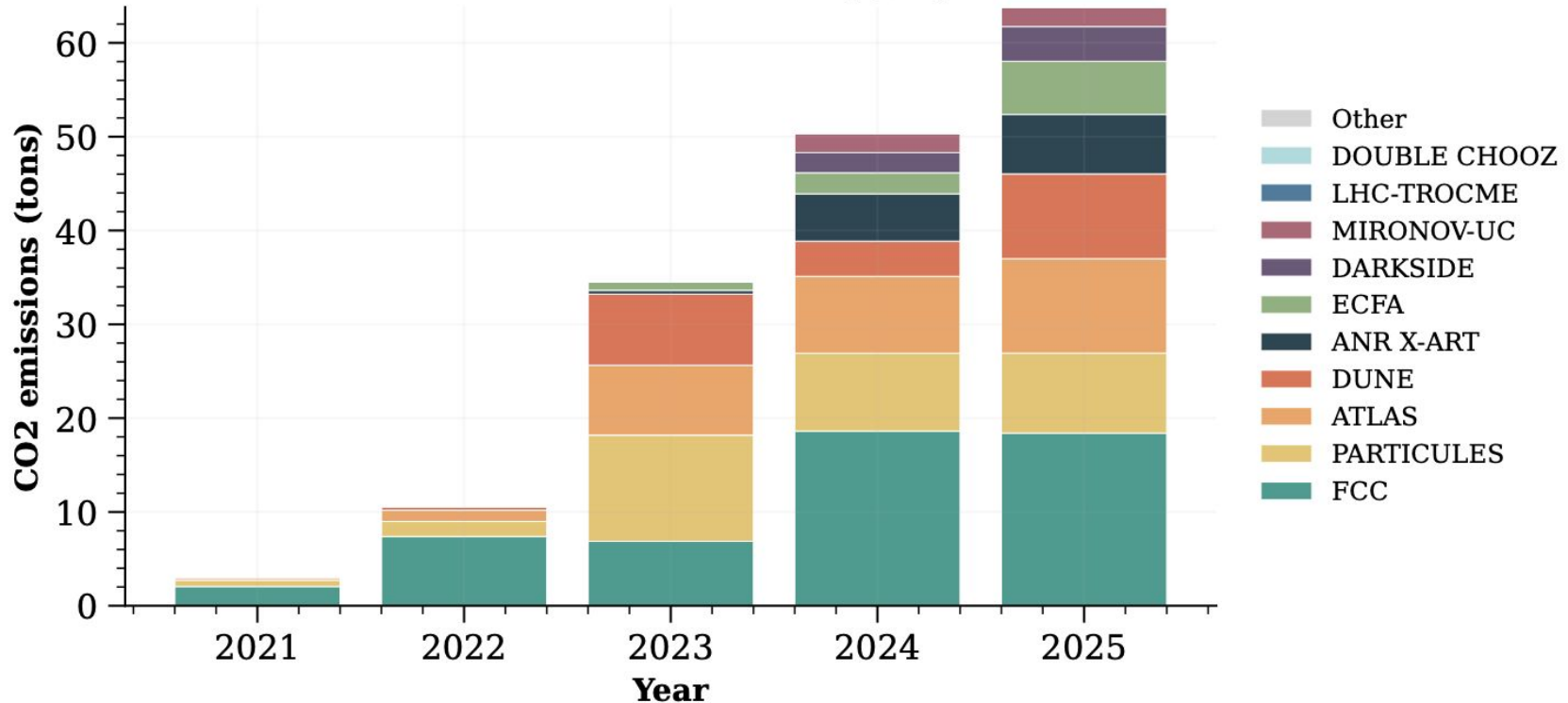
# Evolution by scientific group: Theorie

Theorie — CO2 evolution by project



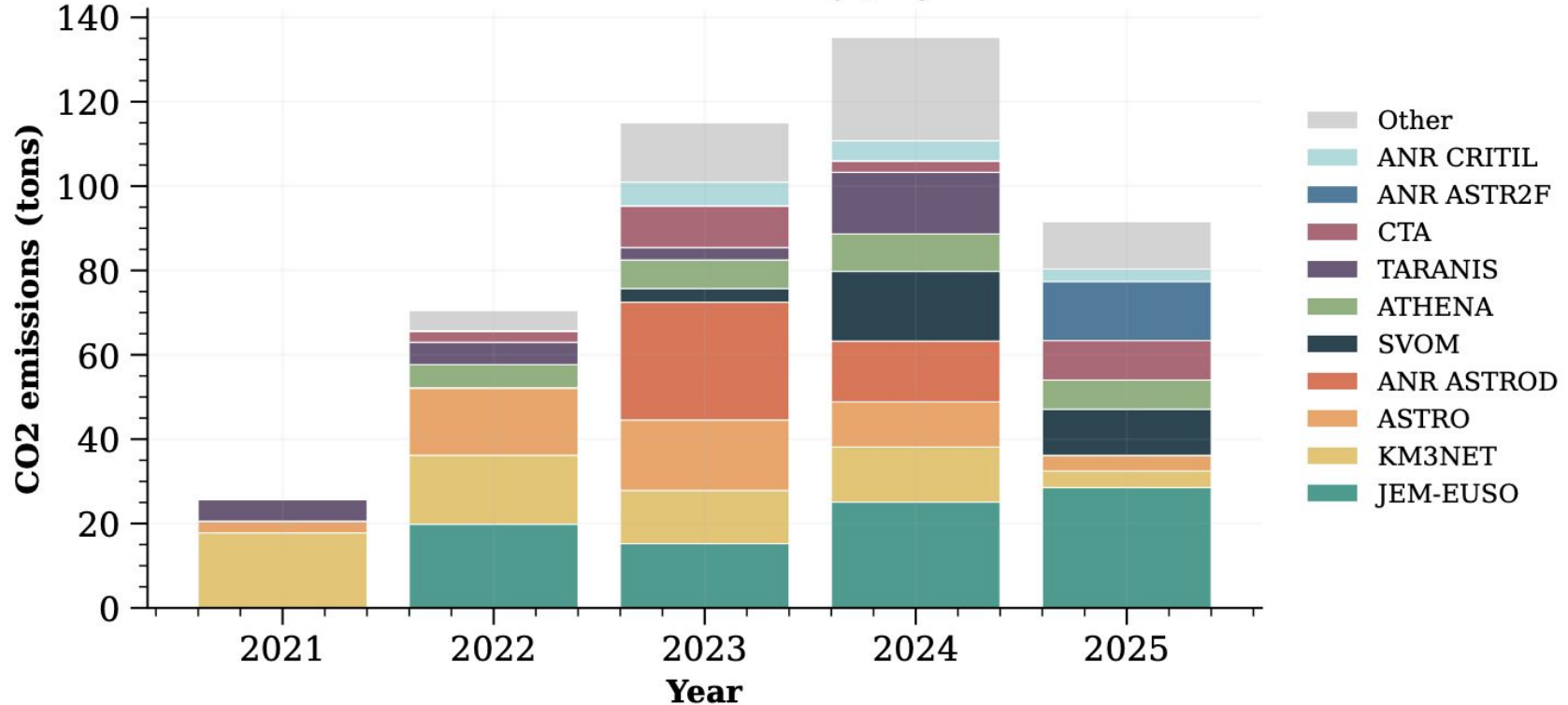
# Evolution by scientific group: Particules

**Particules – CO2 evolution by project**



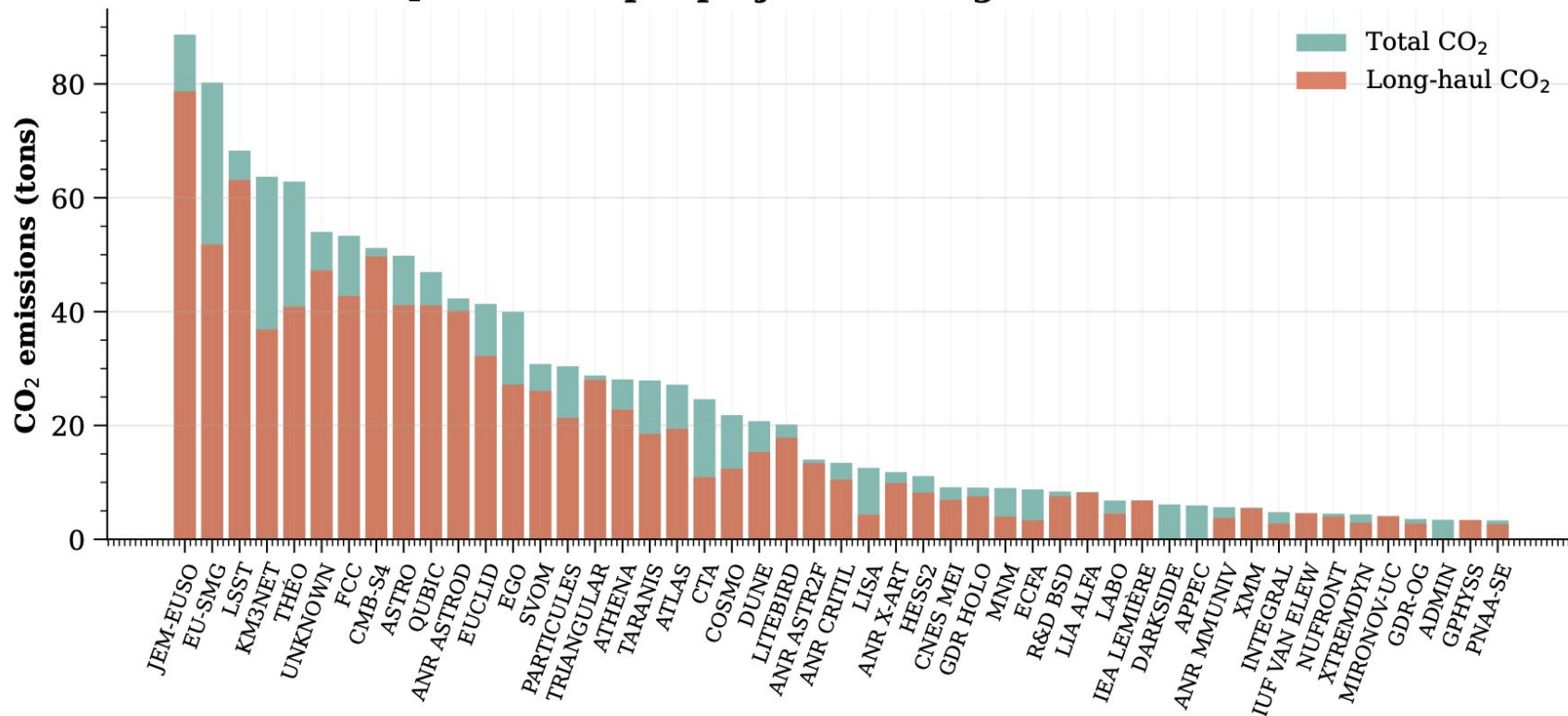
# Evolution by scientific group: AHE

## AHE – CO2 evolution by project



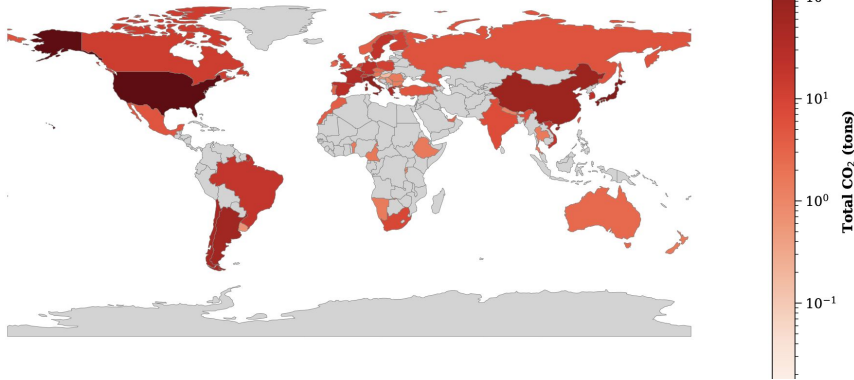
# Impact by project (2021-2025)

## CO<sub>2</sub> emissions per project and long-haul contribution



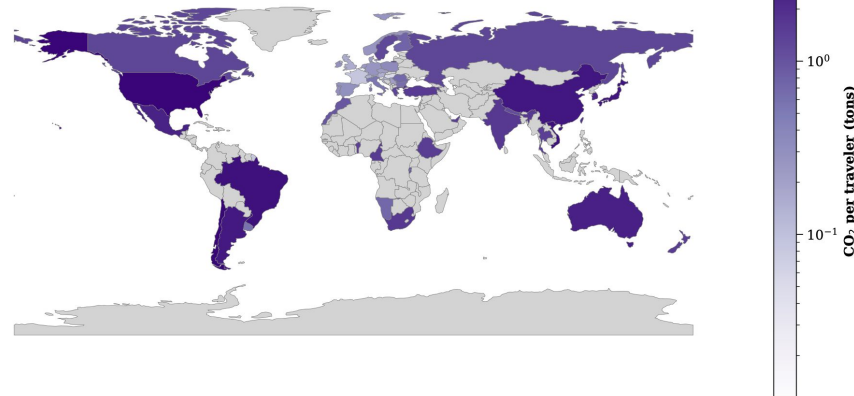
# Geographical distribution of CO<sub>2</sub> emissions (2021-2025)

Total CO<sub>2</sub> emissions by destination country



Country	CO <sub>2</sub> (tons)	Fraction (%)
United States of America	333.2	29.6
Japan	139.9	12.4
Italy	100.6	8.9
China	73.4	6.5
Argentina	62.3	5.5
Chile	50.2	4.5
Greece	41.2	3.7
France	36.1	3.2
Spain	25.3	2.2
South Korea	24.0	2.1

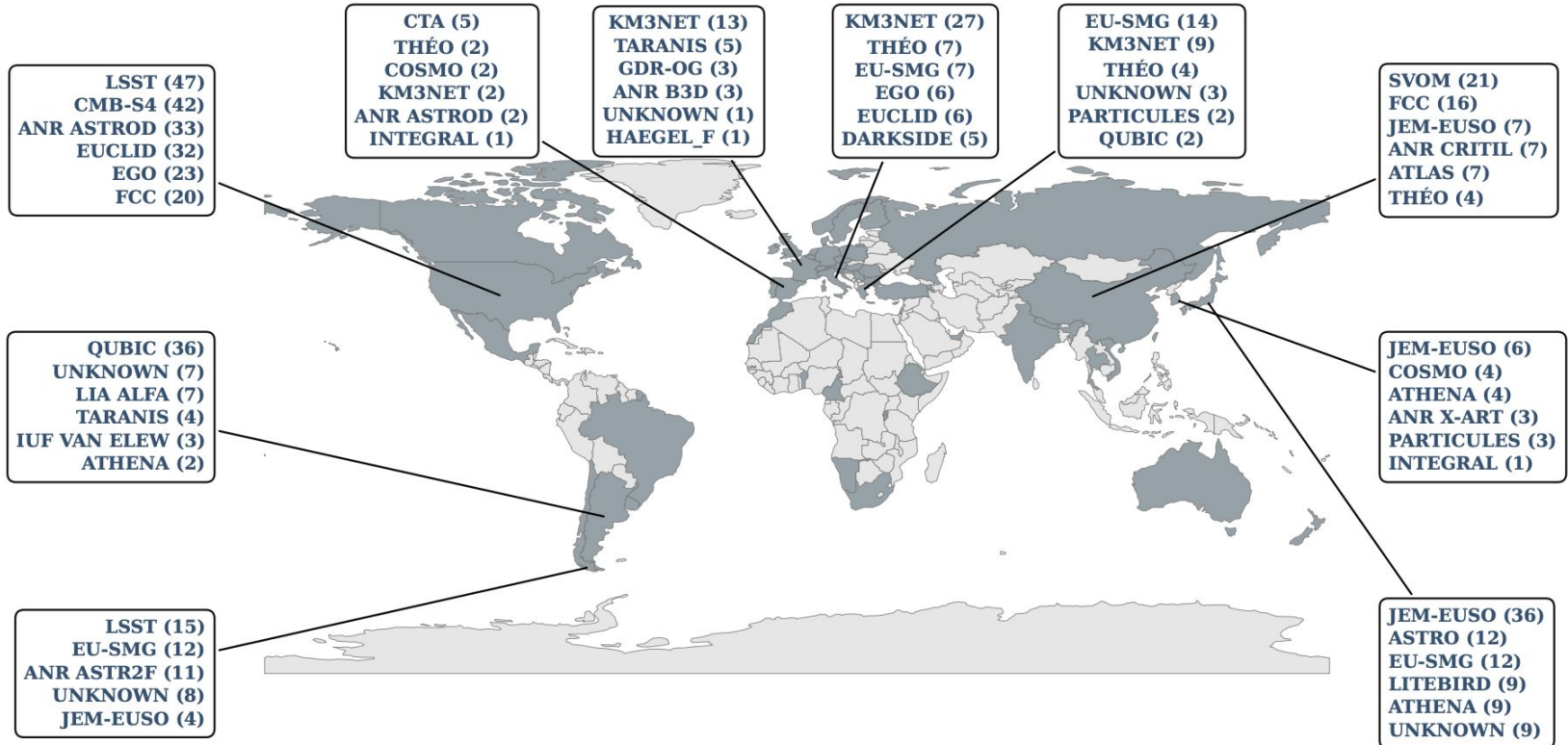
Average CO<sub>2</sub> per traveler by destination country



Country	CO <sub>2</sub> (tons)	Individuals	CO <sub>2</sub> /person
United States of America	333.2	71	4.69
Chile	50.2	11	4.56
Vietnam	18.5	5	3.71
Brazil	18.2	5	3.63
Japan	139.9	43	3.25
China	73.4	23	3.19
Argentina	62.3	20	3.12
Australia	2.6	1	2.58
Mexico	5.1	2	2.54
South Korea	24.0	10	2.40

# Geographical distribution of CO<sub>2</sub> emissions (2021-2025)

## Geographical distribution of CO<sub>2</sub> emissions with dominant projects



# Main observations

## Emission drivers

- Long-haul travel is the dominant source of APC travel emissions.
- CO<sub>2</sub> is strongly correlated with distance, only weakly with mission duration.

## Concentration

- The top 10% of travelers account for ~50% of emissions.
- Emissions are concentrated, but not dominated by a few extreme outliers.

## APC vs non-APC travelers

- ~30% of APC-funded travel emissions originate from non-APC travelers.

## Short-haul flights

- Stand-alone short-haul flights represent only a small fraction of total emissions.
- Most short-haul segments are part of longer itineraries.

## Operational outcomes

- The pipeline for APC travel-emission is validated and can be updated regularly using new Geslab exports.
- APC travel emissions can be monitored on a near real-time basis.
- Historical mission data can be used to evaluate mitigation scenarios proposed by the CdL.
- The framework can quantify both emission reductions and their impact on scientific activity.

## Sustainability of the tool

- Continued operation requires dedicated person-power with some data-analysis and software-development expertise.
- Long-term monitoring could / should be integrated into APC reporting activities.

# Merci pour votre attention

Questions & Discussion

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# Extras: input from Jacques D.

...plutôt que de supprimer les **conférences et workshops en présentiel, qui sont à mon avis indispensables** pour le bon fonctionnement de la recherche, les chercheurs peuvent faire d'**autres efforts** pour réduire leur impact environnemental.

- Ne pas faire de gros calculs inutiles (j'en vois beaucoup);
- Rationnaliser le chauffage et l'air conditionné;
- Venir au labo en vélo ou en transport en communs;
- Ne pas organiser les conférences et workshops dans des endroits loin de tout; l'objectif n'est pas de faire du tourisme (genre, les îles grecques, bateaux croisières, péninsule de Yucatan, Hawaii);
- Privilégier de participer aux conférences pas trop loin.

# Extras: input from Radek S.

Lower APC travel emissions while preserving APC scientific leadership.

Key ideas

- Set the overall targets at the laboratory level allowing for **non-uniform quota** for projects or individuals
- **Differentiate** between project trips and personal trips.

For **personal** trips uniform quota could be an option but need to accommodate special cases: junior visibility, invited talks, theory group, etc

For **project** travel:

- flexible, project-dependent quota dependent on geographical constraints, size, impact, and character of the APC contribution, etc.
- capitalize on projects which do not require many overseas trips to accommodate projects which do.
- require project travel plans for each project, proposed by the project teams, discussed/iterated/uniformized with the Direction / CdL, and enforced by the projects themselves but overseen/reviewed (yearly?!) by the direction/CSP/CdL;

Use/adapt these plans to fit within an APC-wide CO2 envelope.

Revise the scheme yearly and adapt it as needed until it works !