



Workshop on EU-funded R&I for Earth Observation Technologies

21st February 2025, Brussels

Consortium Team

Absolut System/Airbus/BIRA/CNRS/DLR/GG/ICGC/ONERA/UGA



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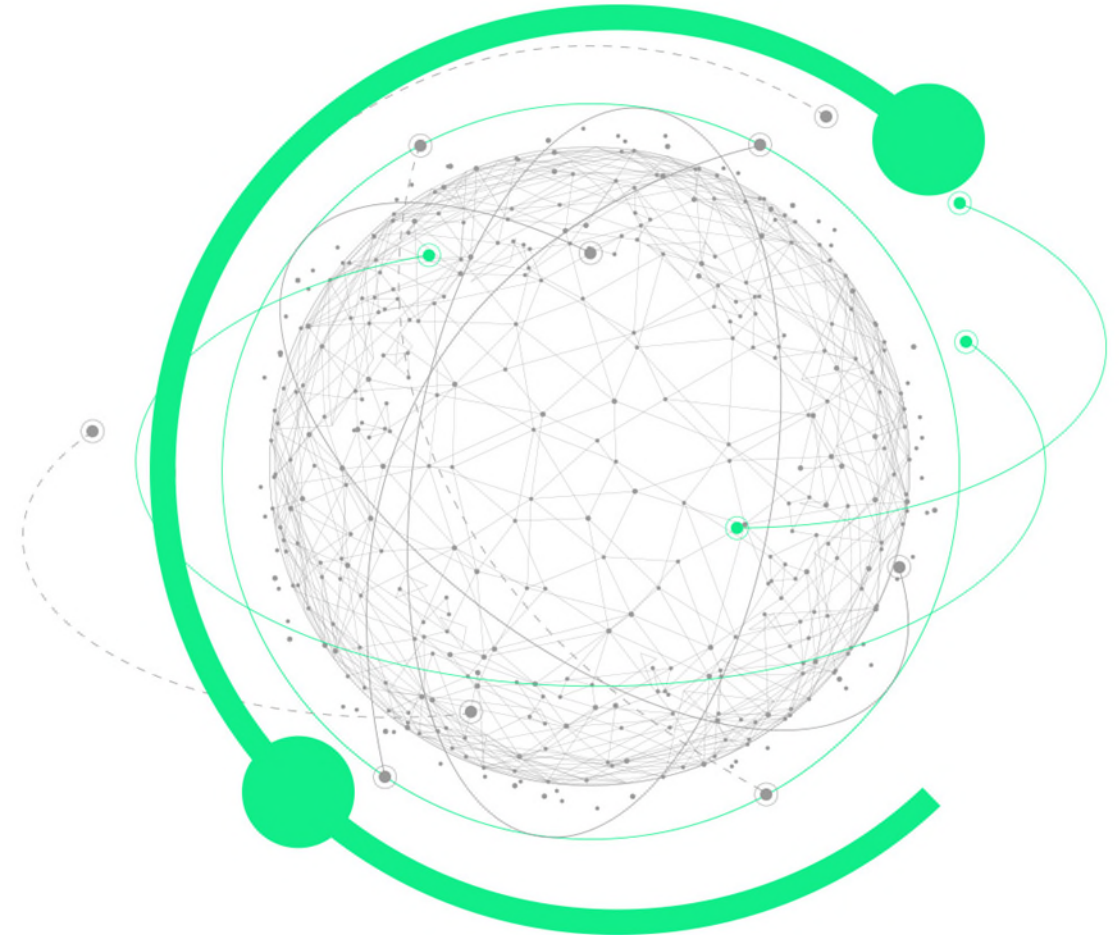
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Project summary and objectives

Laure Brooker



United Nations' insights about Carbon Dioxide:

Climate change is mainly caused by rising anthropogenic greenhouse gases (GHG) concentration in the atmosphere

CO₂ is the **1st largest** GHG contributor to climate change

It accounts to at least **two third** of the global warming today

Yet, no frequent and systematic observations of anthropogenic CO₂ available from Space. Current and emergent constellations are focussing on CH₄ but do not cover CO₂

Project summary & background

Summary:

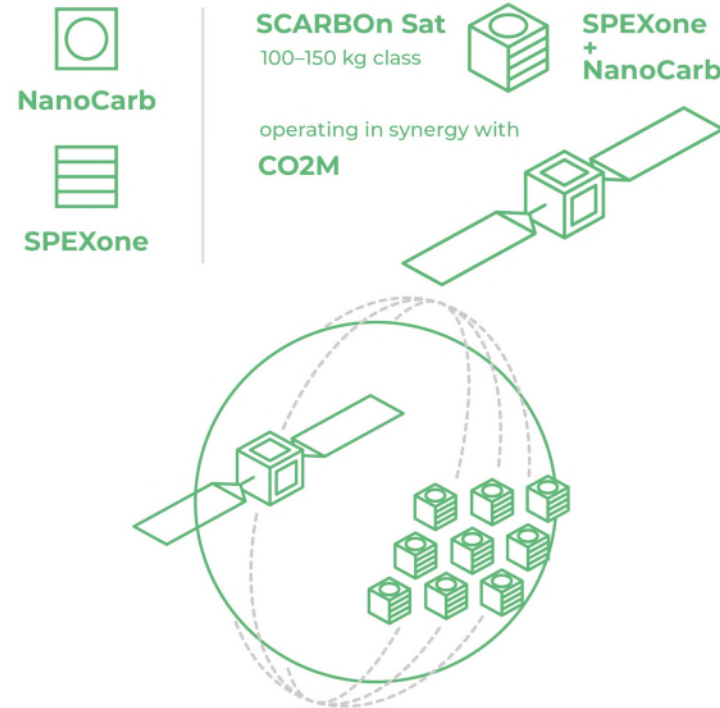
SCARBO next step (2024-2026) - **Space CARBon Observatory's** solution to improve monitoring of GHG emissions and help establishing reliable data for emission trends forecasts

Background:

Successor to the EU **H2020 SCARBO project** (2018-2021), which laid foundations of the innovative technology (constellation of small satellites carrying NanoCarb and SPEXone instruments)

Solution:

Development of small satellite constellation to monitor anthropogenic CO₂ and CH₄ emissions with the objective to deliver twice-daily, high-precision global measurements and to monitor diurnal variations



01 Miniaturised instruments for CO₂, CH₄ and aerosols (swath 200km, GSD : 2 x 2 km)

02 Survey everywhere (global coverage to cover all hotspots systematically)

03 At high frequency to detect changes and overcome cloud issue (12 sats - daily revisit / 24 sats – subdaily)

04 SSO orbits adaptable various orbital planes at different local time (10h, 12h, 14h)

05 Integrated & incremental service to adjust to market demand

06 Complementarity with institutional programs (e.g. CO₂M, MicroCarb, TANGO) and contribution to a European GHG monitoring system.

Key objectives

01

Technical and industrial definition of NanoCarb instrument, raising the instrument TRL to at least 5 by the end of the project.

02

End-to-end Concept validation of GHG point sources monitoring by science data retrieval chain simulation, from raw instrument measurements (Level 0/L0) up to fluxes estimation (Level 4/L4).

03

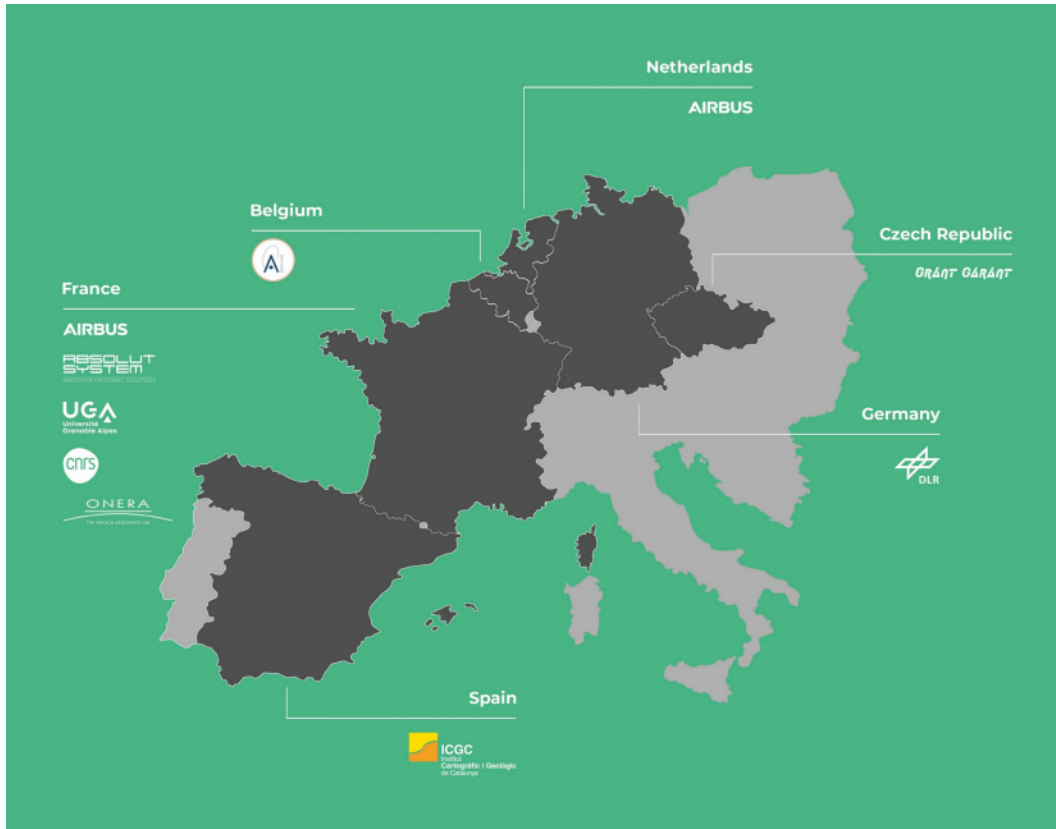
Upgraded NanoCarb Prototype demonstration by Airborne campaign.

04

Enhancement of the constellation concept by adding autonomy and configurability to the mission, addressing short-term industrial implementation, as well as end-to-end system performances optimization.

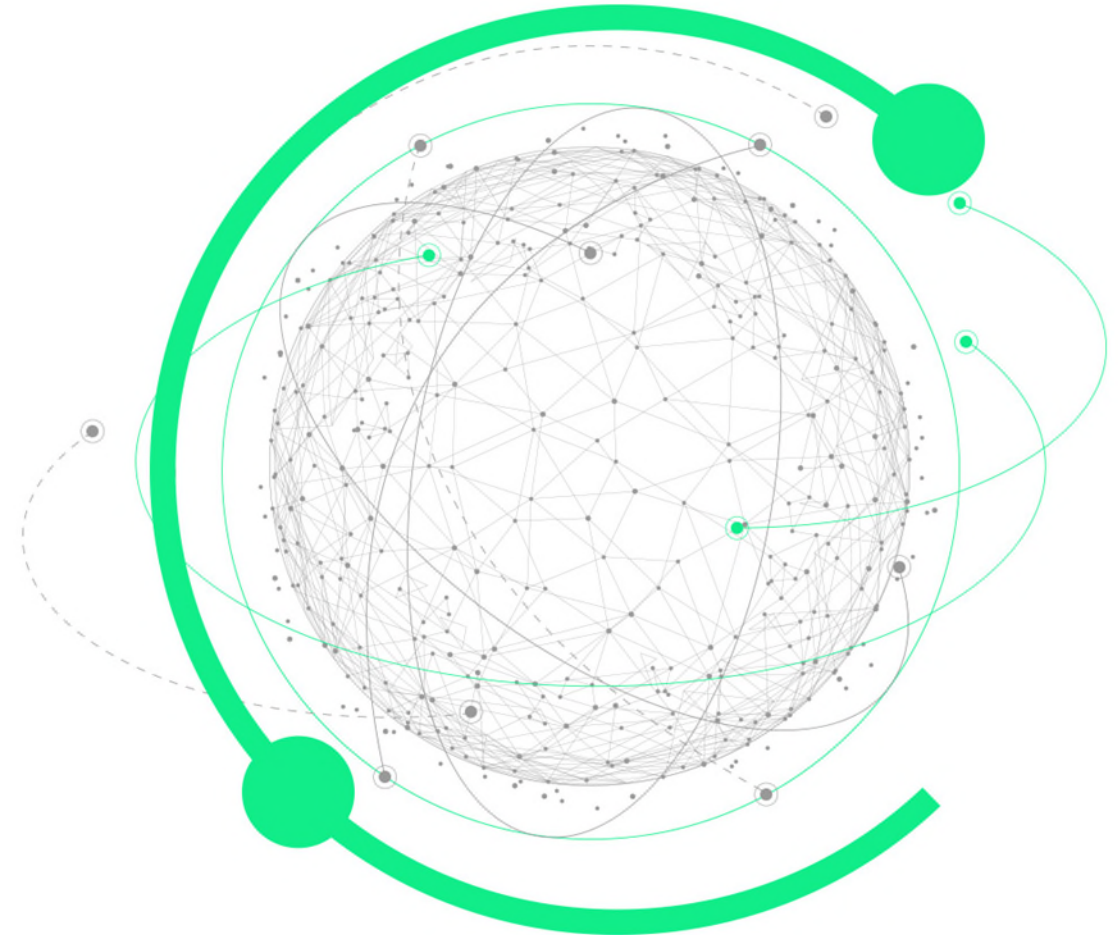
Consortium composition

10 organisations from 6 EU Member States, including scientific institutes and SMEs, led by Airbus Defence and Space, Toulouse (France).



Key Exploitable Results

Laurence Croize



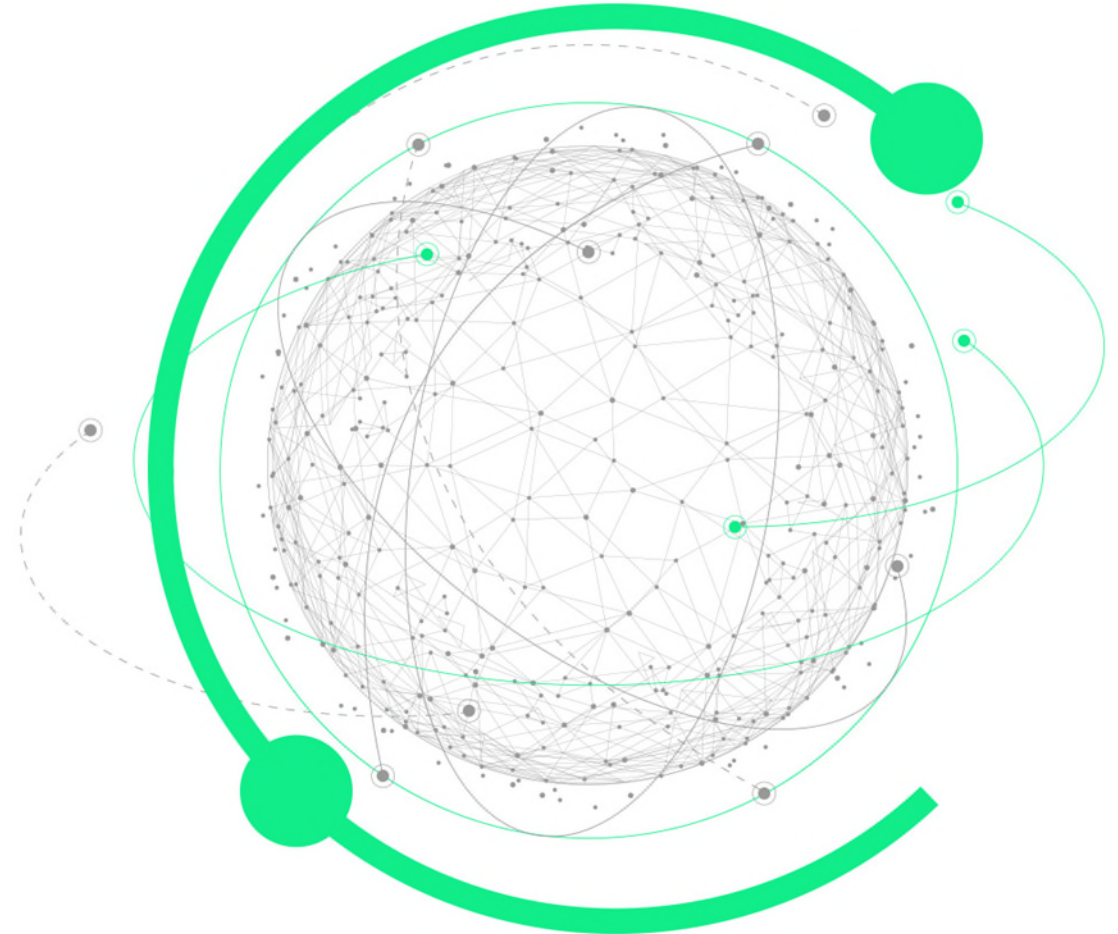
Key Exploitable Results

Key Exploitable Result*	Start TRL	End TRL	Target date (Q/Y)	Lead partner(s)	Validation / testing approach
NanoCarb sensor disruptive technology components (detector, interferometric core, etc.) for commercialization & future research use with many applications	TRL3 to TRL4	TRL5	2026	ONERA, UGA, Airbus-F, Absolut System, Airbus-F	Analyses and characterization tests
Use of Partial Interferogram concept (NanoCarb) designed as an enabling technology for subsequent GHG missions, commercialization & future research use	TRL2 (2018)	TRL5	2026	ONERA, UGA, Airbus-F	Patent by UGA/ONERA. Design validated by analyses , Performances validated by modelling, analyses and flight tests
Data processing chain and emission estimation method and uncertainty	TRL2 (2018)	TRL5	2026	CNRS-LMD, DLR UGA	Modelling and Airborne campaign in 2025
Production & Tooling Guidelines for cost-effective and efficient series production of instruments for satellite constellations	N/A	N/A	2026	Airbus-F	Analyses, know-how/methodology to enable the deployment of satellite constellation systems with relevant constellation partners.

*KER: identified result which has high potential to be exploited, e.g. to be used in a product, process or service, or act as an important input to further research, policy or education.

Use cases and exploitation

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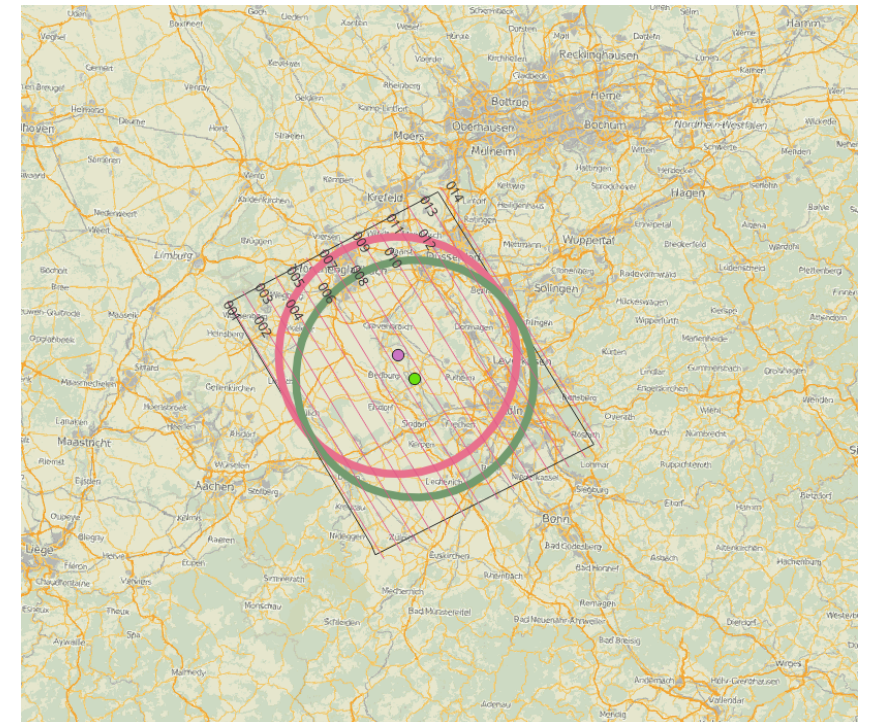
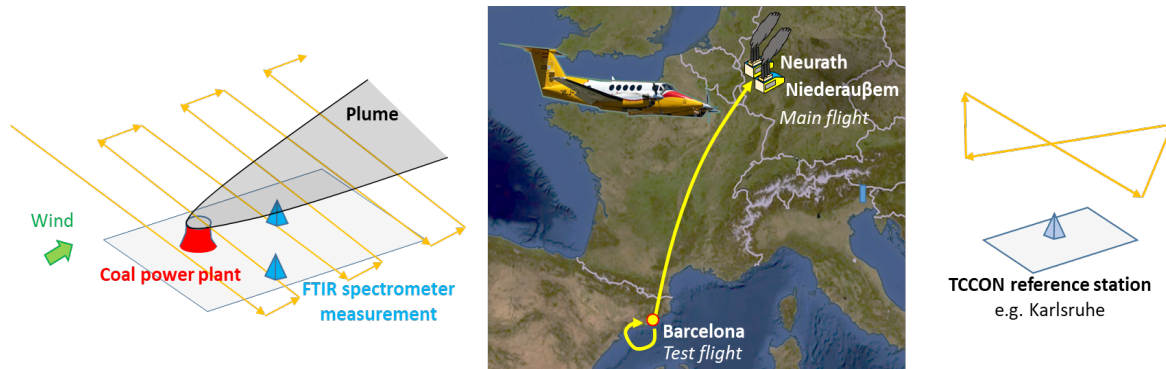


Pilot demonstrations planned in the project

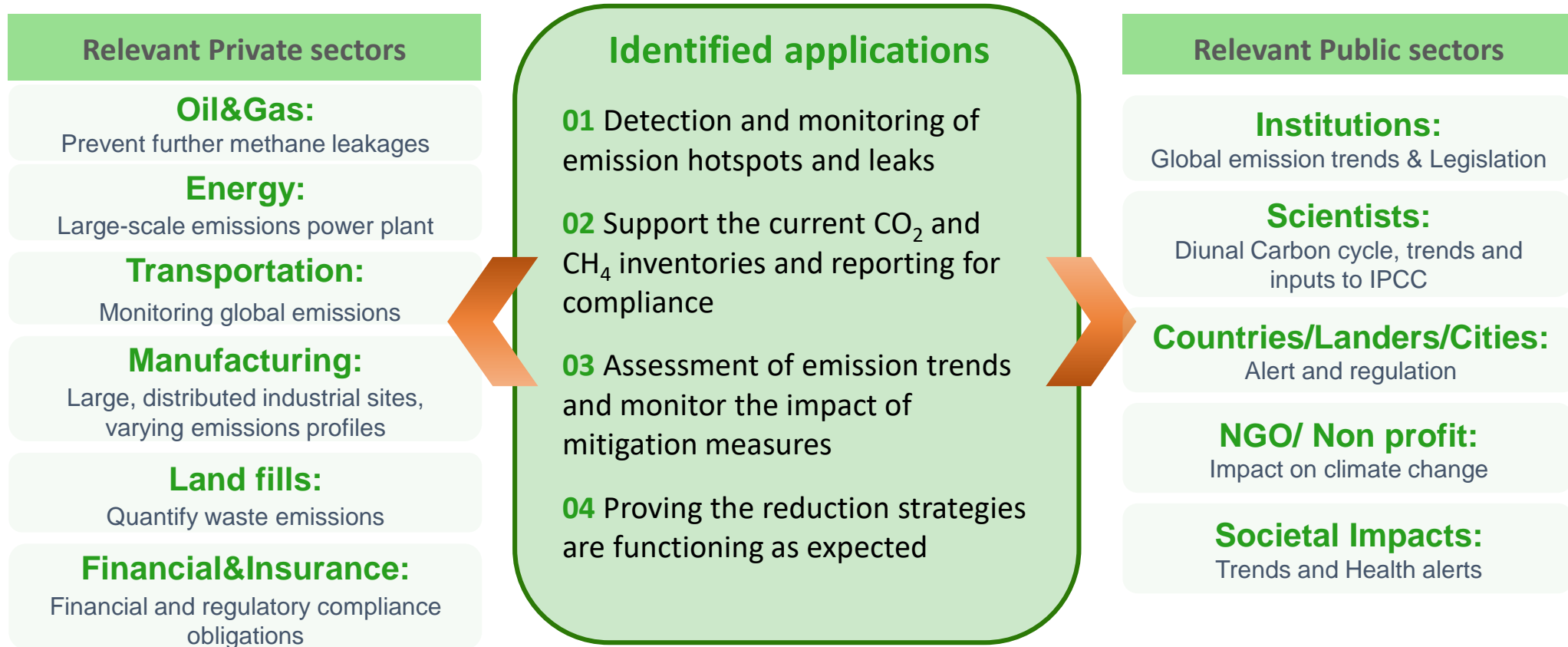
A Flight campaign is planned during Summer 2025 over a powerful coal powerplant (Niederaußem and Neurath)

Objectives :

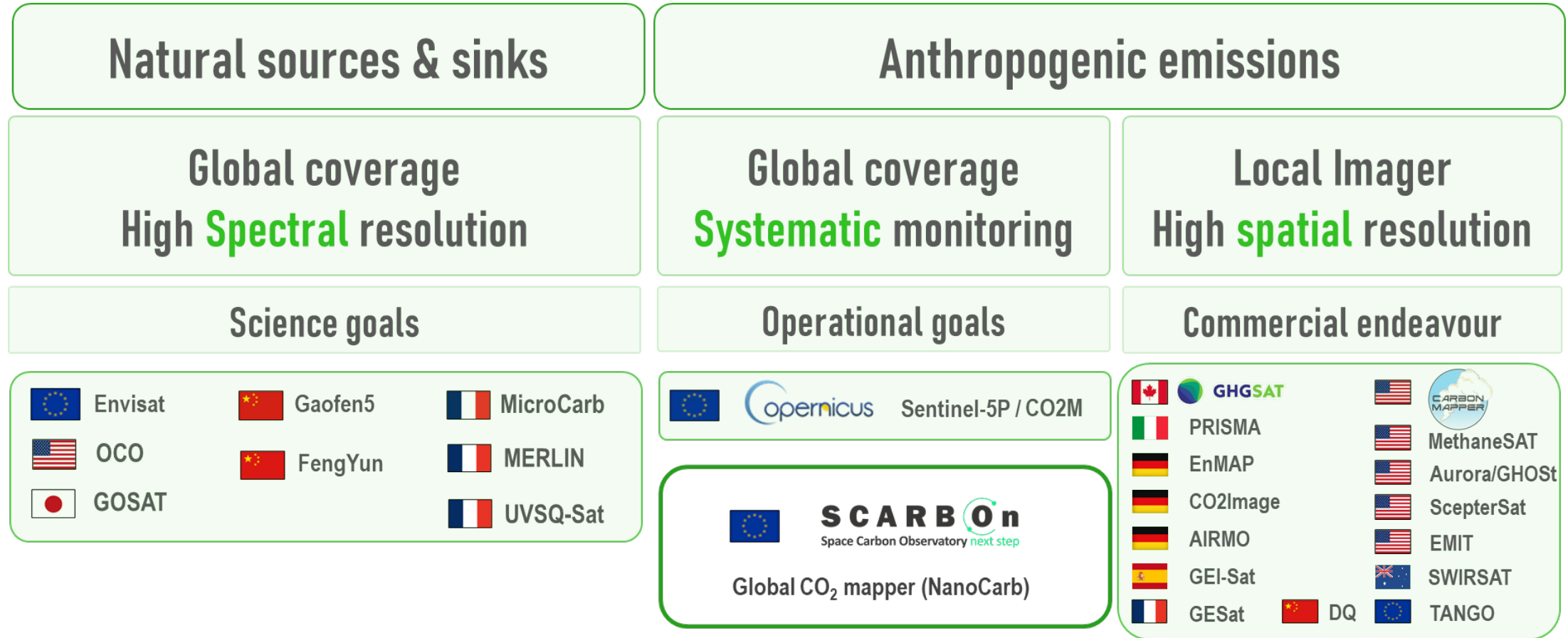
1. To quantify emissions from a greenhouse gas source based on data retrieved during the flight campaign.
2. To assess the performance of the SCARBO measurement concept, including uncertainties of L2 data (greenhouse gas mixing ratios) and L4 data (emissions)



Identified market needs and stakeholder feedback

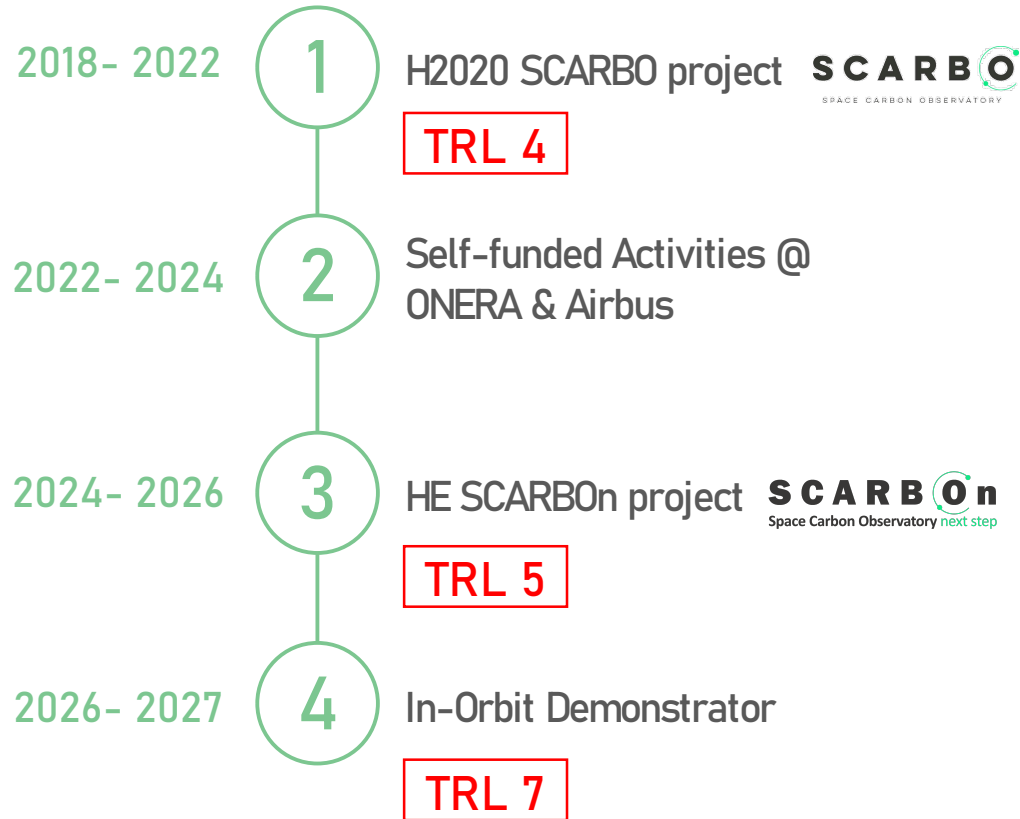


GHG missions Landscape



Market Survey : interest remains in measurement frequency and wide systematic coverage

Roadmap : Path towards increasing the TRL



Objective: Launch a demonstrator at the end of SCARBO_n

- ❖ Targeting IOD/IOV Horizon Europe Program for demonstrator
- ❖ Challenge / gaps:
 - No other IOD/IOV opportunity after 2026 ?
 - No financial frame for Nanocarb instrument TRL5 → TRL6 raising after SCARBO_n

Challenges for commercial use and exploitation

01

Time to market

GHG emissions monitoring market is a dynamic ecosystem that is moving quickly with emerging new comers

02

Cost of the constellation

To achieve financial sustainability, the constellation should be designed with cost-effective components (e.g. detection chain)

03

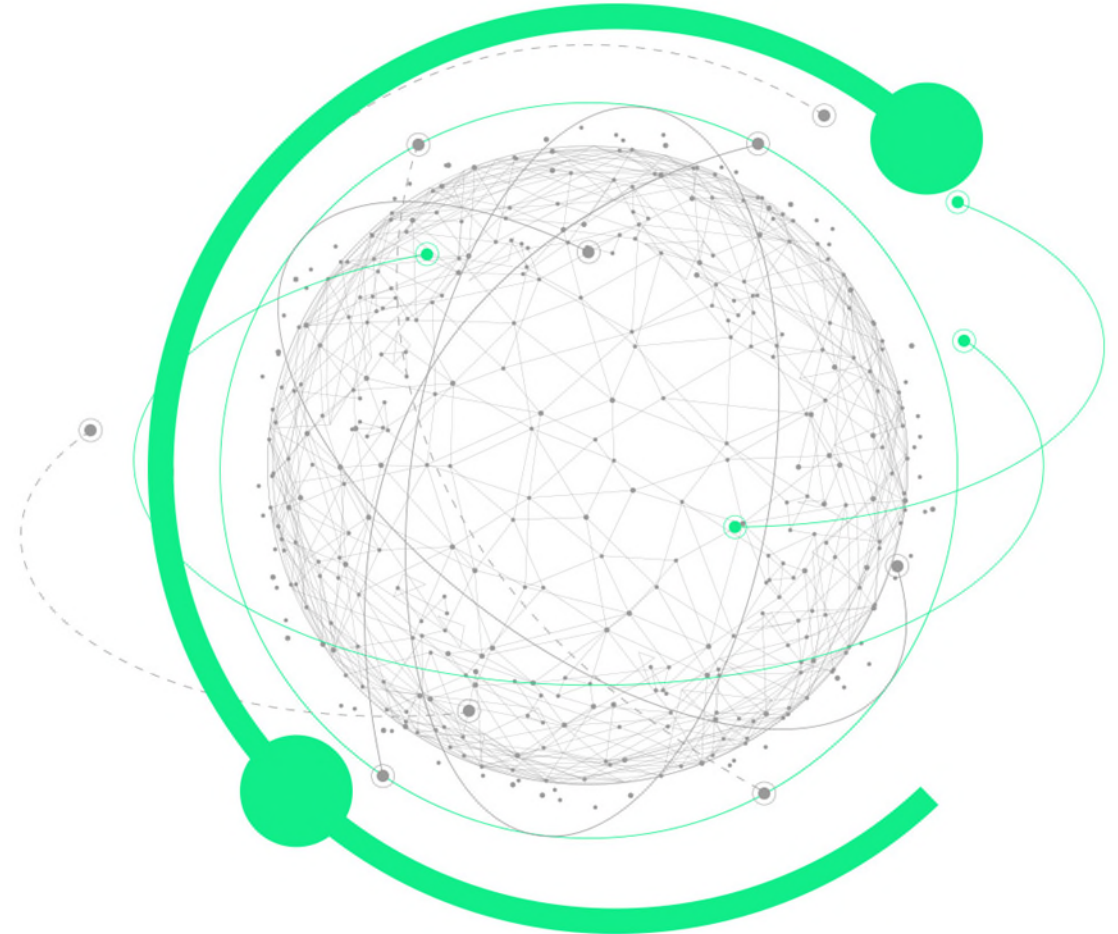
CO₂ commercial market not proven yet until legislation is in place - Private customers currently focus on **methane leak detection business**

04

Institution and public sector focus on the delivery of the upcoming institutional space missions : CO2M, MicroCarb, TANGO

Copernicus & other funded projects

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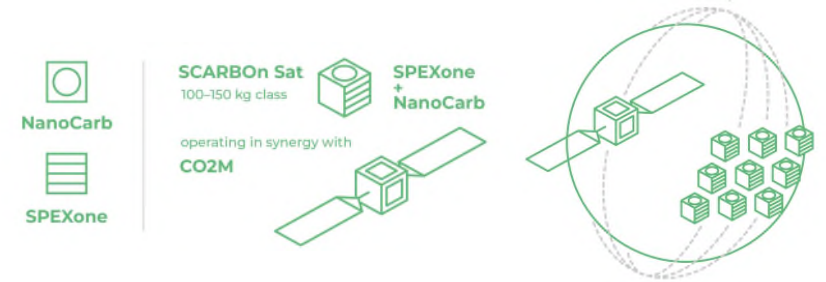


Synergies with Copernicus and other funded projects

01

Complementary to the future Copernicus Sentinel Mission (CO2M)

SCARBOn constellation of small satellites can revisit sites multiple times a day and provide local time diversity to CO2M products.



02

Synergy with ongoing HE STEP project

T2SL European Collaboration for a non-dependent supply chain for large eSWIR FPAS (<https://www.step-project.eu/>) aiming at securing Europe's autonomy in developing high-performance, large-area Type-II Superlattice eSWIR Focal Plane Arrays for Space exploration Earth observation.



03

Synergy with ECMWF projects

SCARBO in synergy with ECMWF-coordinated VERIFY and CHE projects – SCARBOn objective to liaise with ECMWF and Copernicus CO2 service (CoCO2) outcomes



SCARBOn

SPACE CARBON OBSERVATORY *next step*

„Space CARBOn Observatory next step“ (SCARBOn) is an innovation project funded by the HADEA under the [Horizon Europe programme](#)

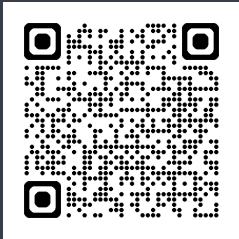
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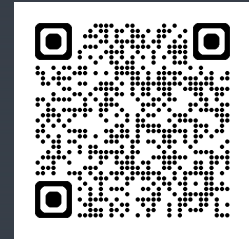
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