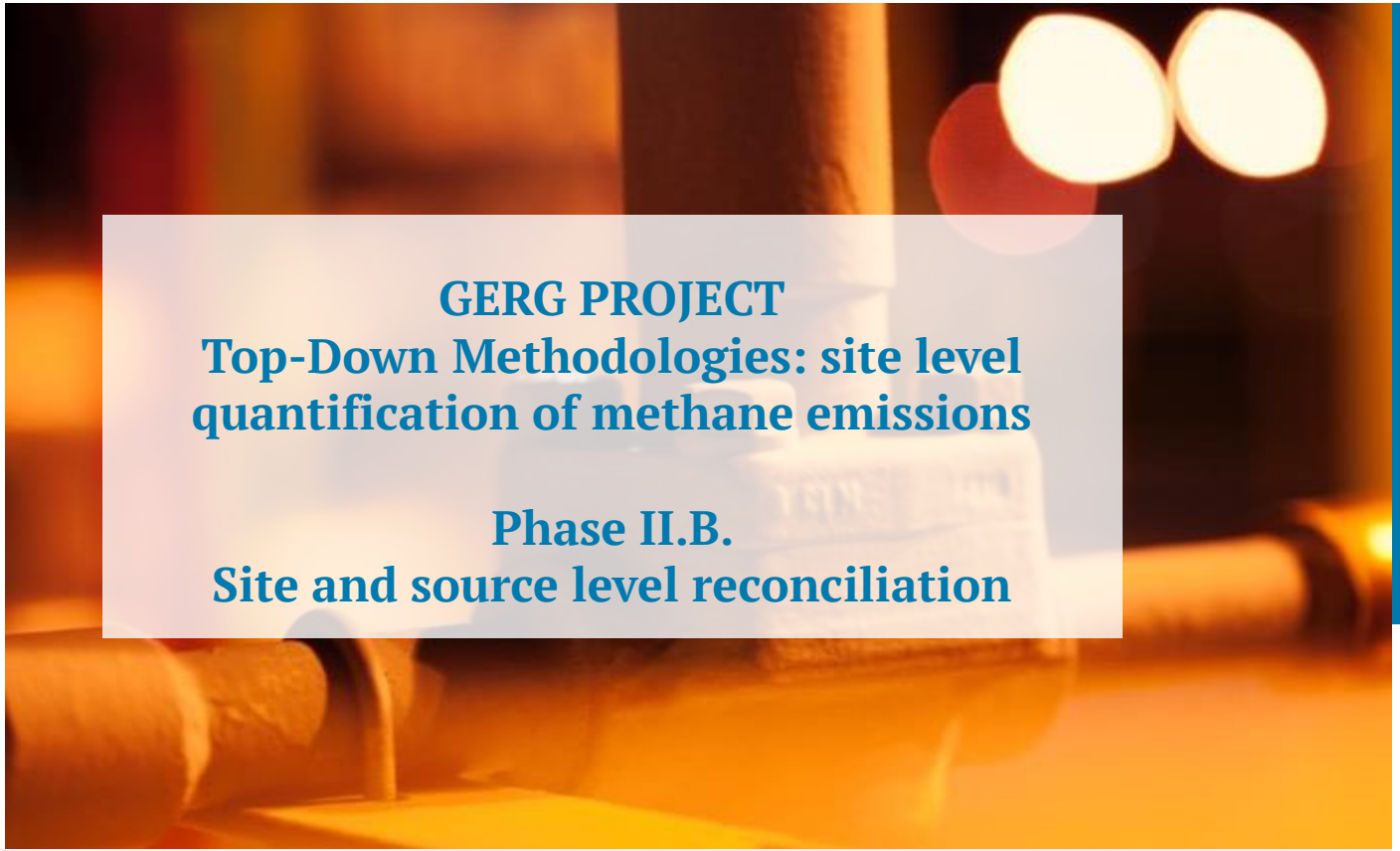


GERG PROJECT
Top-Down Methodologies: site level quantification of methane emissions

Phase II.B.
Site and source level reconciliation

Sept 22

GERG
THE EUROPEAN GAS RESEARCH GROUP

Context

GERG Project(s) on Site Level Technologies for Gas Infrastructure

This project is part of a series of projects launched by GERG recently focusing on site level technologies for Mid-Stream (High Pressure) Gas Infrastructure

Phase I
State of the art study of site level technologies
Lead by RICE (GRTgaz)
2021

Phase II.A.
Technology Benchmark of site level technologies
Lead by Enagas
2021

Phase II.B.
Source and site level reconciliation. Test in a (simple) site in operation
Lead by Enagas
2022

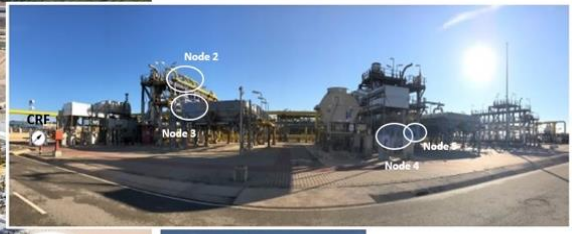
Phase II.C.
Source and site level reconciliatoin. Test at several sites across EU
Lead by Enagas
2022-23

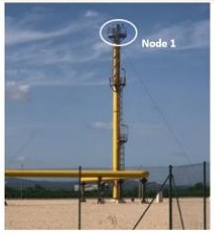


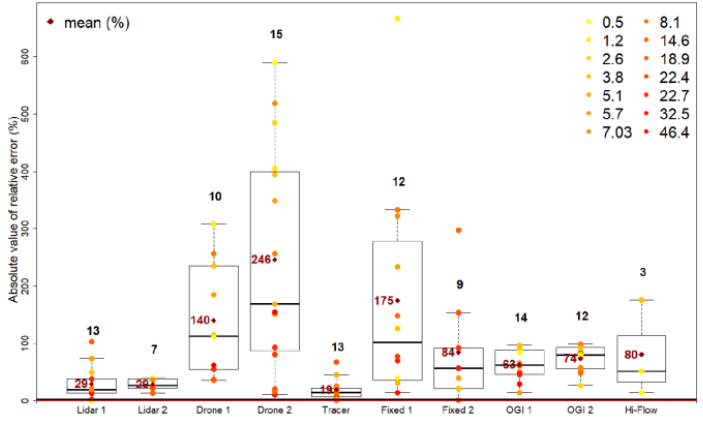


Phase II.A. Technology benchmark

A first-of-its-kind research project covering midstream assets was launched
Blind controlled release tests to analyse the performance / measurement uncertainty of most promising site level technologies (quantification for the 0,01 – 50 kg/hr range)







Absolute value of the relative errors (ARE, %) on the quantification estimated for each test

- Inerted and isolated Compressor Station
- 9 most promising site-level technologies
  3 bottom-up
- 1 week of blind tests with controlled releases of methane
- 17 different emissions rates
- Different heights and gas diffusion at the outlet
- Independent analysis to assess accuracy and repeatability

Phase II.B. Site and source level reconciliation

Measurements in **a Compressor Station in Belgium (Fluxys)**

→ Systematic bottom-up quantification by recognized provider.

→ Selection of site level technologies adapted to the site.

! Selection based on results of previous phases.

Measurements to be performed as simultaneously as possible

Tests took place in Spring 2022

EXPECTED OUTPUT

Assessment report by independent academia scientists

- Advantages/disadvantages of each approach
- Identification of gaps of approaches (spatial, temporal aspects)
- Recommendation of how technologies & methodologies can be combined to further reduce uncertainty of final estimation.

Final aim is be to elaborate a set of guidelines to be applied when top-down methodologies are used, establishing a harmonised approach within EU (midstream sector)
for the application of top-down in combination with bottom-up estimations

-- Analysis of Measurements Results Underway --

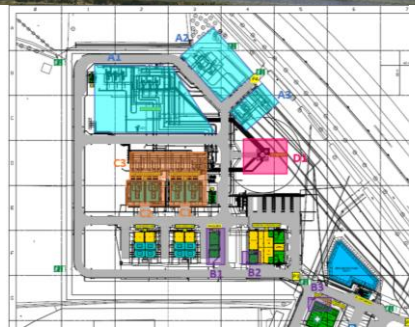
ADVISORY BOARD to validate the scope and test program and to contribute to the data analysis of the results
Internationally recognized experts from Authorities and Institutions, Academia, Industry and Civil Society

Phase II.B. Site and source level reconciliation for localised sources on a site

Compressor Station in Belgium

Small plant --> Ideal for testing different technologies, first pilot on reconciliation.

- 4 electric driven compressors and 23 meters high vent stack
- Compressors depressurized (mode 1) + 1 compressor pressurized (mode 2).
- Exhaustive bottom up quantification



Areas A
A1, A2, A3: pipelines /connections

Areas B
B1, B2, B3: boilers (methane from incomplete combustion)

Areas C
C1, C2, C3: Compressor buildings + valve nodes infrom of compressors

Area D
D1: Vent Stack

Sources of emissions:

Vents/open ended lines. Detection with OGI and FID analyzer. Quantification with anemometer or bagging.

- Vent stack: 25 vents, isolation/vent valves emissions.
- Seal vents of compressors' dry gas seals.
- Gas Chromatograph

Fugitive emissions.

- Full inventory + FID for detection. Correlation factors EN 15446 and bagging for quantification. QOGI for inaccessible leaks.

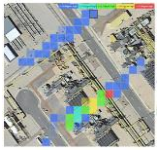
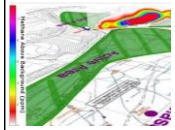
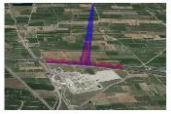
Incomplete combustion:

- 3 burners for heating of building purposes. Minor emissions, only present during start and stops.

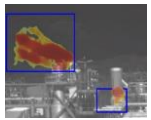
Phase II.B. Site and source level reconciliation

Technologies involved for the reconciliation

Top-down/site-level technologies

	AEROMON	CHARM	DIAL (NPL)	ABB Mobile Guard	ABB HoverGuard	Tracer Gas Methodology (DGC)
Picture of the equipment						
Picture of their measurements				no results in previous phase	no results in previous phase	
Sensor used	Tunable Diode Laser Spectrometry (TDLS). NDIR and MOS sensors were also implemented, but NDIR failed to detect methane in majority of tests and MOS failed to detect methane in a few tests.	LiDAR DIAL (by Adlares). Measurements (IR-DIAL) provide directly the georeferenced total column density of methane (in ppm*m). Background concentration is subtracted.	Differential Absorption Lidar (DIAL). Laser is operated at two wavelengths (one is absorbed by methane and the other not). The difference in the absorption is used to calculate methane concentration.	Off-Axis Integrated Cavity Output Spectroscopy (OA–ICOS)	Off-Axis Integrated Cavity Output Spectroscopy (OA–ICOS)	Concentration of methane and acetylene measured with a ultra portable gas analyzer: off-axis integrated cavity output spectroscopy (OA-ICOS) by Los Gatos Research + Garmin GPS recevier.
Platform used	Drone: UAV Matrice 300 RTK from DJI	Helicopter (AirLloyd)	Truck	Car	Drone: DJI 600 Pro	Van

Continous monitoring

Sensia	Sensirion
	
	didn't participate in previous phase
Two OGI cameras were used; Carolyne fyl (an uncooled LWIR detector) and Mileva 33-F (cooled MWIR detector).	MOx sensors
Unmanned cameras	Unmanned fixed sensors across the site (downwind potential sources)

Bottom up / source leve technologies

OPGAL OGI	High Flow Sniffer
	

Phase II.B. Site and source level reconciliation

Photos Fluxys Belgium - David Samyn

Phase II.B. Site and source level reconciliation

PRELIMINARY CONCLUSIONS

- **Top down measurements** complementary to bottom up quantification are important to include **all emission sources.**
  - Not all technologies are sufficiently accurate to allow a quantitative comparison.
  - In any case, **qualitative analysis** of sources found by top down measurements is the key point.
  - Some OGI cameras have potential to qualify for reconciliation.

- Our preferred approach to validate annual emissions: **OGMP 2.0 Level 4 (bottom up) annual quantification taking into account operational parameters + qualitative reconciliation of a snap shot at a certain time.**
  - Could there be rare **intermittent sources**? Operational parameters provide insight. **Snapshot reconciliation** is essential, for known values of **operational parameters**. Next phase will include other continuous monitoring technologies to understand their added value.
  - Efforts on improving bottom up estimations might be more effective than frequent top down measurements, once you have a clear understanding of all potential emission sources in the site.

Final aim is be to elaborate a set of guidelines to be applied when top-down methodologies are used, establishing a harmonised approach within EU (midstream sector) for the application of top-down in combination with bottom-up estimations

To be continued.. Next phase with further measurements across EU to be launched shortly

Phase II.B. Site and source level reconciliation

Funding Partners

Thank you

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