# Site level quantification of methane emissions

PHASE II.A: TECHNOLOGY BENCHMARK FOR SITE LEVEL METHANE EMISSIONS QUANTIFICATION PROJECT

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# Phase II.A: GERG 'Technology Benchmark for site level methane emissions quantification

GERG
THE EUROPEAN GAS RESEARCH GROUP

**Conclusions of the study of the state of the art**

## A first-of-its-kind research project covering midstream assets!

Blind above-ground controlled releases to analyse the accuracy of the most promising site level technologies (quantification)

| WP1 | WP2 | WP3 | WP4 |
|---|---|---|---|
| Detailed definition and preparation of tests | Perform the tests | Analysis of results ($CH_4$ quantification) | Definition of next steps for Phase II.B. (test in sites) |

**ADVISORY BOARD** to validate the scope and test program and to check the results
Internationally recognized experts from Authorities and Institutions, Academia, Industry and Civil Society

# Partners of the project















# Phase II.A: GERG 'Technology Benchmark for site level methane emissions quantification

WP1
Detailed definition and preparation of tests

**Location -** hybernated (inerted) Compressor Station in Spain

- ✓ Inerted
- ✓ Isolated (no other methane sources nearby)
- ✓ Flat field, can be easily surrounded by car
- ✓ No strong winds normally
- ✓ Premises available

# Phase II.A: GERG ‘Technology Benchmark for site level methane emissions quantification’

WP1
Detailed definition and preparation of tests

- 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

# Tests organization / coordination

| | |
|---|---|
| ■ Tests organization managed by a collaborative team: | enagas + BUREAU VERITAS |
| ■ Releases plan determined by a collaborative team: | enagas + LSCE |
| ■ Field coordination managed by Bureau Veritas: | BUREAU VERITAS |
| ■ Independent analysis of data and results | LSCE |

# Controlled emissions

- Flow rates of methane varying from 0.01 kg/h to 50 kg/h (randomized releases)
- Heights were defined to represent fugitives and vents average heights in midstream sites

WP2
Perform the tests

| CRF | location | height | type of exit |
|---|---|---|---|
| node 1 | vent stack | 28 | open end |
| node 2 | structure1 | 9 | open end |
| node 3 | structure1 | 4 | ring shaped |
| node 4 | structure 2 | 1,5 | linear |
| node 5 | structure 2 | 1,5 | open end |


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Node 1

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Node 2

# Controlled emissions

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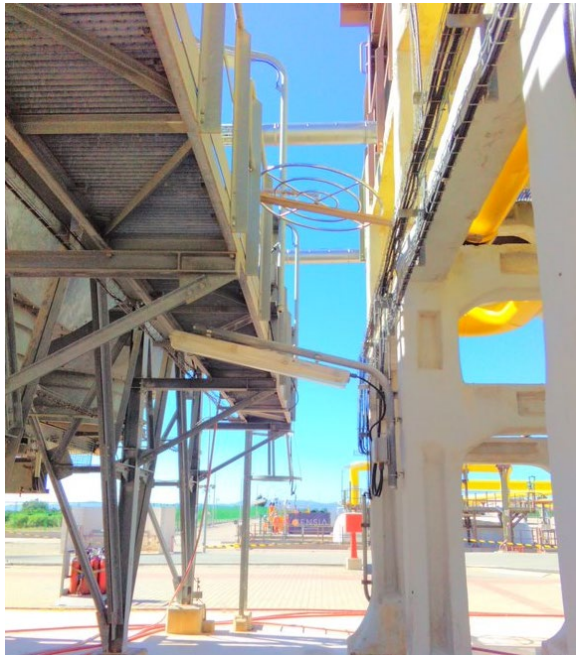
Node 3



# Controlled emissions

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WP2
Perform the tests

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Node 4

# Controlled emissions

- Flow rates of methane varying from 0.01 kg/h to 50 kg/h (randomized releases)
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WP2
Perform the tests

| CRF | location | height | type of exit |
|---|---|---|---|
| node 1 | vent stack | 28 | open end |
| node 2 | structure1 | 9 | open end |
| node 3 | structure1 | 4 | ring shaped |
| node 4 | structure 2 | 1,5 | linear |
| node 5 | structure 2 | 1,5 | open end |


Node 5

# Technologies

**12 technologies were tested!**

- **9 Top-down / Site-level**
- **3 Bottom-up**


| | |
|---|---|
| Top-Down / Site-level | ABB Hover Guard |
| | ABB Mobile Guard |
| | Aeromon |
| | DGC Tracer Gas |
| | Dial NPL |
| | SeekOps |
| | CHARM |
| | Mirico |
| | Sensia |
| Bottom-up | FLIR |
| | OPGAL |
| | HFS Prototype |

# Technologies

## ABB Hover guard

- Off-Axis Integrated Cavity Output Spectroscopy (OA–ICOS) technology
- Mounted on a drone
- With GPS and anemometer

## ABB Mobile guard

- Off-Axis Integrated Cavity Output Spectroscopy (OA–ICOS) technology
- Mounted on a car
- With GPS and anemometer

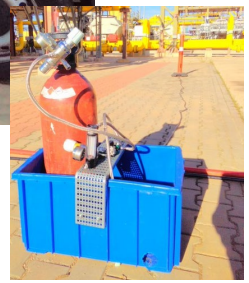
# Technologies

## Aeromon

- NDIR (Non-dispersive infrared), MOS (Metal-oxide semiconductor) and laser spectroscopy
- Mounted on a drone

## DGC tracer gas

- Tracer gas technology (Acetylene)
- Cavity Ring Absorption Spectroscopy for measurement

# Technologies

## SeekOps

- Turnable diode laser absorption spectrometer sensor (SeekIR)
- Mounted on a drone

## DIAL NPL

- LiDAR DIAL sensor
- Mounted on a truck
- 3D picture

# Technologies

## CHARM

- LIDAR DIAL
- Mounted on a helicopter
- High travelling speed
- Photographic documentation

## MIRICO – ORION CH4

- Laser Dispersion Spectroscopy (LDS) for concentration measurement
- 10 retroflectors were located across the site to return the laser beams to the detector
- Not affected by climate adversities

# Technologies

## SENSIA

- Caroline FYL
  - Uncooled LWIR detector
  - OGI analytics for mass flow quantification
- Mileva 33F
  - Cooled MWIR detector

## FLIR

- FLIR OGI QL320
  - Handheld device
  - Temperature assessment
  - Colorized video

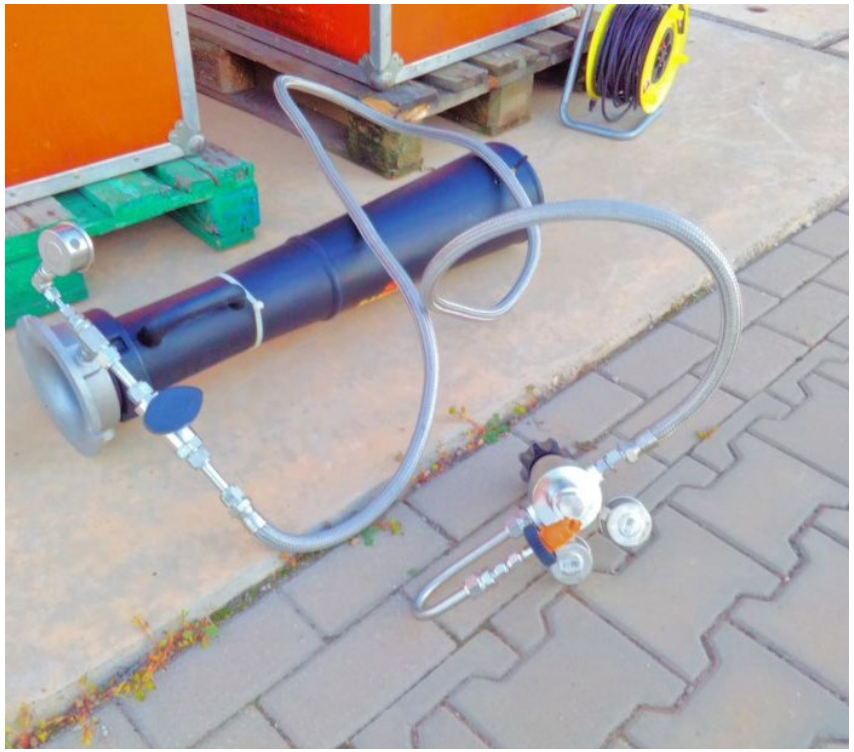
# Technologies

## OPGAL

- EyeCGas 2.0 - OGI
    - Handheld device
    - Temperature assessment

## HFS Prototype /RICE

- Pneumatic Venturi Prototype (low TRL)



# Tests coordination

## Full week tests plan

| | Monday | Tuesday | Wednesday | Thursday | Friday |
|---|---|---|---|---|---|
| 7:00 | Arrival<br>Safety briefing<br>Organisational briefing<br>Antigen tests | Arrival + Time for preparation | Arrival + Time for preparation | Arrival + Time for preparation | Arrival + Time for preparation |
| 8:00 | | | | | |
| 9:00 | | **Experiment 3** | **Experiment 7** | **Experiment 11** | **Experiment 15** |
| 10:00 | **Installation time for:**<br>**CRF**<br>**All technologies** | | | | |
| 11:00 | | **Experiment 4** | **Experiment 8** | **Experiment 12** | **Experiment 16** |
| 12:00 | Lunch break | Lunch break<br>LSCE instructions for reporting | Lunch break | Lunch break | Lunch break<br>Debriefing |
| 13:00 | | | | | |
| 14:00 | **Experiment 1** | **Experiment 5** | **Experiment 9** | **Experiment 13** | **Experiment 17** |
| 15:00 | | | | | |
| 16:00 | **Experiment 2** | **Experiment 6** | **Experiment 10** | **Experiment 14** | Desisntallation |
| 17:00 | | | | | |
| 18:00 | Calibration of Mini CRF | | | | |
| 19:00 | | | | | |

# Phase II.A: GERG 'Technology Benchmark for site level methane emissions quantification'


WP3
Analysis of results
($CH_4$ quantification)

→ **Independent report** – **Before end of December**
(only for partners and key stakeholders)

→ **Peer-reviewed article**
**Q1 2022**

# Phase II.A: GERG 'Technology Benchmark for site level methane emissions quantification'

WP4
Definition of next steps for Phase II.B. (test in sites)

- **Phase II. B** to be kicked-off probably in **February 2022.** Further work is needed to determine how these technologies can be applied to reconcile bottom-up/source-level quantification.
- Select technologies based on the findings of the study of the state of the art and the results of phase II.A

Bottom-up

Top-down
Site-level

**Reconciliation to be done with external support**

# THANK YOU VERY MUCH!

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TOP-DOWN METHODOLOGIES: SITE LEVEL QUANTIFICATION OF METHANE EMISSIONS

PHASE II.A: TECHNOLOGY BENCHMARK FOR SITE LEVEL METHANE EMISSIONS QUANTIFICATION PROJECT