



METHOD DESCRIPTION



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OVERVIEW

ReSource Sverige AB has developed a methodology aimed at finding and quantifying leaks and emissions from facilities operating in the following industries:



Oil & gas
(upstream, midstream,
downstream)



Landfill and biogas



Wastewater
treatment

The end-to-end solution is designed to collect data with ground and drone-mounted gas analysers to achieve three outputs:

Measuring gas flux for equipment and sites of interest known as top-down approach or L5 site-level

Determining volumetric ratios between two gases which can be used to determine combustion efficiency of exhausts and flares and better identify different emission sources

Mapping near-ground (<30m) methane concentrations to locate emissions sources known as leak detection

All quantification measurements take place outside the fenceline or site borders, leading to minimal disruption for operations.

The following is a description of the site-level approach for quantification.





STRUCTURE OF THE SERVICE

The service is structured into two tiers:

Tier 1

Designed for first-time customers, it includes an on-site survey conducted by a team using qualified drone pilot and survey assistant along with equipment. The deliverable is a comprehensive technical report detailing emission rates at the equipment and/or site level. The results are presented in both tabular and visual formats and include associated uncertainties and error estimates.

Tier 2

Focuses on enabling customers to conduct data collection independently. This tier includes the rental of survey equipment and a training program to ensure proper data collection following quantification methodology. Collected data are processed by ReSource and delivered to the customer on a per-project basis.

Additionally, access to the proprietary data logger and visualization platform is available via a subscription model.





FLUX AND SITE-LEVEL MEASUREMENTS

Method summary

Flux measurements are conducted by deploying a drone to fly through the gas plume downwind from emission sources (10–500m), including entire sites or specific components like flares. Most measurements occur outside the facility's fenceline to minimize disruption and avoid ATEX-related issues. Furthermore, a weather station records local meteorological conditions at heights of 2 and 10 meters and at the height of the drone by means of a drone-mounted ultrasonic anemometer while the gas plume is mapped. For best results, the optimum wind speed should be between 3 and 11 m/s, with a constant wind direction throughout the measurements. The data is collected through a cloud-based platform.

The collected data undergoes processing with comprehensive uncertainty calculations at each stage. This approach directly measures site-level emissions escaping a facility, indicating the volume of potentially lost product while providing clear evidence of emitted carbon dioxide equivalent. This enables data-driven calculations (not emission factors) of Global Warming Potential (GWP) for specific sites or components.



Equipment

This quantification method can also be applied to other GHGs or VOCs species. The following lists the equipment required for data acquisition to determine emission rates:

UAV platform

DJI Matrice series 350/400/600 Pro, calibrated by the manufacturer.

Data logging

Proprietary Android-based application.

Option – CH₄/CO₂

A highly accurate Off-Axis Integrated Cavity Output Spectroscopy (OA-ICOS) sensor, that measures CO₂ and CH₄.

Alternatively, a highly accurate light weight Tunable Diode Laser Absorption Spectroscopy (TDLAS) analyzer that measures selectively CH₄.



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Option – N₂O/CO₂

This solution is based on a photoacoustic infrared spectroscopy gas analyzer with ppb-level sensitivity that operates up to 5 Hz for data acquisition.

Option – CH₄/C₂H₆

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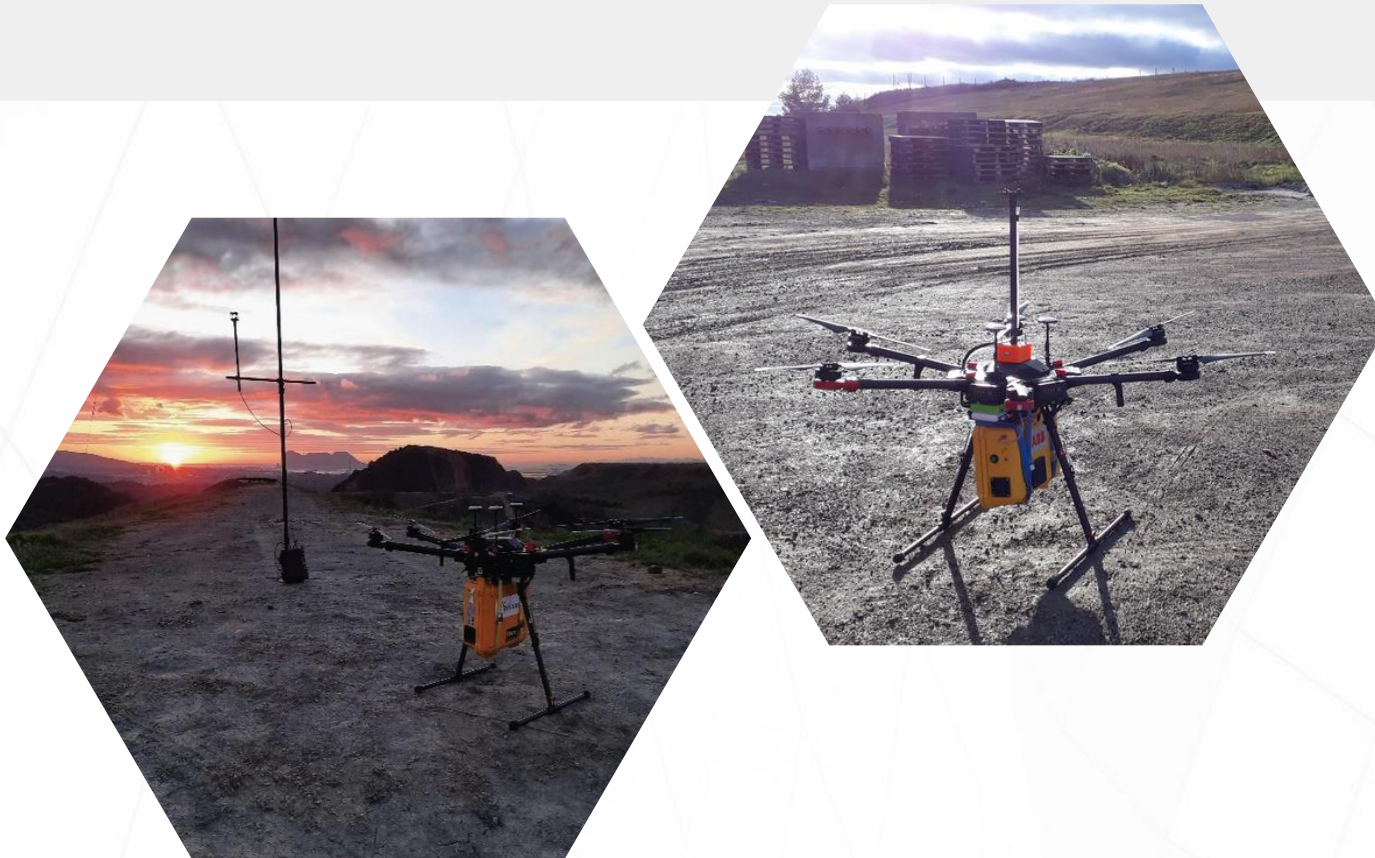
Wind

Anemometer, Barometer, Thermometer: LI-COR Trisonica Mini LI-550. Calibrated prior to start of the measurement campaign for zero value, temperature and humidity. Otherwise calibrated by the manufacturer and validated on site.



GENERAL TECHNOLOGICAL REQUIREMENTS

- A sensor that can measure the target gas at a precision and measurement range suitable enough for the type of measurement approach
- Data measured by the sensor can be collected with time stamps or directly fed to our proprietary payload system
- The payload selected is not heavier than 5,5 kg and can be mounted on a heavy-lifting drone with a MTOM<25Kg
- A training protocol can be used to train up the local operator or partner to collect the data in line with the quantification methodology.



ANALYSIS

The flux method is a top-down approach for quantifying emissions using an Airborne Survey Point Sensor (AS-PS). It complies with the EN 17628 technical specification for measuring fugitive emissions. The method applies Lagrangian mass-balance modelling. Air samples are collected both inside and outside the emission plume to reconstruct its shape and gas concentrations, while also estimating the background methane concentration upwind of the source. From these data, the emission rate is inferred.

Measurement uncertainty is explicitly quantified based on the uncertainties of the input variables, allowing a reliable standard uncertainty to be reported for each estimate. Results are expressed as mass per unit time (e.g., kg/h) and are typically reported as a mean value together with lower and upper bounds corresponding to a 95% confidence interval.



PAIR CH₄/CO₂ WITH OFF-AXIS INTEGRATED CAVITY OUTPUT SPECTROSCOPY (OA-ICOS)

Sensors have their own detection thresholds (LOD), while quantification limits depend on the calculation method used (LOQ). In this specific gas pair the following is considered during the data elaboration:

Category	Details / Specs
Methane Sensor	ABB LGR-ICOS™ GLA131-GGA Microportable Greenhouse Gas Analyzer; factory-calibrated; repeatability <0.9 ppb (CH ₄), <350 ppb (CO ₂); baselined per transect
Anemometer / Thermometer / Barometer	LI-COR Trisonica™ Mini LI-550; pre-campaign zero & temp/humidity calibration
UAVs	DJI Matrice 600 Pro or Matrice 400; factory-calibrated
Data Logging	Proprietary android application
Methane Sensor Uncertainty	0.004 ppm (1 σ , 1 Hz); inlet 60 cm below rotors
Anemometer Uncertainty	±0.1 m/s, ±1°
Thermometer / Barometer Uncertainty	±0.1 °C / ±10 mB
Background Emissions	Measured downwind, fitted with probability distributions
Wind Speed / Direction	Flight averages; cosine correction for direction; typical error <5%
Systematic / Assumptions	Height above ground, canopy effects, vertical mixing, plume edges, turbulence, limited near-ground data, plume heterogeneity, horizontal wind shifts
Optimum Conditions	Wind speed 3–11 m/s; constant wind direction

The range of emissions that can be measured also varies according to the type of sources being investigated. Therefore, the table below refers specifically to the current airborne platform and sensor operating over a typical site with a sampled area of 10–100 hectares involving measurements of the gas pair CH₄/CO₂:

Limit of Quantification (LOQ ¹)	<0,1 kg·h ⁻¹
Limit of Detection (LOD ²)	CH ₄ <0,9 ppb at 1Hz CO ₂ <350 ppb at 1Hz
Uncertainty ranges at 95% C.I. ³ on average of 10 measurements	±15–20%

[1] IUPAC definition <https://goldbook.iupac.org/terms/view/08022>

[2] IUPAC definition <https://goldbook.iupac.org/terms/view/L03540>

[3] IUPAC definition <https://goldbook.iupac.org/terms/view/C01246>

DELIVERABLES

Results for emission rates are given on a written report in either mass basis (kg/h or g/s) or volumetric (e.g. m³/s, scfh) with relative uncertainty defined in percentage terms.

Error margins for the transects are unique for each data set but ranges of +/- 15–20% are to be expected, with most uncertainty coming from windspeed and wind direction. Increased number of transects contribute to a reduction of the error. Uncertainty is estimated specifically for campaign conditions. The reported standard uncertainty comprises an uncertainty budget and a statistical approach.

An example of deliverables for a specific flight is given in Appendix 1. The technical report can be expanded or adapted to customer needs.

COSTS

Factors affecting the prices are the locations and number of sites, flight restrictions, demand on deliverables, time schedule and urgency. Travel costs will be calculated separately and added to the quoted price. Price for performing the quantification service includes the following components:

Tier 1

- Work preparation
- Project planning
- Permitting process
- Flight planning
- Project management meetings and coordination
- Field survey with operational staff
- Equipment usage
- Data processing and calculations
- Reporting.

Tier 2

- Training
- Project management meetings and coordination
- Equipment usage
- Data processing and calculations
- Reporting.

REQUIRED INFORMATION FOR A QUOTATION

The following information is required to give a detailed price quotation:

- Site/component location preferably in geospatial data friendly format (.kml, json, etc.)
- Requested Tier (1 or 2)
- Availability of local drone operator
- Deadline for project.



SCHEDULING AND OPERATIONAL DEPLOYMENT

Factors influencing services and operational performance:

Key Dependencies

- Weather conditions
- Crew travel logistics
- Equipment availability
- Site access conditions

Survey Planning

- A preliminary time window of 1-2 weeks is typically established with the customer for survey deployment.
- A more precise time frame of 1-3 days can be confirmed just prior to the survey.

Coordination

- The customer collaborates with the project manager to finalize the timing for the selected sites.



APPENDIX 1 – SAMPLE OF MEASUREMENT REPORT

Results

General synopsis

By means of top-down approach, methane gas emissions from the whole compressor station could be successfully quantified in [Site Name]. Description of the flights for quantification and timing is given in the results in chapters below. Along with quantification results, flight reports have been included at the end of this document.

Flux results overview

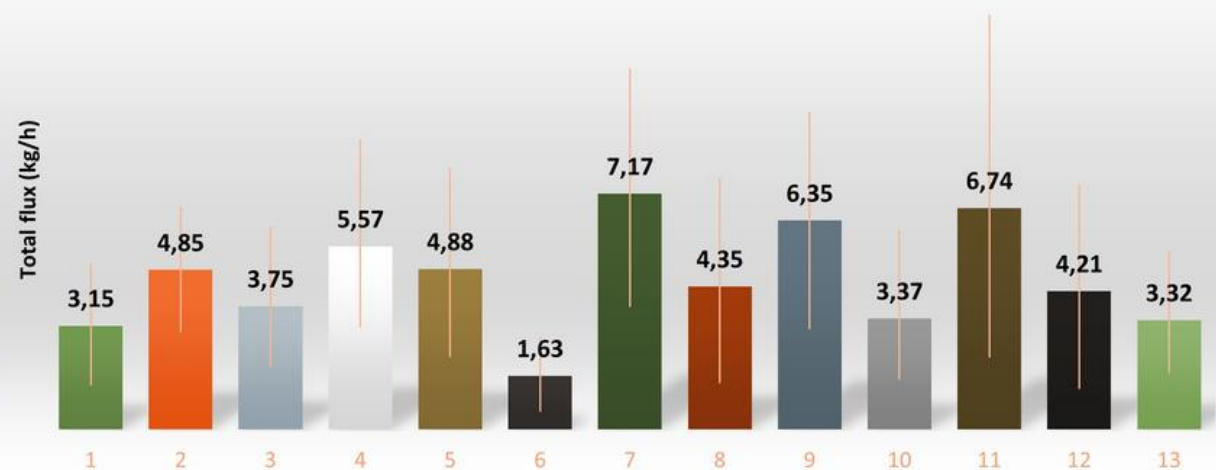
Measurement transects with corresponding flux results are shown in Table 1 below. A total average flux has been calculated for the site-level quantification. Minimum and maximum values are also given.



Measurement	Target source	Calculated CH ₄ emission rate (Kg-h ⁻¹) at 95% CI	Time of flight (local)
1	Site-level	3,152 [1,337; 5,038]	2023-09-17 10:48:48 - 10:53:51
2	Site-level	4,85 [2,958; 6,778]	2023-09-17 10:58:53 - 11:05:38
3	Flare	3,745 [1,879; 6,163]	2023-09-17 11:13:48 - 11:19:34
4	Flare	5,569 [3,097; 8,819]	2023-09-17 11:25:48 - 11:32:34
5	Compressor station	4,878 [2,205; 7,933]	2023-09-17 11:39:36 - 11:45:56
6	Compressor station	1,627 [0,542; 2,8]	2023-09-17 12:37:24 - 12:44:24
7	Site-level	7,17 [3,716; 10,98]	2023-09-17 12:56:09 - 13:03:02
8	Wastewater basin	4,35 [1,399; 7,631]	2023-09-17 13:09:11 - 13:14:45
9	Biogas reactor	6,354 [3,053; 9,660]	2023-09-17 13:20:34 - 13:26:48
10	Blower	3,373 [1,502; 6,068]	2023-09-17 13:38:21 - 13:45:22
11	Biogas reactor	6,735 [2,179; 12,62]	2023-09-17 14:15:15 - 14:22:22
12	Gas well	4,206 [1,219; 7,443]	2023-09-17 15:06:41 - 15:13:49
13	Gas well	3,323 [1,706; 5,394]	2023-09-17 15:18:16 - 15:25:25

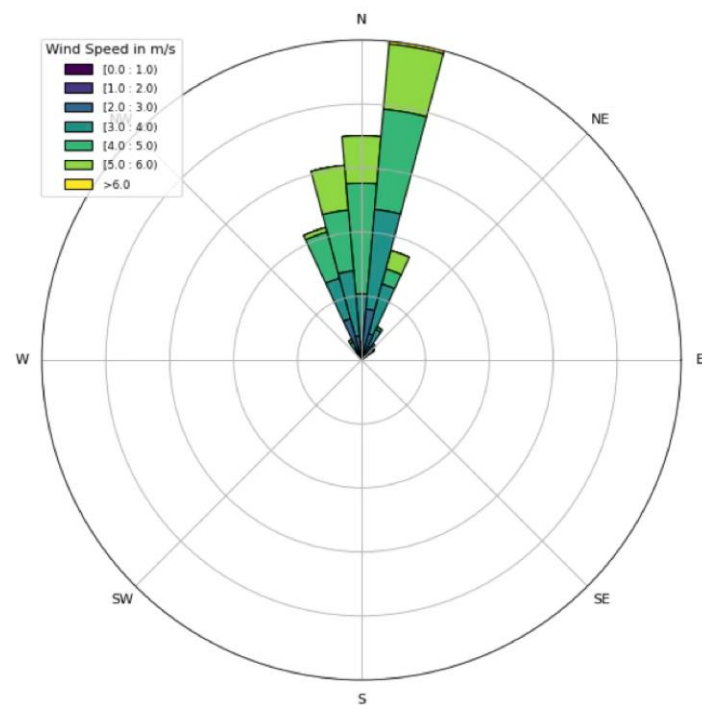
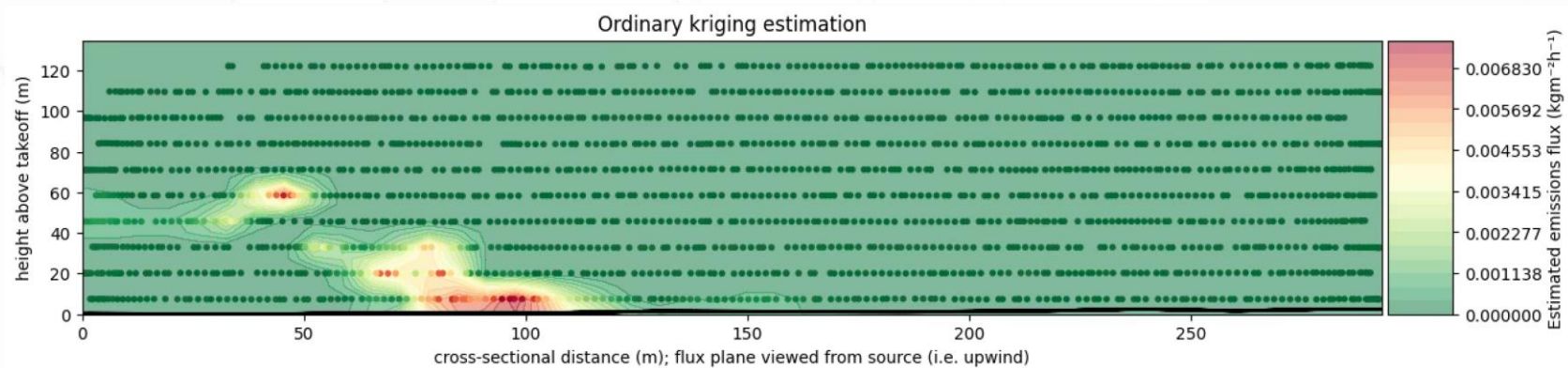


Emission rates with 95% CI



Result	
Start/end of data [Local time]	2023-09-17 hh:mm:ss- hh:mm:ss
Transect start/end co-ordinates	46.202592°, 20.715993° 46.203794°, 20.711464°
Transect altitude range	22m - 90m (AGL)
Mean wind speed (9.3m) and direction (2m)	3.6ms ⁻¹ ± 1.0ms ⁻¹ at 275° ± 15°
Estimated total methane flux [95% C.I.]	105.7 Kg·h ⁻¹ [95.2; 112.3] Kg·h ⁻¹
Peak flux location	45.202905°, -20.716019° 23m (AGL)°





Wind speed and
direction



Flight path and average wind
arrow