European harmonization of methods to quantify methane emissions from biogas plants

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Background and motivation

- need for robust and reliable monitoring of CH_4 emissions from biogas plants
  - environmental, safety and financial issue
  - data basis/emission inventories
  - reflect and improve operational efficiency, acceptance
- **BUT**: CH_4 losses can arise from various plant components (several source types)
  - Stationary and diffuse emission sources
  - Point and area sources, time variant sources
- various attempts to quantify single & overall emissions
  → *difficult comparison of emission factors derived from different methods*

Research project MetHarmo

- MetHarmo - **European harmonization of methods to quantify methane emissions from biogas plants**
- Project duration: 01.03.2016 – 28.02.206
- Project coordination: Deutsches Biomasseforschungszentrum
- Project partner:

Research project MetHarmo

- MetHarmo is funded in the framework of ERA-NET (European Research Area) – 9th call
- Project administration by the national funding agencies
  - Germany: Fachagentur Nachwachsende Rohstoffe e.V. (Agency for Renewable Resources)
  - Austria: Klima- und Energiefonds (Climate and Energy Fund)
  - Sweden: Swedish Energy Agency
- Overall funding: ~ 760,000 EUR

Aim of the project

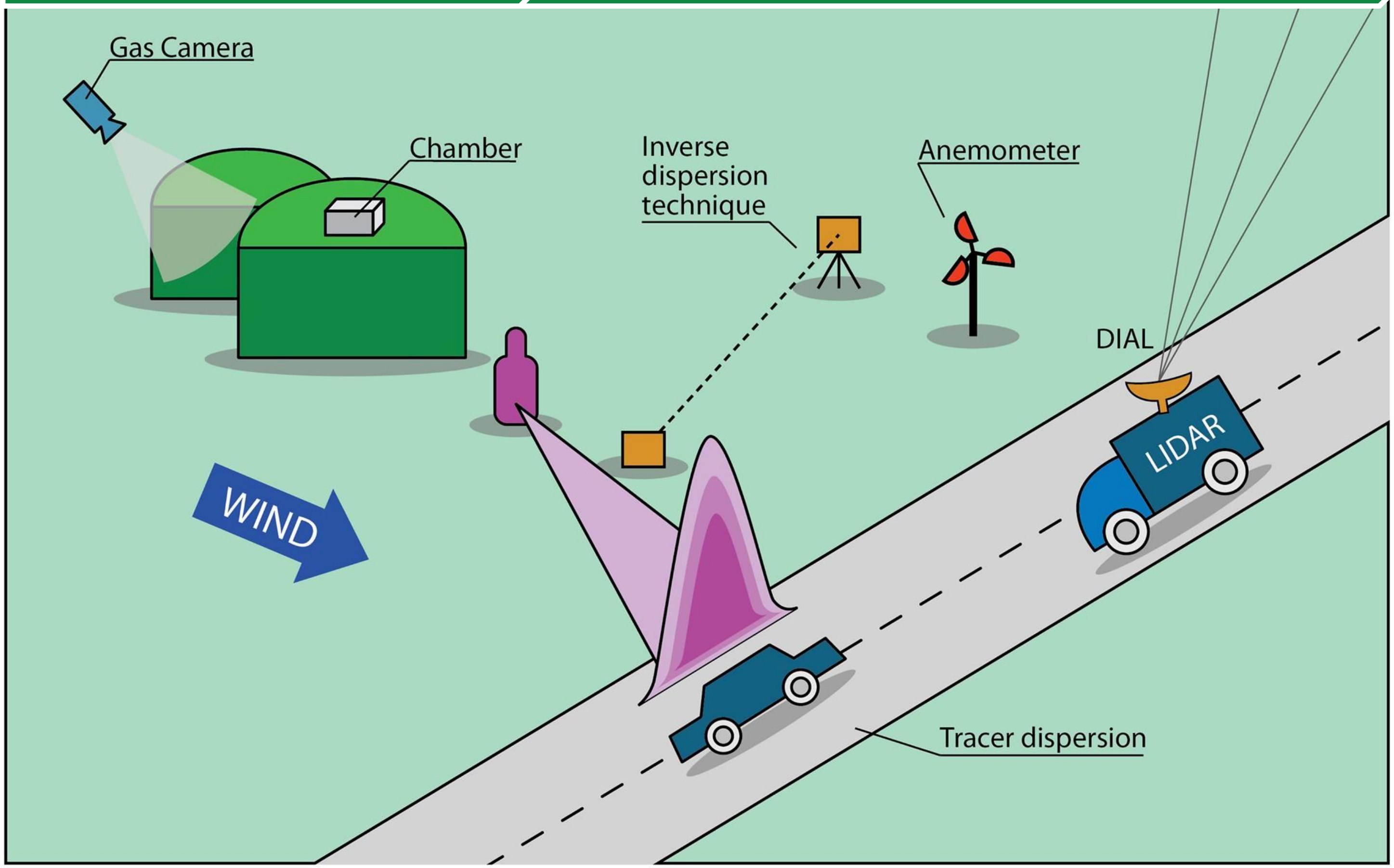
- Method harmonization for standardized guideline using on-site and remote sensing approaches
  - Evaluation of method accuracy
  - Categorization of results from different methods (transferability of results)
- Recommended use of methods (written guideline on how to measure and calculate methane emissions)
  - Performance of methods (need for instrumentation, calibration, qualification of personnel)
  - Instrument placement, atmospheric condition, need for topographical conditions
  - Required monitoring period, operational state of biogas plant

Content of project

- Two international workshops
  - Workshop in Leipzig (2016) – Introduction of project and methods
  - Workshop in Malmô (2018) – Presentation of project results
- Two intercomparison campaigns in 2016 and 2017
  - First measurement campaign includes the participation of a subcontractor using a DIAL system (Differential Absorption LIDAR)
- Extended emission measurements in Germany and Austria (transferability of the improved method to other biogas plants under different conditions)

Measurement approaches

On-site → **Remote sensing**



Measurement approaches

On-site

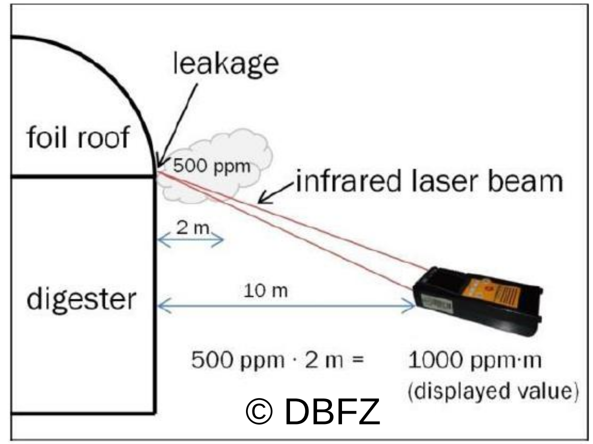
- Leakage detection
- Quantification of single sources
- Summation of single emission rates
- Use of enclosure techniques, gas cameras

Remote sensing

- Determine whole site emissions
- Up- and downwind measurements of CH_4 concentration
- Depend on transport processes in the atmosphere
- Do not affect plant operation
- Dispersion modelling or tracer gas comparison

On-site methods

- Leakage detection:
  - IR camera
  - Hand-held methane laser

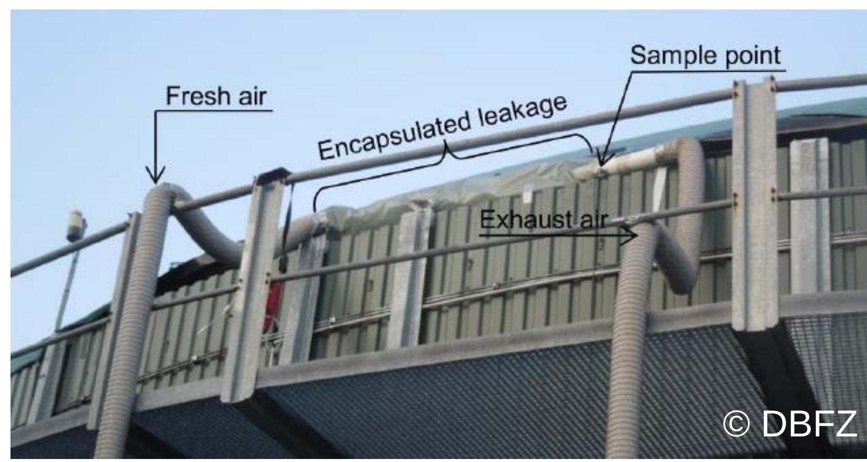


- Enclosure techniques

$$E = \dot{V} \cdot \rho \cdot (c_{out} - c_{in})$$

- (Gas formation tests)
- Measurement teams

DBFZ SP bioenergy2020+



Remote sensing approaches

- **Inverse dispersion modelling:**
  up- and downwind concentration measurements (OP-TDLS) combined with meteorological data using a dispersion model

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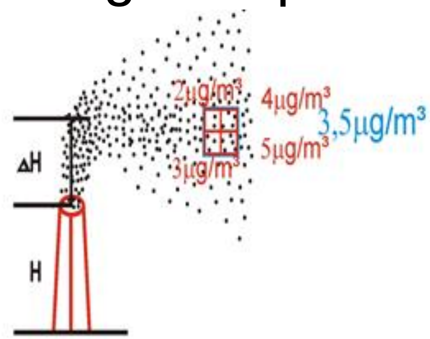
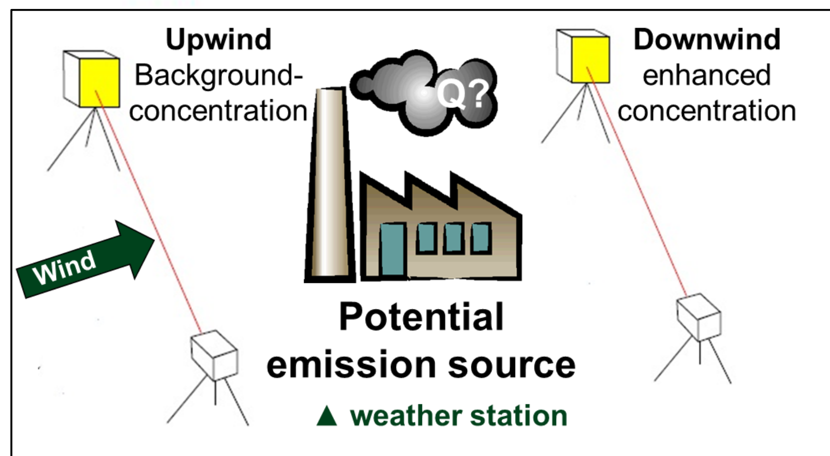


- Measurement teams:

DBFZ

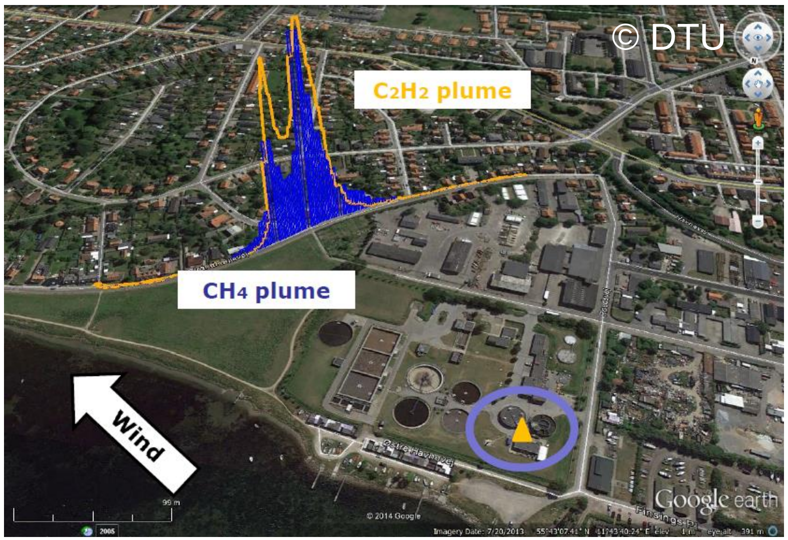
ABF BOKU

University of Stuttgart
Germany



Remote sensing approaches

- **Mobile tracer dispersion:**
  controlled gas release combined with measurement of downwind concentration (C_2H_2 as tracer and CH_4)

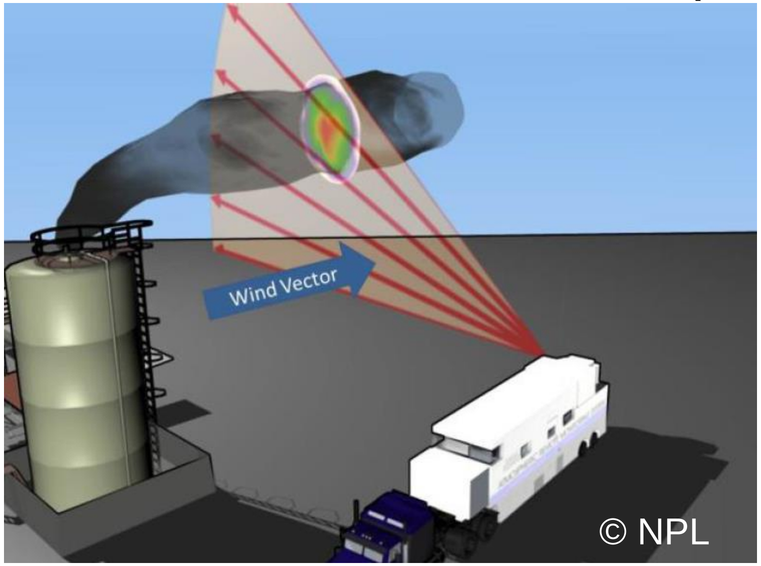


- Measurement team:

DTU Technical University of Denmark

Remote sensing approaches

- **DIAL – Differential Absorption Lidar**
  backscatter laser-based system to determine location and concentration of methane (at ranges up to 3 km)



- Measurement team:

NPL
National Physical Laboratory

Method comparison

	On-site	Remote sensing
Advantages	• Localization and quantification of single sources • Derivation of mitigation strategy • Weather independent • Low detection limit (for total site emissions)	• Determination of whole site emissions • Do not affect plant operation • Time effort independent of plant size • Continuous/long-term monitoring possible (with high resolution) • No prior identification of single source needed
Disadvantages	• Time effort dependent of plant size (time consuming on large plants) • Possibility to miss single sources (or that no all sources are accessible) • Measurement over short-time period • Assuming constancy of emission in the summation • Influence of measurement on emissions	• No identification of single sources • Depending on weather conditions (e.g. wind direction, wind speed, etc.) • Limited in complex topographical and infrastructural conditions (e.g. forest areas, hills, dense array of buildings) • Uncertainty of dispersion model/tracer placement

Thank you for your attention!

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