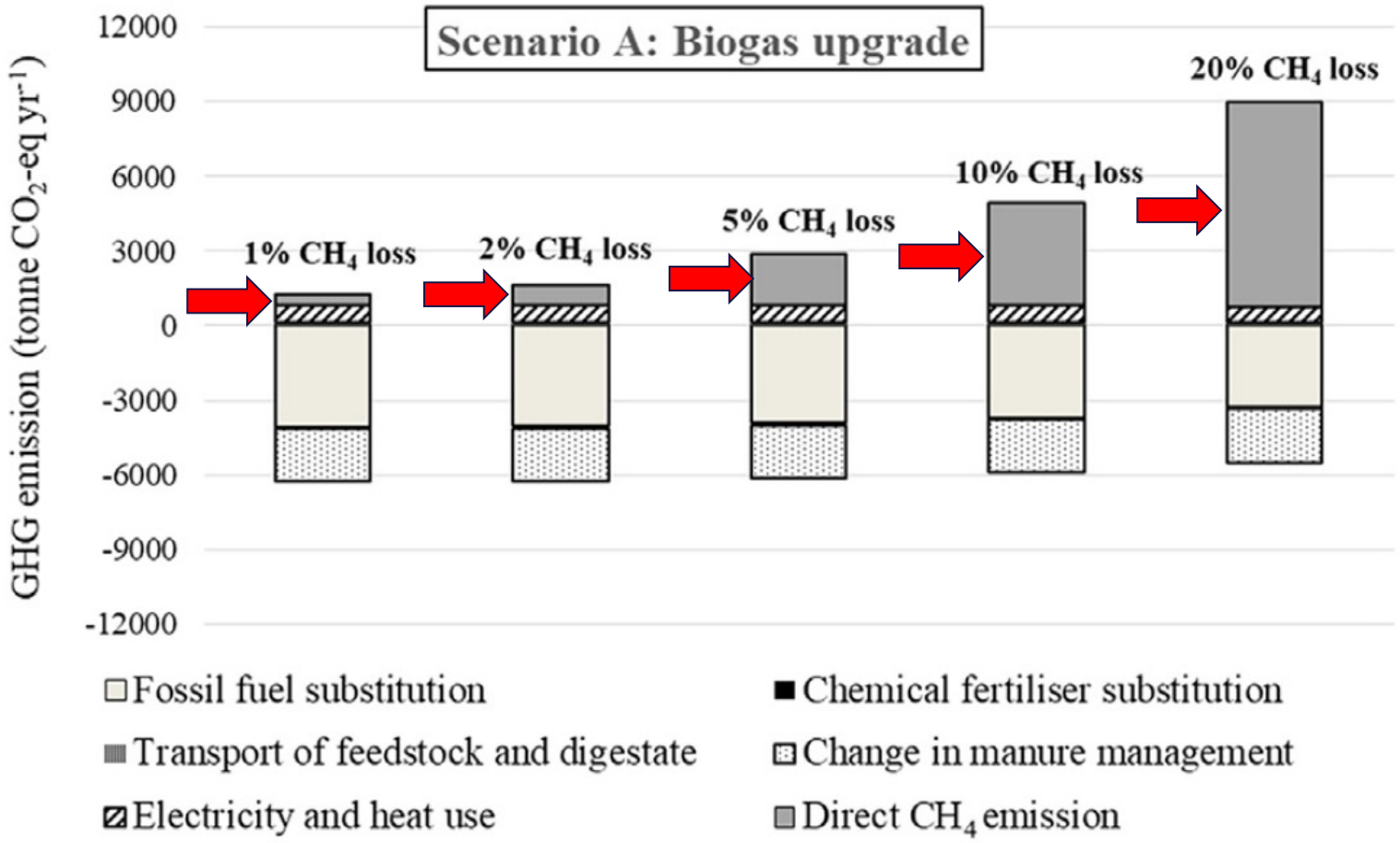
Sustainability and methane leakage | 21st April 2022

Charlotte Scheutz, Einar Gudmundsson & Anders M. Fredenslund

Methane emissions from biogas production plants

Methane loss and GHG performance



Scheutz & Fredenslund, 2019. Total methane emission rates and losses from 23 biogas plants. Waste Management 97, 38-46

Project content – ”Metantab fra danske biogasanlæg”

- **Task 1: Build and disseminate knowledge to reduce methane loss**
  - Development of self control programs for biogas facilities and determine BAT
  - Guidance materials for the biogas industry to reduce methane loss
  - Facilitate experience between biogas producers on reduction options
  - Feasibility studies, individual plants

- **Task 2: Measurement program**
  - Development, QA, best practice regarding measurements of methane emission
  - Leak search on biogas plants
  - Quantification of emission (total emission and selected point sources)
  - Establish a national database on emissions for use in the national reporting of GHG emissions

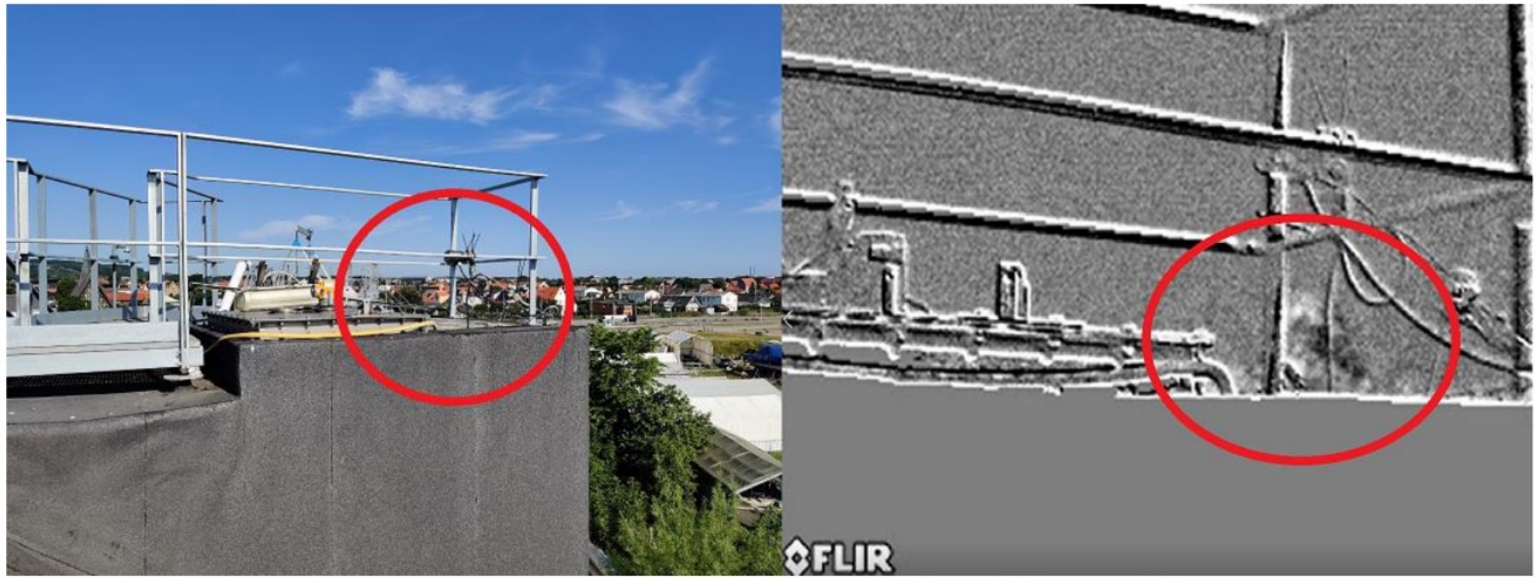
RAMBØLL Bright ideas. Sustainable change. DTU Miljø Institut for Vand og Miljøteknologi FORCE TECHNOLOGY TEKNOLOGISK INSTITUT Energistyrelsen

Participating biogas plants

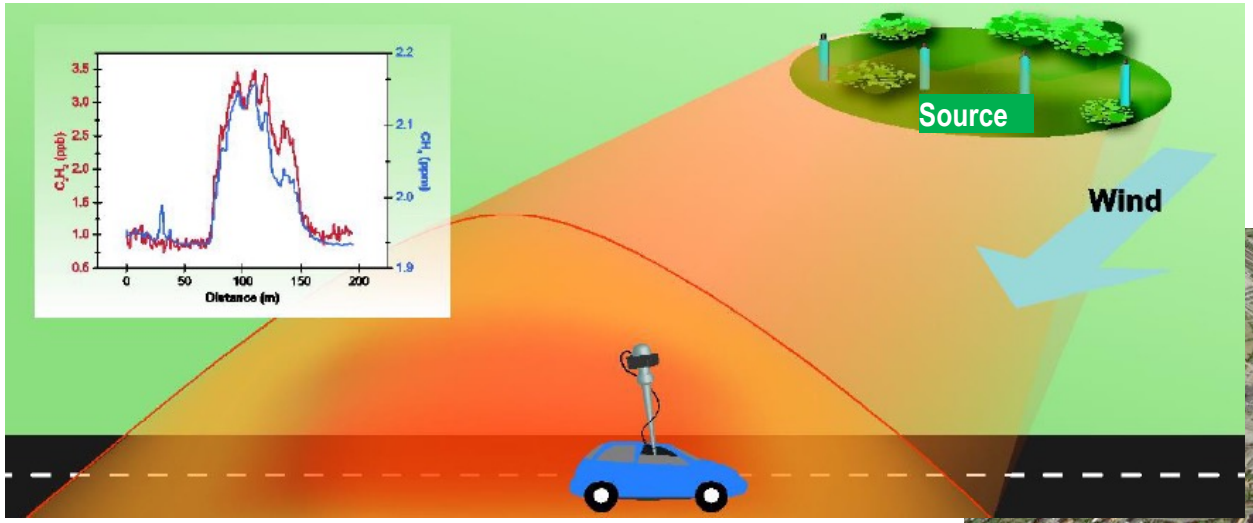
- 60 biogas plants – 35 agricultural plants and 25 wastewater treatment (WWTP) and industrial plants
- 45% of the Danish biogas production
- Previous measurements from additional nine plants included in calculating emission factors
- Variety of plants:
  - Type of plant (agricultural, WWTP)
  - Size (magnitude of gas production)
  - Gas utilization (CHP, biomethane, off-site utilization)
  - Construction year

Methane leak search

Leak search using gas camera



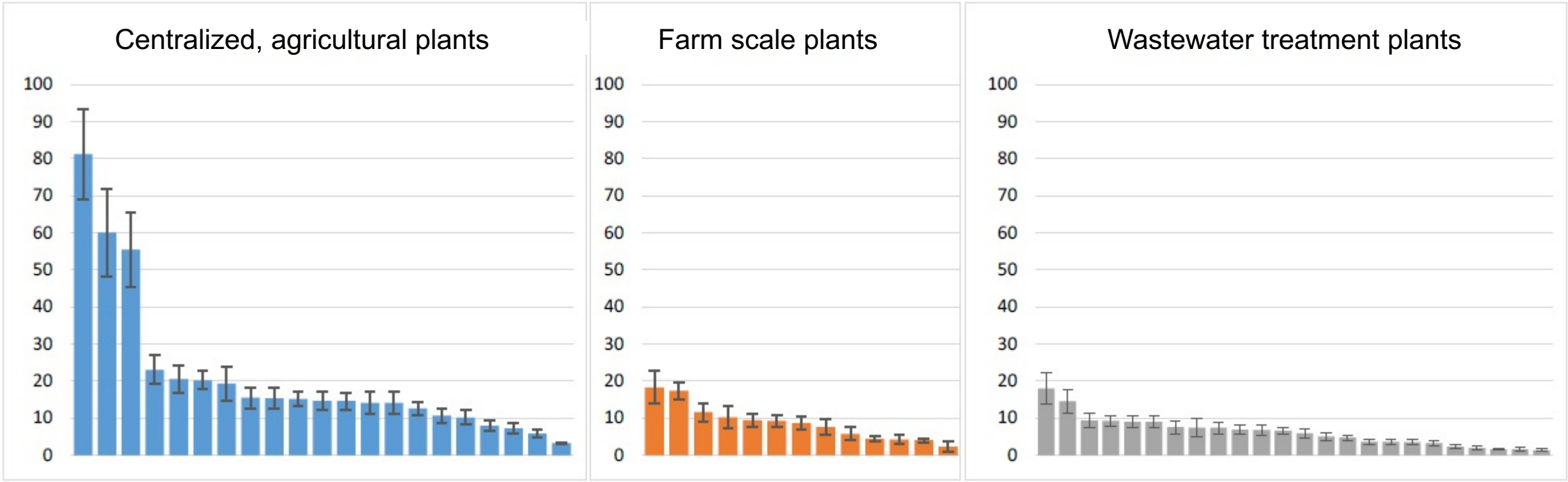
Quantification of whole site methane emission



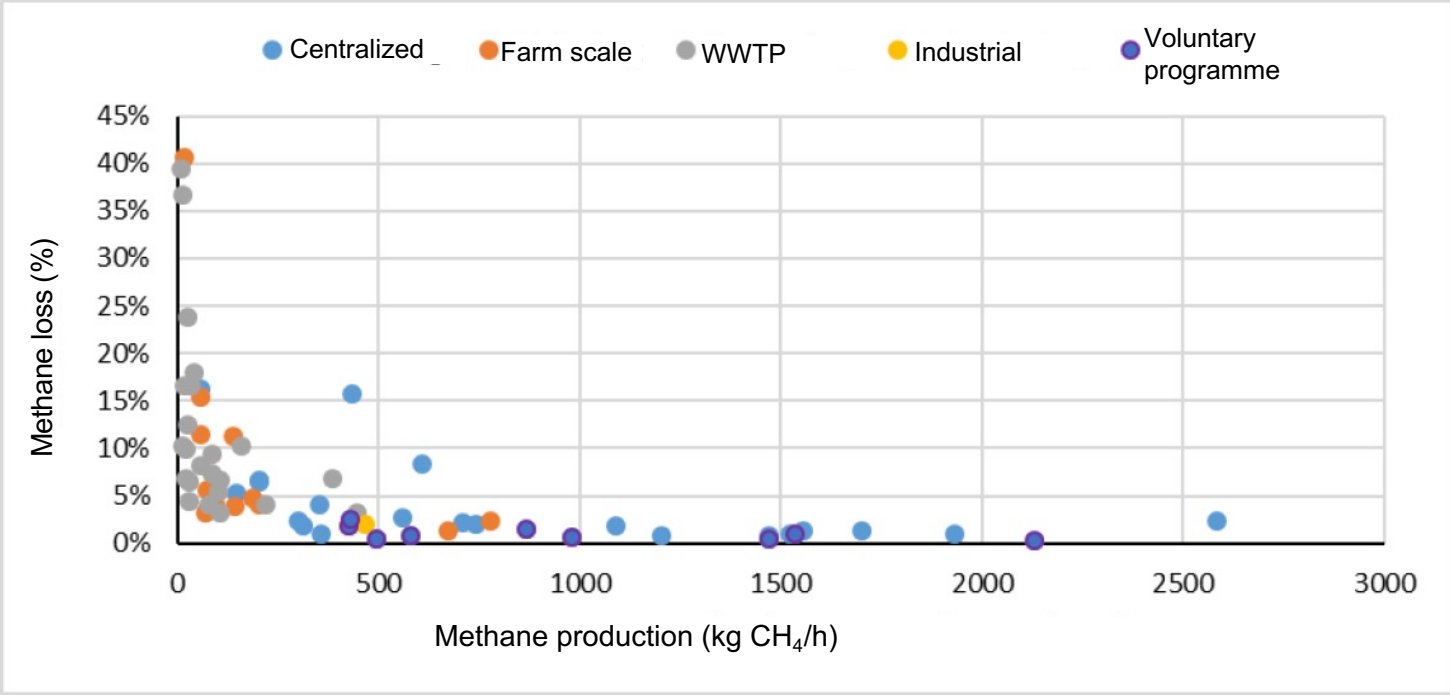
The method is:

- Well-documented (control test and international comparison tests)
- Certified
- Applied at many different sources

Whole site methane emission (kg CH_4/h)



Methane loss (% of methane production)

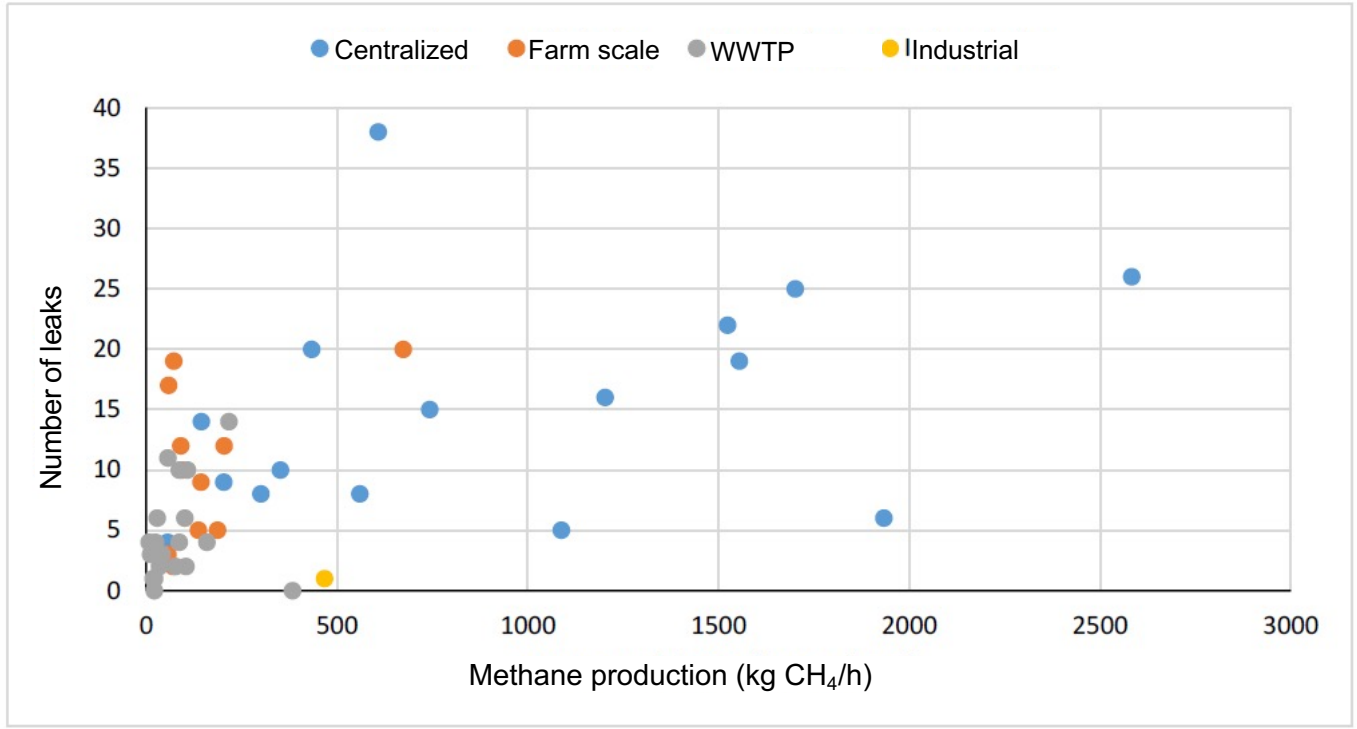


Production weight-based methane loss (%)

Plant type	Number of plants	Emission factor (%)
Centralized agricultural plants	29	1.9
Farm scale plants	15	3.9
Industrial plants	1	2.0
Wastewater treatment plants	24	7.7
All types	**69**	**2.5**

Rapport: Målrettet indsats for at mindske metantab fra danske biogasanlæg

Identified methane leakages

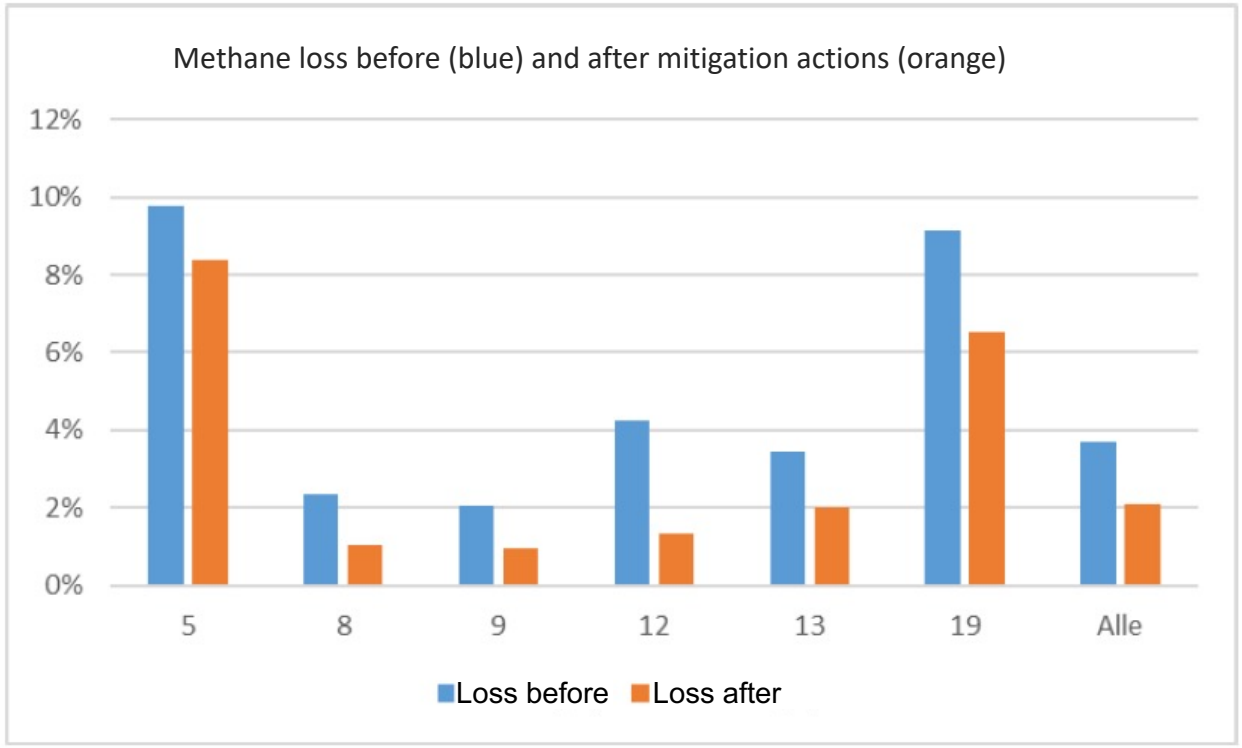


Rapport: Målrettet indsats for at mindske metantab fra danske biogasanlæg

Most common leaks

- Pressure relief valves on digesters
- Biomass storage w/o gas collection (especially WWTP)
- Leakages at gas bearing components (gas storage, piping, inspection hatches and more)

Measured effect of emission reduction actions



- All 6 plants reduced methane loss
- Reduction in emission were equal to:
  - 1,5 mio. Nm^3 methane/år
  - Increase in revenue of app. 1 mio. €/year
  - 29.000 tons CO_2-eq./year
  - 3.300 (Danish) person equivalents (GHG)

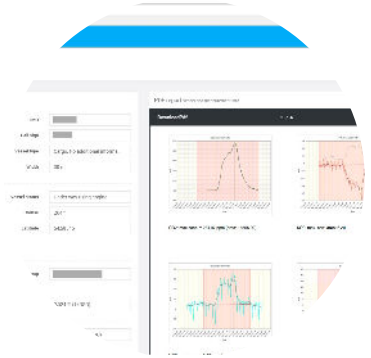
Rapport: Målrettet indsats for at mindske metantab fra danske biogasanlæg

Conclusions

- High variation in methane emission (kg CH_4/h) and methane loss (% of production) between plants
- Important contributors to methane emission from biogas production:
  - Pressure relief valves on digesters
  - Biomass storage w/o gas collection (especially WWTP)
  - Leakages at gas bearing components (gas storage, piping, inspection hatches and more)
- Methane losses were higher than expected
- Focus on methane loss can reduce emissions significantly
- In some cases, emission reducing actions can pay for themselves (positive NVP 10yr, feasibility studies at some of the plants)
- It is possible to emit less than 1% (national target set by Danish biogas producers)

We need to measure our GHG emissions

> We need to start measuring our GHG emissions to track the impact of green initiatives and emission reduction technologies, as society invests heavily in a fast green transition



Knowledge

To know our current emissions:

What, where, how much?

Mitigation

To monitor and document mitigating actions:

What works?

Cost

To ensure cost-efficiency of mitigating actions

Is it worth it?

Impact

To improve emissions models and impact assessments

Will we reach our targets?

Reporting

To correctly report on GHG and inform policy

Are we making the right choices?

Development of new measurement technology and incentive

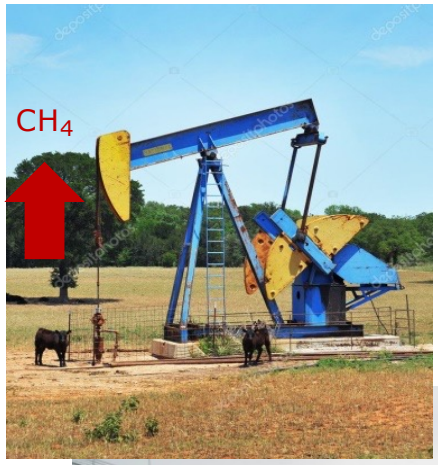
- Development of gas sensors
  - Multiple gases
  - High sensitivity and fast response
  - Robust
  - Light weight
  - Affordable

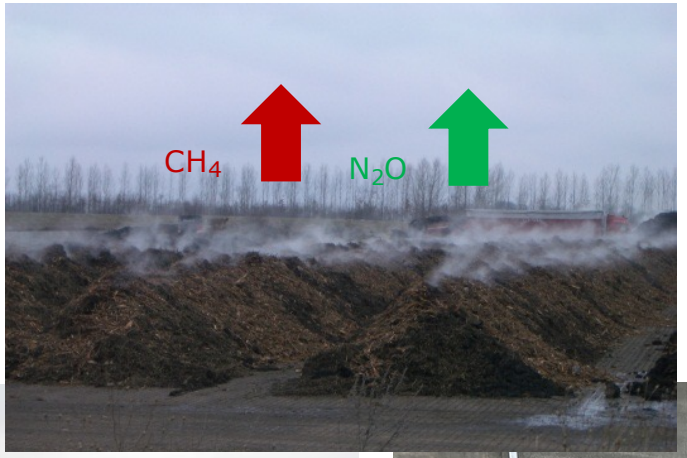
- Development of new measurement approaches
  - Tracer based methods
  - Drone-based methods
  - Continuous measurement method
  - Fence-line monitoring systems
  - Leakage

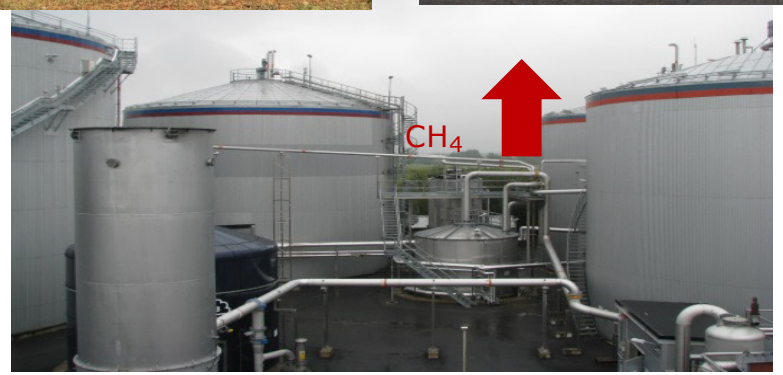
- Development of incentive
  - Lack of knowledge about emissions
  - Lack of attention of the problem
  - Global impact – not driven by local environmental effects
  - Lack of regulation
  - Lack of potential mitigation actions, associated costs and effect

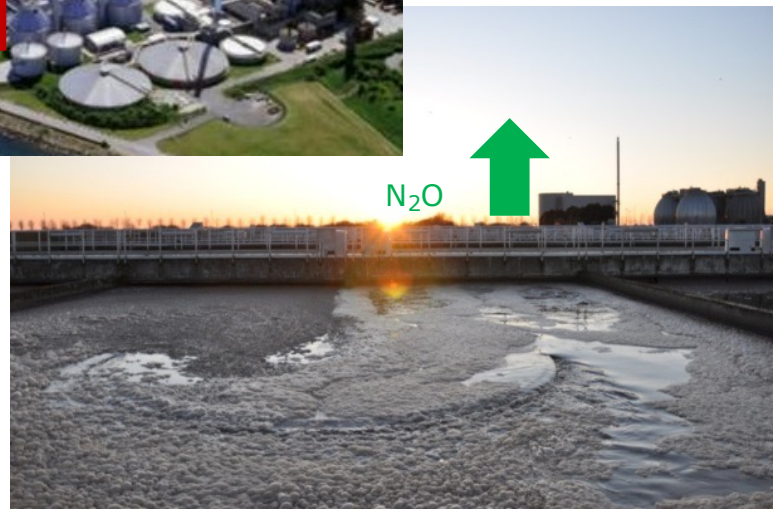
Many other sources and GHGs

- Many sources, different gases
- Large and complex
- Diffusive and dynamic by nature
- Difficult to locate and quantify









Contact information

Charlotte Scheutz

chas@env.dtu.dk

Anders Fredenslund

amfr@env.dtu.dk

Thank the Danish Energy Agency

Link to the Danish biogas report:

https://ens.dk/presse/ny-rapport-om-metantab-fra-danske-biogasanlaeg