



Advances in GHG monitoring and mitigation at the Ejby Mølle WRRF: trace gas quantification, CH₄ capturing, and N₂O mitigation

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VCS – A Sustainable Utility

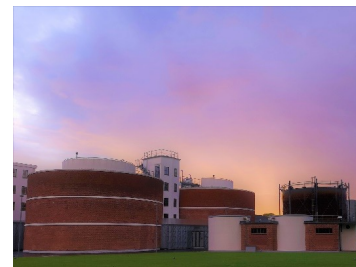
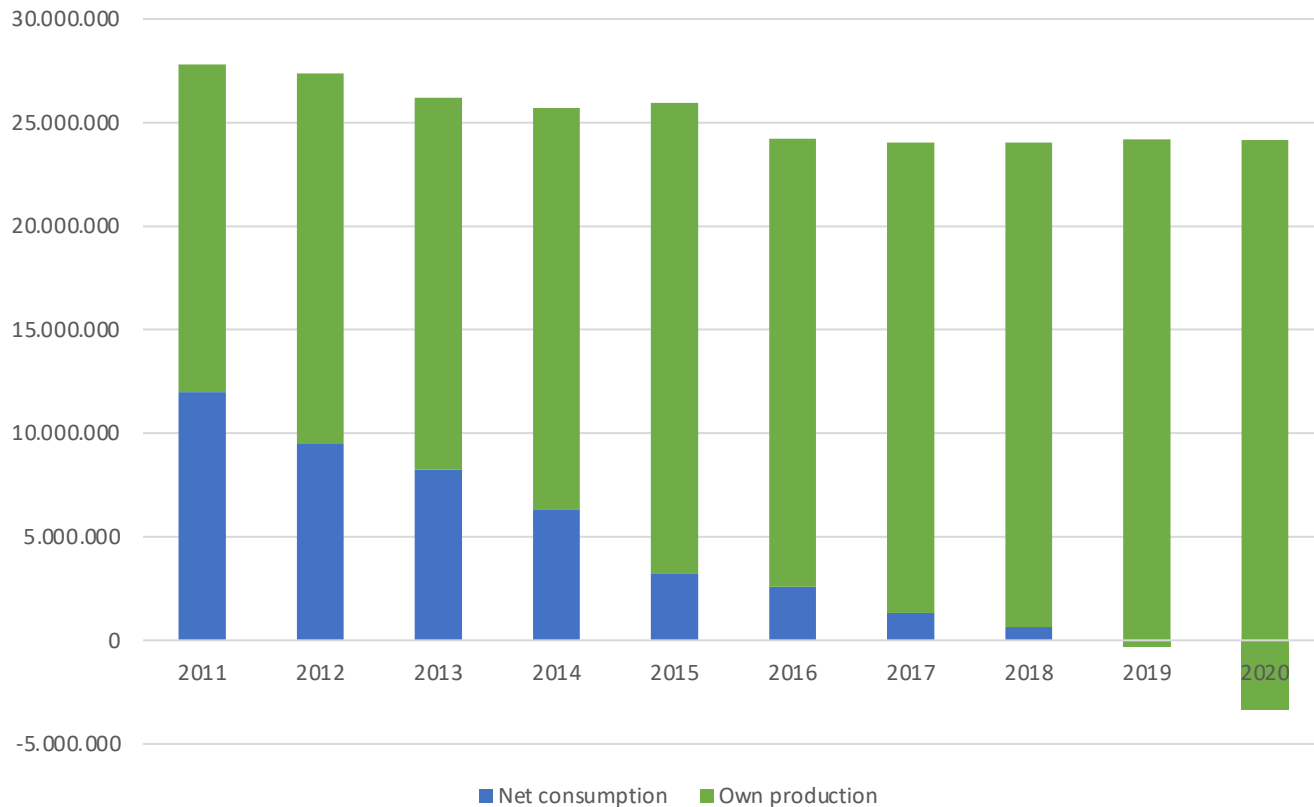
- Established in 1853 as first modern waterworks in Denmark
- 3rd largest water and wastewater company in Denmark. HQ in Odense.
- Operates 6 WTPs and 8 WWTPs with 3,400 km of conveyance
- Ejby Moelle WWTP, 410.000 PE
- **Energy neutral utility achieved in 2019**
- **Strong focus on implementation of UN sustainability goals**
- **Committed to innovation and development**



Courtesy of Google Maps (Altered by
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Energy producing utility



We have to take emissions serious

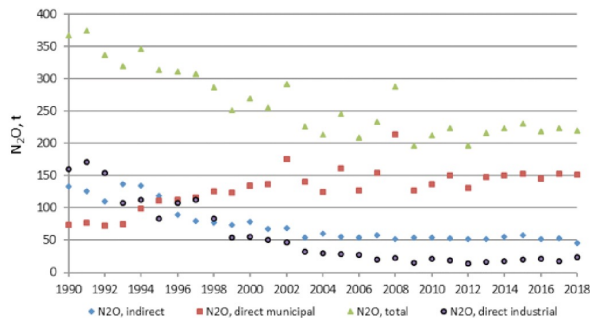
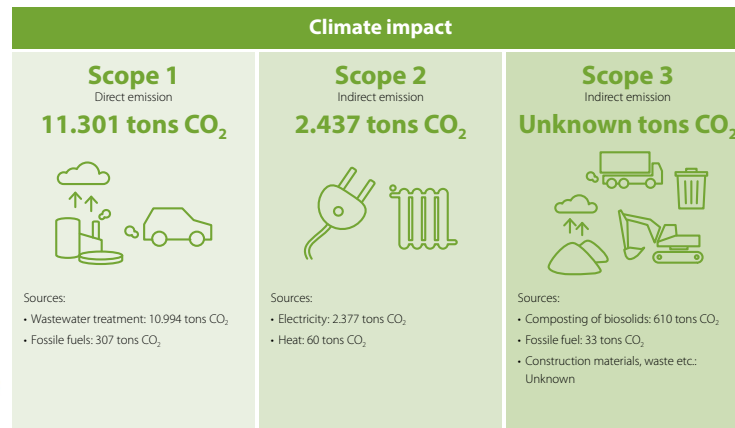
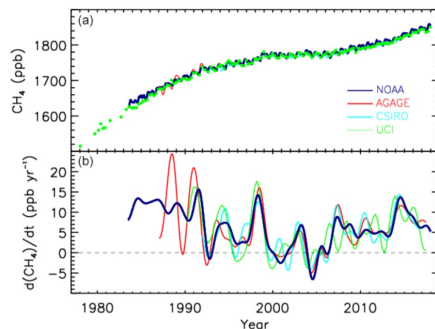
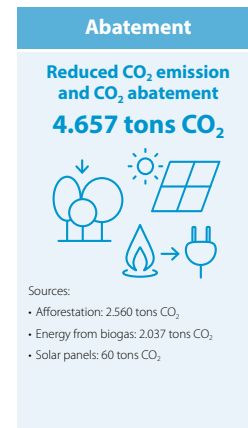


Figure 7.5.2 Time trends for the direct and indirect emission of N_2O (from wastewater effluents) and total N_2O emission.

M. Saunois et al.: The Global Methane Budget 2000–2017



VCS CSR report 2021



ARES (Active Reduction of Emissions) a recent initiative

- Project goal - Reduced emissions from wastewater treatment
- Methane CH₄ and Nitrous Oxide N₂O – are the main problems
- The project includes:
 - New advanced sludge handling
 - Advanced measurements at treatment plants
 - Advanced measurements in sewer systems
 - Pilot plant testing of new and enhanced control strategies
 - Online measurement – new approach



Miljøministeriet
Ecoinnovation - MUDP



BIOFOS

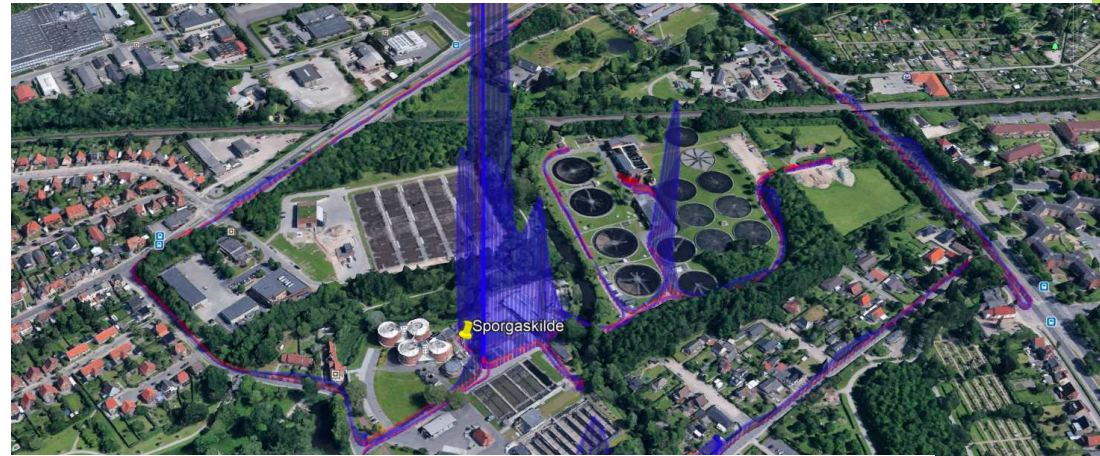


DTU Environment
Department of Environmental Engineering



Finding the emissions

- Identification and quantification of emissions of methane and N_2O from WWTP using trace gas method
- Measurement of methane and N_2O from the sewer system in Odense using trace gas method

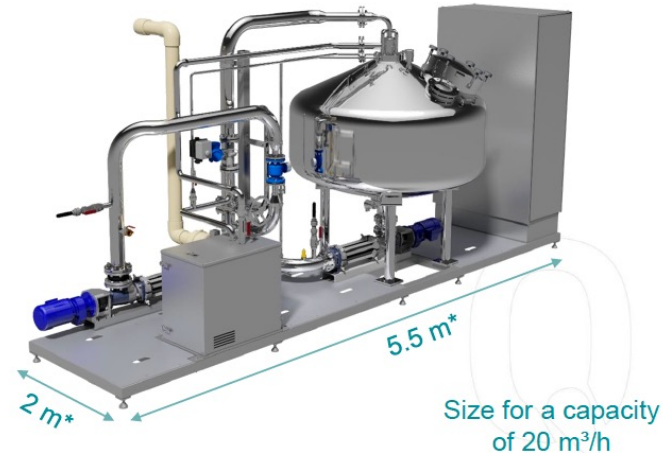
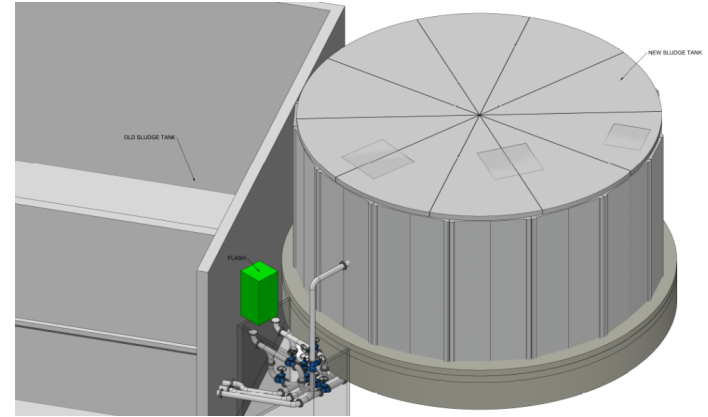


Figur 1: Lækage #1, fra vandlås på rådnetank. Lækagen kan ses ved den mørke sky, som er markeret på billedet til højre. Udklip fra MOV_0937.

Reduction of emission from sludge storage

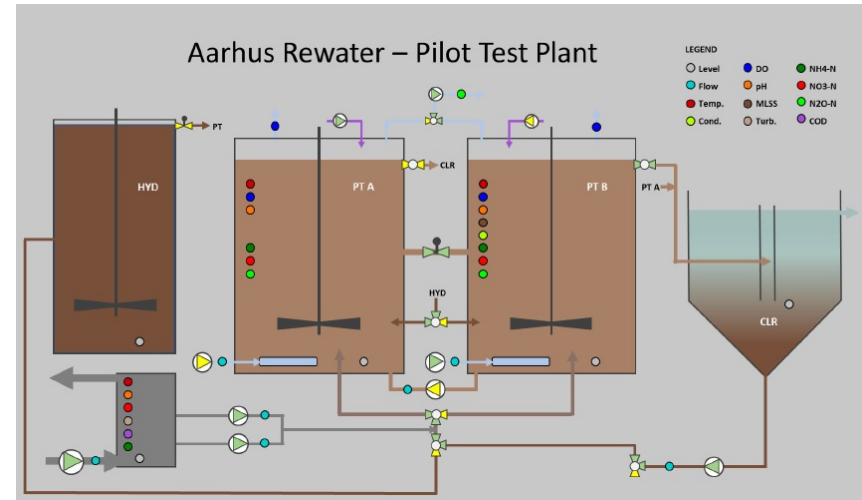
Development and test of closed sludge storage tank including vacuum technology for maximized methane extraction

- Maximizing gas production from the plant



Integrated N₂O emissions reduction from main- and side stream processes

- Aarhus Vand will conduct pilot studies aiming at reduction of emissions using a pilot plant.
- Test including combination of headspace measurements and general online measurements.
- Test of CAS and granular systems



N₂O Abatement by CAlytic Treatment

NACAT

- Can we remove N₂O and not just reduce it?
- Test of a catalytic process for decomposition of N₂O

mudp 2021

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Hillerød Forsyning

EnviDan

TÅRNBYFORSYNING

DTU

HALDOR TOPSOE



NACAT - N₂O Abatement by CAlytic Treatment



NACAT

- Evaluation of effect of existing treatment
- Test on:
 - Deammonifikation process
 - Ventilation air from biological treatment
- LCA evaluation of the technology
- Development of a mathematical model for evaluation of emissions, plant performance, energy consumptions etc

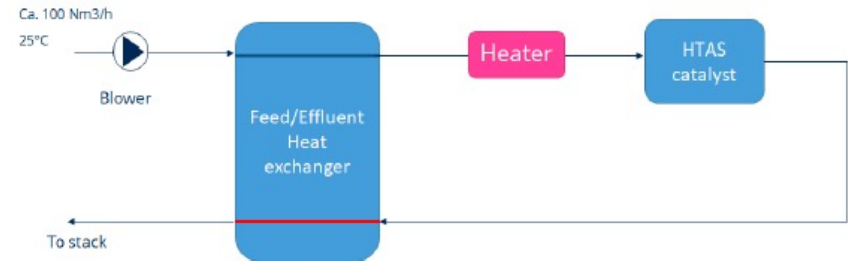
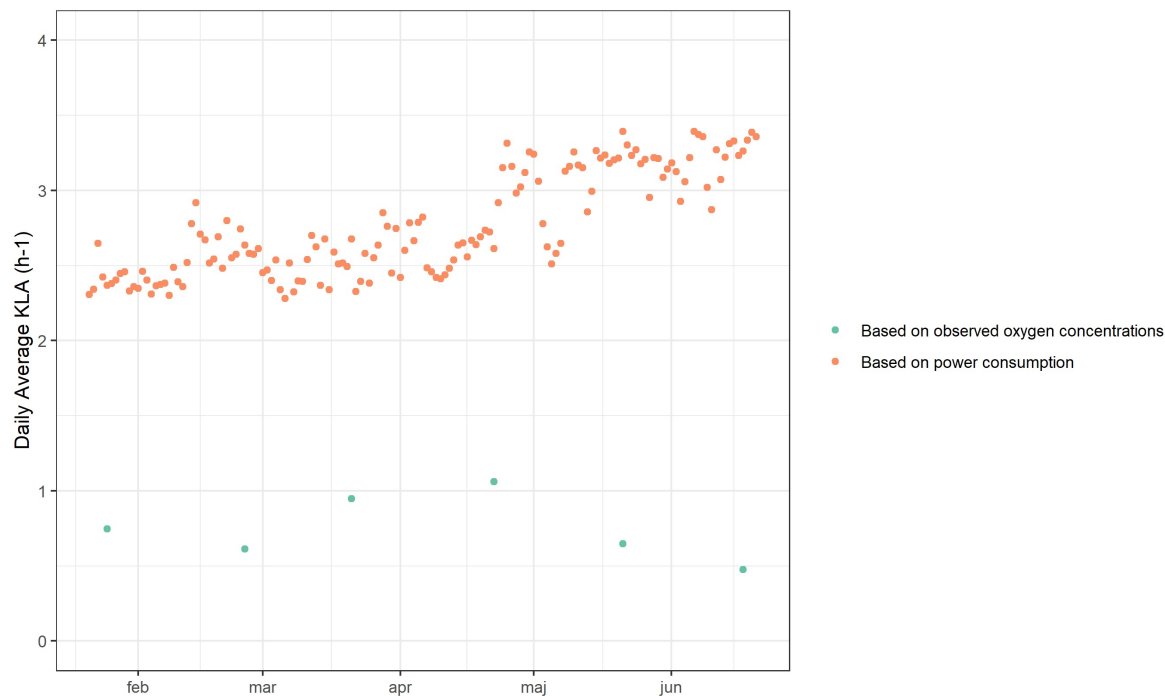


Figure 1: Schematic illustration of the catalytic treatment process.

Evaluation at Ejby Mølle



2019

Calculated daily average $K_{La(h-1)}$ with two different methods

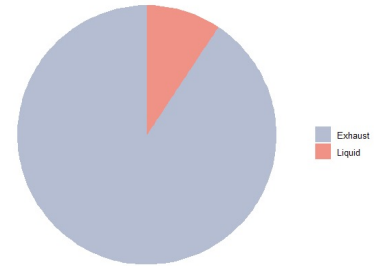
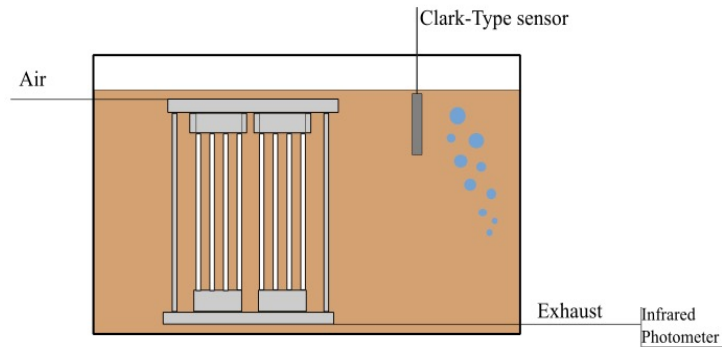
N₂O Emissions from Ejby Mølle Full-Scale Evaluation of Conventional Activated Sludge and MABR N₂O emissions

<https://www2.mst.dk/Udgiv/publications/2020/08/978-87-7038-216-8.pdf>

Nitrous oxide emissions - 2021



- Nitrous oxide emissions were one order of magnitude lower than those from AS
- While HRT was 7-8 times lower



3 years of operation!!

Two reactors

Change of feed and operational conditions

Lots of operational data

More than 3 million data points

Status

- On the agenda for more than 10 years – and still no solution
- Development of liquid online sensor N₂O
- Deammonification processes a challenges
- Still difficult to measure – if not impossible
- Methane slip and production - a problem as well



Thank you

