Hoogheemraadschap van
Schieland en de Krimpenerwaard

Making N_2O business as usual

Hoogheemraadschap van
Schieland en de Krimpenerwaard

Regional Water Authority near Rotterdam

CO_2 neutrality

Goals and ambitions

Energy
2025 100% self sufficient

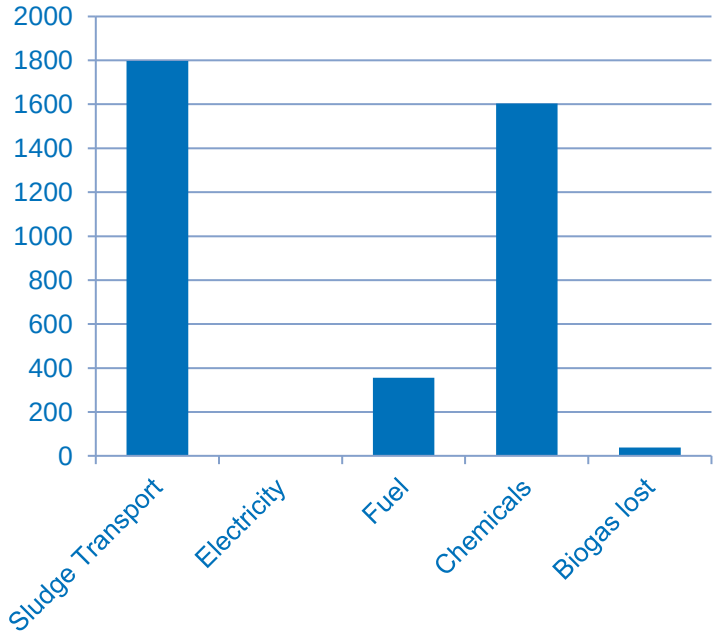
Climate
2050 zero net emissions of greenhouse gasses

Resources
2050 completely circular

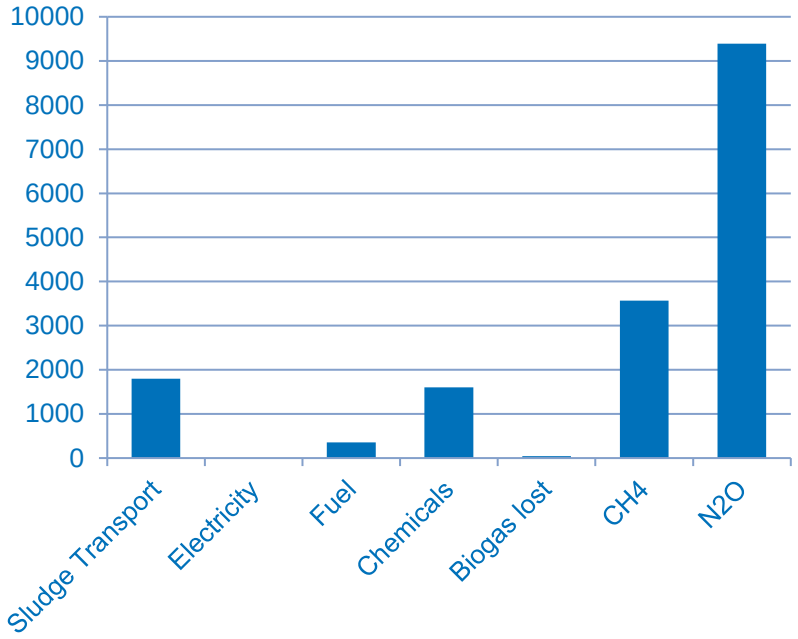
CO_2 neutrality

Climate monitor of 2018

Total: ~4000 tonnes CO_2eq



Total: ~17000 tonnes CO_2eq



STOWA

Risk assessment

Stowa 2019-05

Risk assessment to estimate your emissions

Again, WWTP Kralingseveer should have enormous emissions

Effluent		Risk - High		Risk - average		Risk - low	
	unit	Value	Score	Value	Score	Value	Score
NH_4	mg N/l	> 2	3	> 1 - 2	2	< 1	1
NO_2	mg N/l	> 0.5	6	0.2 - 0.5	4	< 0.2	2

N_2O risk	Indication emission (% of total N-incoming)
low (score < 4)	0,05 (0,01-0,1)
Average (score 4-5)	0,5 (0,1-1)
High (score => 6)	3 (1-5)

New measurements

New sensors a new method

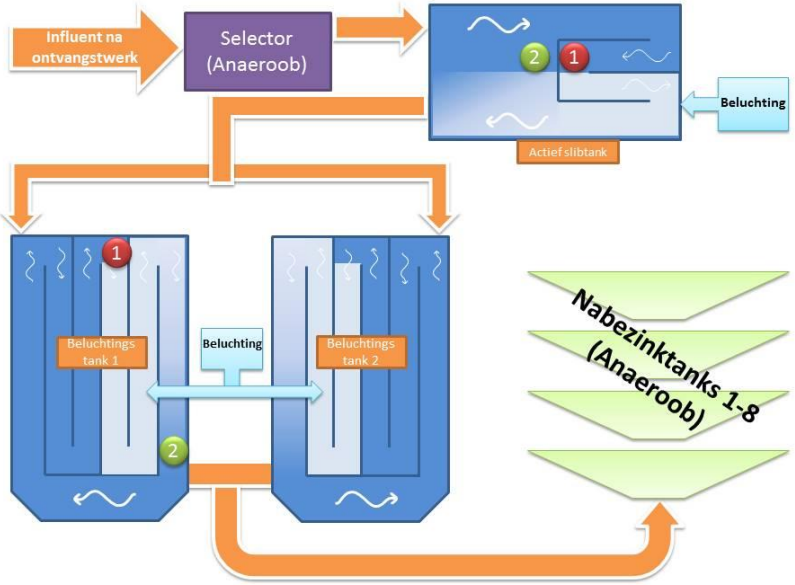
Measuring in the waterphase

- Risk assessment
- Unisense
- How do you reduce when you don’t know what and where you emit it
- Start measuring!

Measurements

Locations

Measure at the start



- Original suggestions were to start measuring at each start of a zone
- Unaerated sensor was moved downstream
- Aerated sensor needed to find a sweet spot

Measurements

Locations

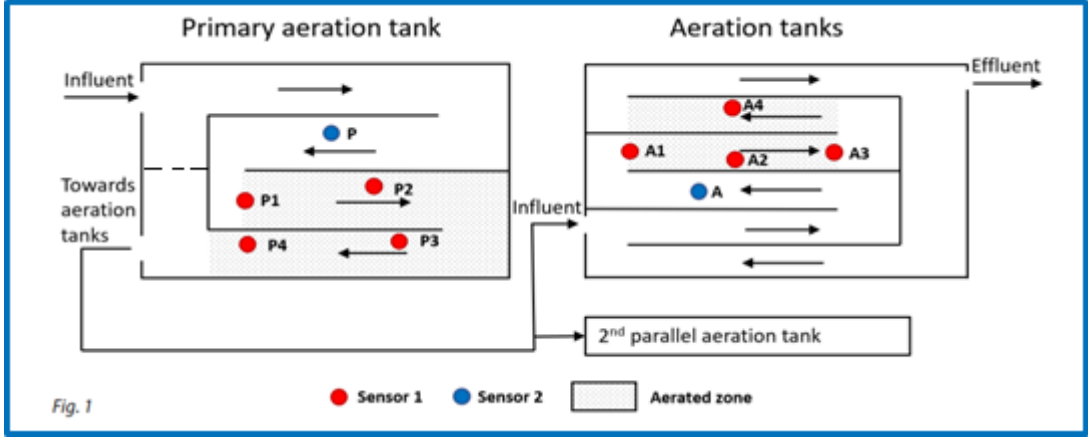
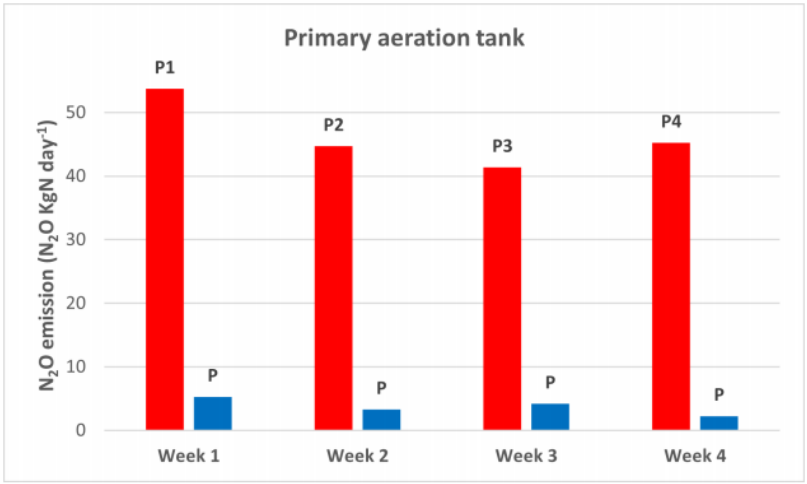
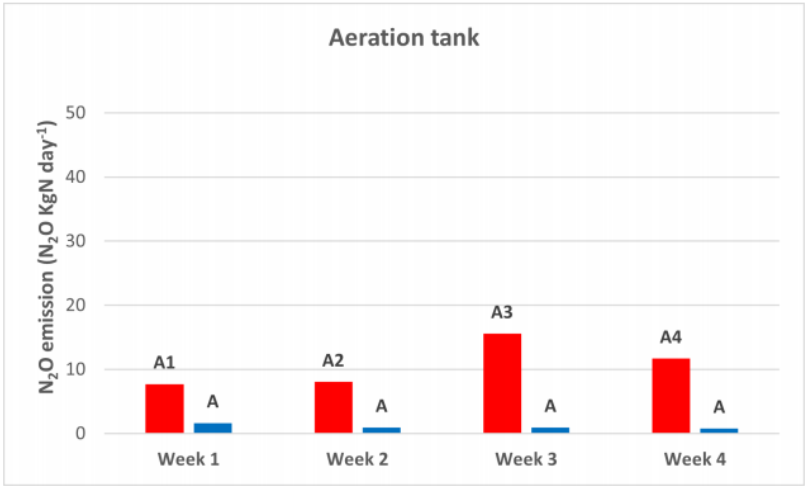


Fig. 1





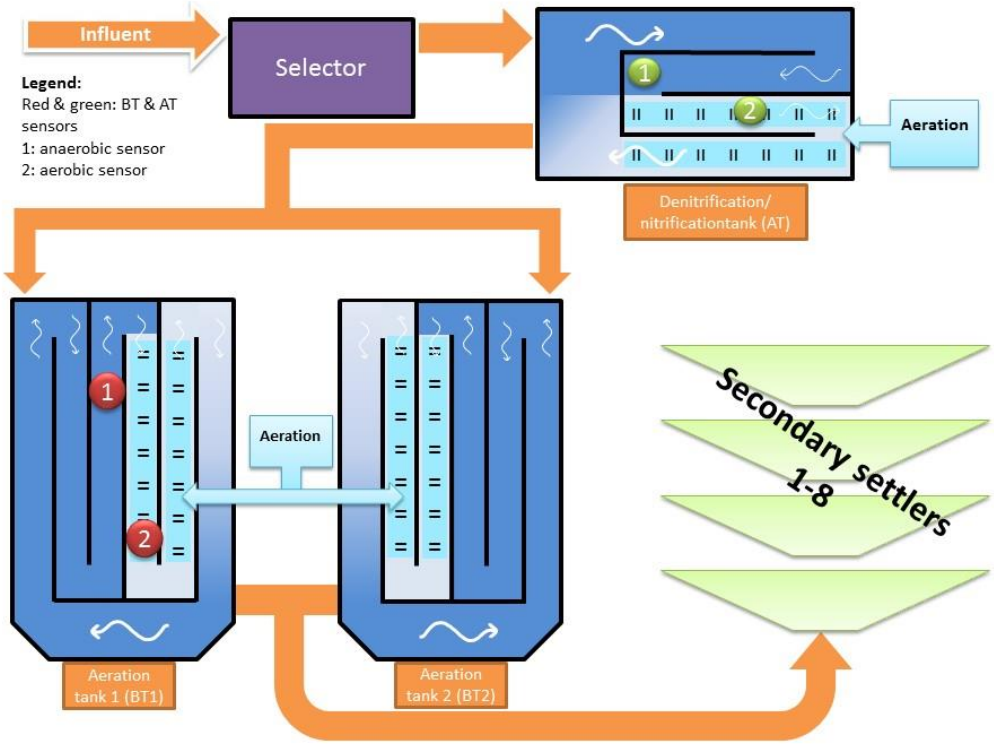
- High load at the start (shock?)
- Similar measure throughout the aeration zone
- Position at P2

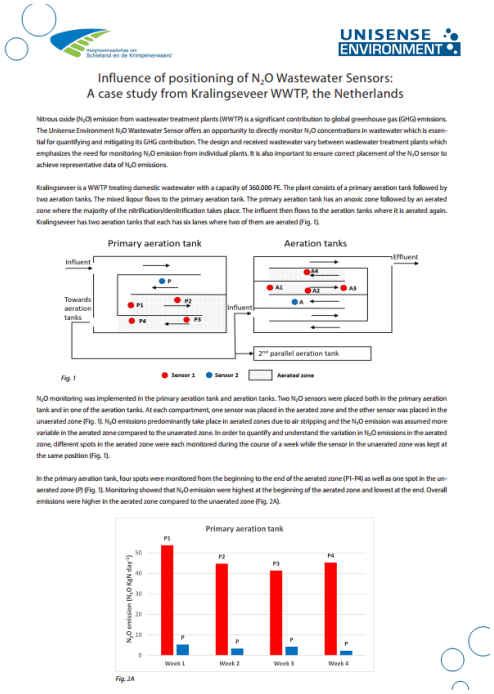
- Higher emissions towards the end (COD limitation?)
- High variation in the zones
- Average emission between A2 and A3

Measurements

Locations

Measuring at new locations





Influence of positioning of N_2O Wastewater Sensors:
A case study from Kralingseveer WWTP, the Netherlands

Nitrous oxide (N_2O) emission from wastewater treatment plants (WWTP) is a significant contribution to global greenhouse gas (GHG) emissions. The Unisense Environment N_2O Wastewater Sensor offers an opportunity to directly monitor N_2O concentrations in wastewater which is essential for quantifying and mitigating its GHG contribution. The design and received wastewater vary between wastewater treatment plants which emphasizes the need for monitoring N_2O emission from individual plants. It is also important to ensure correct placement of the N_2O sensor to achieve representative data of N_2O emissions.

Kralingseveer is a WWTP treating domestic wastewater with a capacity of 360.000 PE. The plant consists of a primary aeration tank followed by two aeration tanks. The mixed liquor flows to the primary aeration tank. The primary aeration tank has an anoxic zone followed by an aerated zone where the majority of the nitrification/denitrification takes place. The influent then flows to the aeration tanks where it is aerated again. Kralingseveer has two aeration tanks that each has six lanes where two of them are aerated (Fig. 1).

Primary aeration tank
Aeration tanks
Influent
Towards aeration tanks
Effluent
2nd parallel aeration tank
Sensor 1
Sensor 2
Aerated zone
Fig. 1

N_2O monitoring was implemented in the primary aeration tank and aeration tanks. Two N_2O sensors were placed both in the primary aeration tank and in one of the aeration tanks. At each compartment, one sensor was placed in the aerated zone and the other sensor was placed in the unaerated zone (Fig. 1). N_2O emissions predominantly take place in aerated zones due to air stripping and the N_2O emission was assumed more variable in the aerated zone compared to the unaerated zone. In order to quantify and understand the variation in N_2O emissions in the aerated zone, different spots in the aerated zone were each monitored during the course of a week while the sensor in the unaerated zone was kept at the same position (Fig. 1).

In the primary aeration tank, four spots were monitored from the beginning to the end of the aerated zone (P1-P4) as well as one spot in the unaerated zone (P) (Fig. 1). Monitoring showed that N_2O emission were highest at the beginning of the aerated zone and lowest at the end. Overall emissions were higher in the aerated zone compared to the unaerated zone (Fig. 2A).

Primary aeration tank
Week 1
Week 2
Week 3
Week 4
Fig. 2A

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Make it part of the weekly routine

One of the many sensors

Cleaning and calibration is something the operators are familiar with

- Daily/weekly route
- Check data on the controller
- Calibrate every two months
- Replace sensor head every 6 months

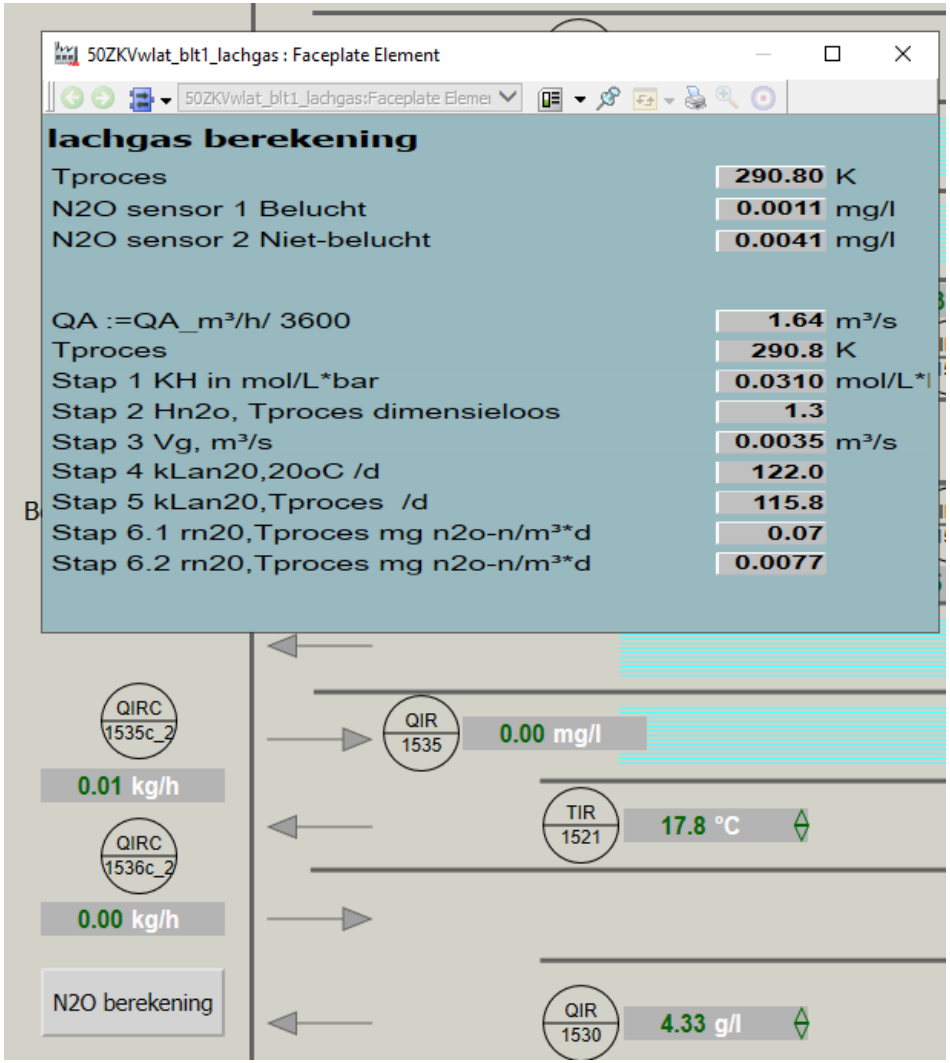
- Quick customer service by Unisense for broken parts

Data analyses

Store it online!

Add it to the process automatization

- Connecting the sensor was quickly done.
- You already have the airflow and the temperature at each moment
- Immediately calculate the emission

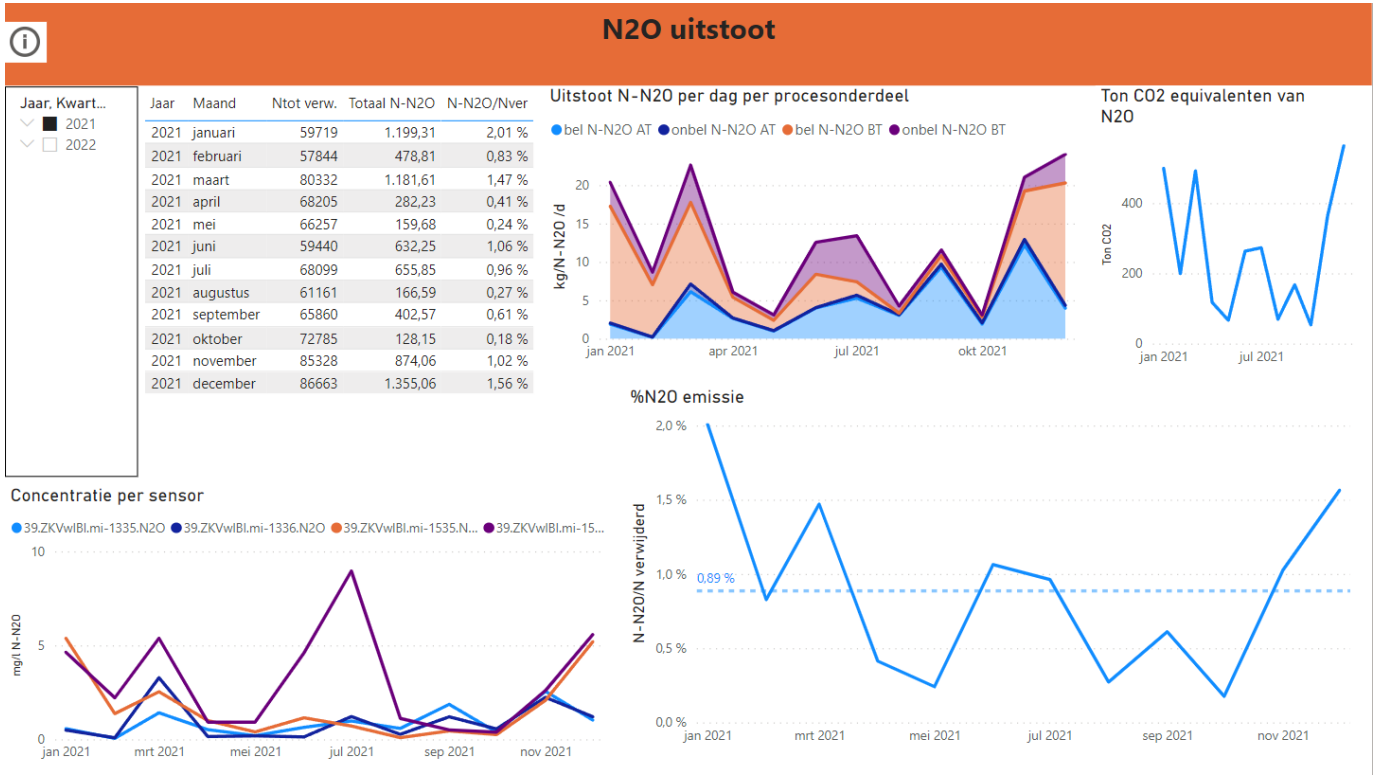


Data analyses

Store it online!

Add it to your reports/ dashboards

- Upload data to central system
- Download all relevant parameters at the same time
- Calculate and visualise the emissions quickly and intuitively



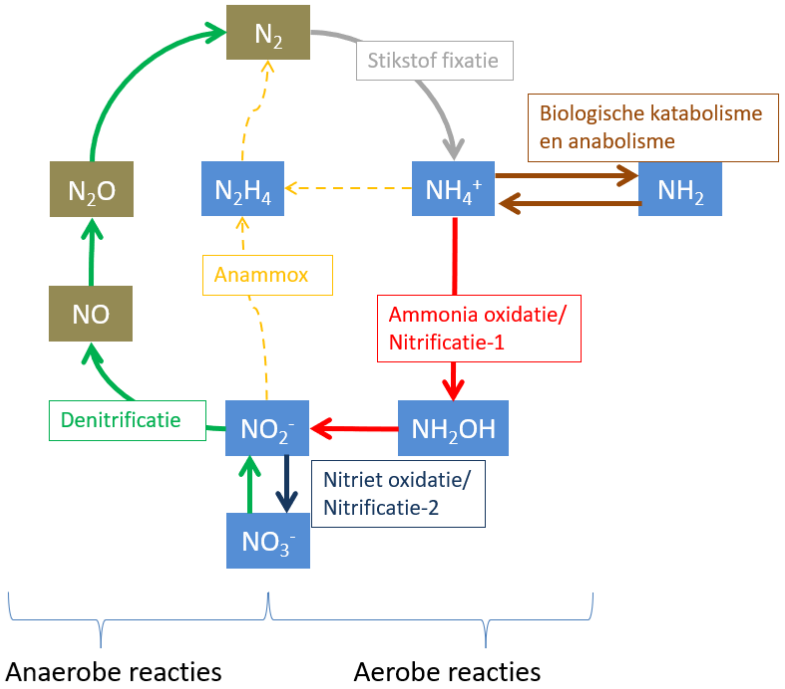
The future

What are the next steps for us

Assessment and research

- DNA sequencing
- Can AI control your plant and take into account N_2O?
- More understanding of origin N_2O
- Can we use this knowledge when designing a new plant?
- What do the emissions look like on low risk plants?

- Long story short, lots of possibilities left to explore



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