The Road Towards
Climate and Energy Neutral
Water Utilities

WORKSHOP

10:30-12:00 Wednesday 14/9

Room B3 g

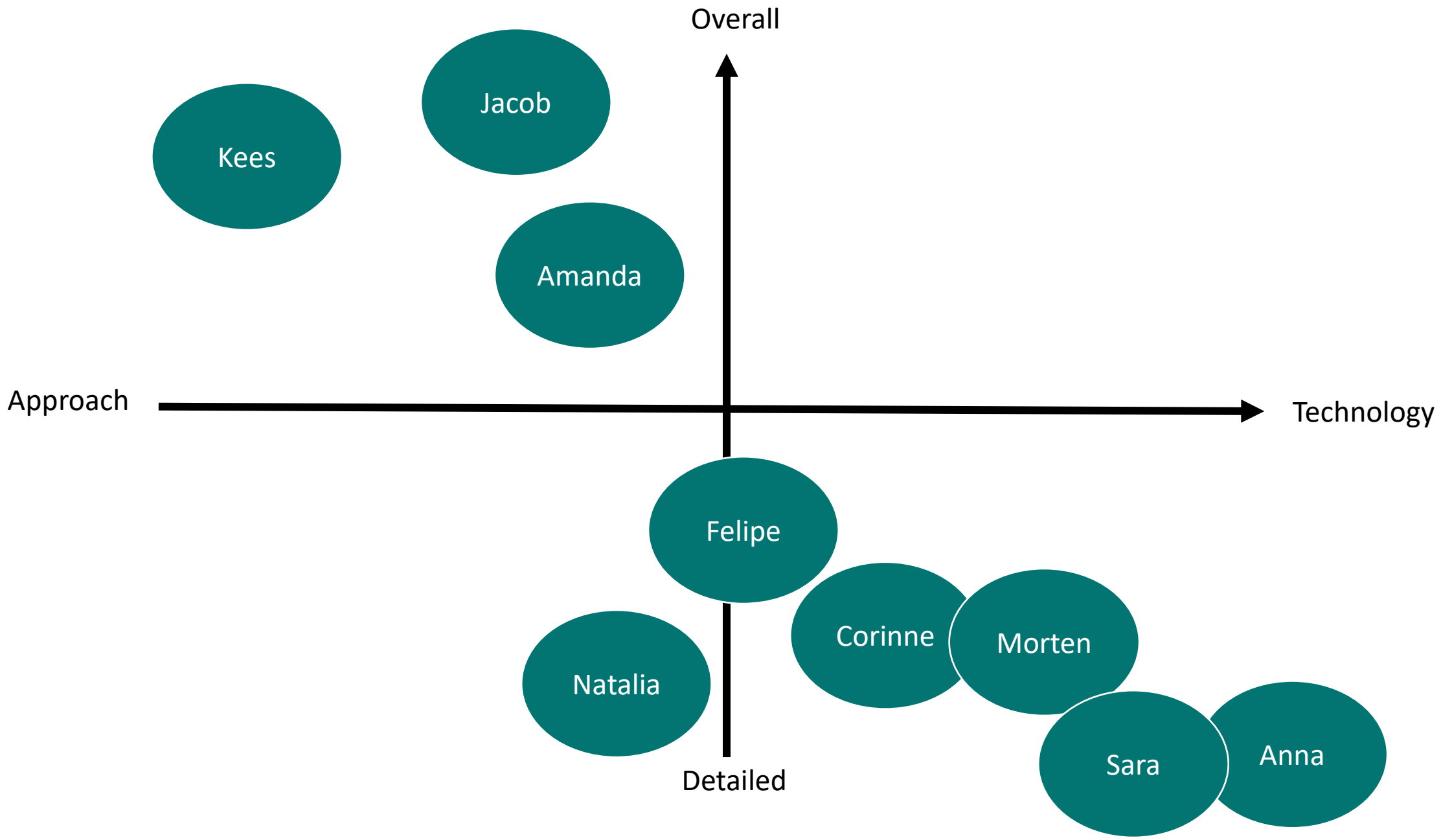
Introduction

- Why are we here today?
  → **Accelerating our work towards climate and energy neutral water utilities**
  - Sharing and discussing experiences from leading water utilities
  - Sharing Nordic Principles for a Climate Neutral Water Sector
  - Making new connections

- IWA Climate Smart Utilities
  - Knowledge sharing
  - Recognition programme

AGENDA:

Welcome & introduction by *Pär Dalheim*, Svenskt Vatten & *Marie R. Sagen*, Bergen Water
Presentation of report – Nordic principles for Climate Neutral Water Sector: *Jacob Kragh Andersen*, Envidan, Denmark
Short pitches – examples of experience from utilities 1. *Kees Roest*, KWR, Netherlands 2. *Amanda Lake*, Jacobs, UK 3. *Corinne Trommsdorf & Nicolas Lesur*, Grenoble Utility, France 4. *Felipe Andres Sanchez* Ihl, Aguas Andinas, Chile 5. *Natalia Adamczyk*, Bergen Water, Norway 6. *Morten Rebsdorf*, Aarhus Vand, Denmark 7. *Sara Ekström*, VA Syd, Malmö, Sweden 8. *Anna Kuokkanen*, Helsinki Region Environmental Services HSY, Finland
World café – discuss with presenters at tables. Each participant chooses which table to discuss on.
Feedback from tables and wrap-up discussion, every table to share one insight from the table discussion, facilitated by invited expert Jacob & the two workshop chairs


Overall
Jacob
Kees
Amanda
Approach
Technology
Felipe
Corinne
Morten
Natalia
Sara
Anna
Detailed

EnviDan

Nordic Principles

- for a climate neutral water sector

Jacob Kragh Andersen, Envidan
14th September 2022
IWA WWCE, Copenhagen

Overall aim and content

- Report: Nordic principles for a climate neutral water sector
- Overall aim: *"…reach a common understanding of national climate accounting models"*

  "…not to create a common Nordic model since all countries are already working on national models"

  "…create common principles for making climate accounting models for the water sector in the Nordic countries"

- Content:

Part I: Background and status in the four Nordic countries and presentation of common principles

Part II: Application of common principles and examples of use of climate accounting models (real data from utilities in the four Nordic countries).

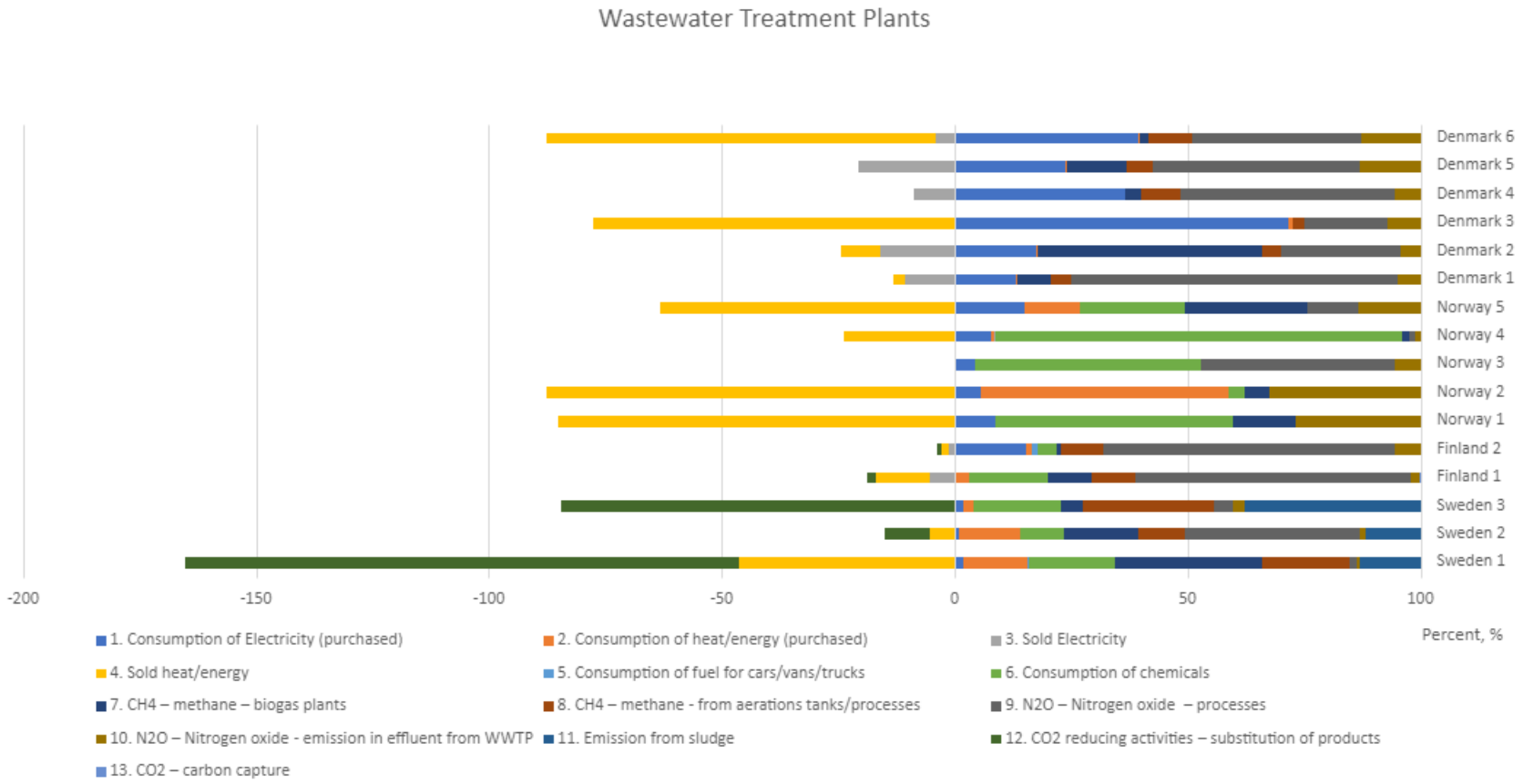
Part I: Common Principles

- Cooperate and learn from each other
- Include all emissions (and avoided emissions) from both water supply (water works), transportation of wastewater (sewage system) and Wastewater treatment (WWTPs)
- Start by including the operational level – emissions from construction and demolition can be included in a later phase
- Start measuring climate emissions and establish baseline calculations
- Emission factors should be based on latest calculations, measurements, scientific results
- Keep the model and reporting as simple as possible, while still including the most important contributions
- Start by selecting contributors where data availability and significance is high

	Parameter	Data availability	Importance		Comments	Suggested result
WW	Consumption of electricity and heat	Good	Medium		Typically, low consumption, easy to evaluate	●
	Consumption of chemicals	Good	Low	Medium	Typically, low consumption, easy to evaluate	●
	Handling of residues	Good	Low		Typically, low production, easy to evaluate	●
	Transportation	Good	Low		Typically, low contribution, easy to evaluate	●
	Afforestation	Medium	Medium		Not a typical parameter for the water sector, but might be relevant	●
	Other CO_2 reducing activities	Variable	Medium	High	New reduction measures in relation to N_2O emissions from WWTP. Important to reach climate neutrality	●
Sewers	Consumption of electricity and heat	Good	Medium		Typically, relatively low consumption, easy to evaluate	●
	Production of pipes	Not relevant, since the focus is on the operation phase				
	Construction	Not relevant, since the focus is on the operation phase				
	Handling of filter materials	Good	Low		Typically, low consumption, easy to evaluate	●
WWTP	Consumption of electricity and heat	Good	Medium	High	High consumption, but varying EF for production, e.g., high in Denmark, low in Sweden.	●
	Consumption of fuel	Good	Low		Typically, low consumption, easy to evaluate	●
	Sold energy	Good	High		Typically, high amount, easy to evaluate	●
	Consumption of chemicals	Good	Medium	High	Variable amounts, e.g., low chemical consumption in Denmark, high in Sweden. Easy to assess.	●
	Consumption of filter materials	Good	Low		Typically, low consumption, easy to evaluate	●
	Sludge handling	Medium	Medium	High	Typically, low contribution, relatively easy to evaluate	●
	Transportation	Medium	Low		Typically, low contribution, but might be tricky to evaluate transportation distances (e.g., for sludge disposal)	●
	CH_4 emissions (biogas)	Low*	High		High contribution, typically. Bad data availability unless the emissions are measured at the specific WWTP	●
	N_2O emissions (process)	Low*	High		High contribution, typically. Bad data availability unless the emissions are measured at the specific WWTP	●
	N_2O emissions avoided	Not relevant, since the focus is on the operation phase				
	CH_4 from septic tanks	Medium	Medium		Significant contribution, but variable importance due to variations in number of septic tanks in different areas	●
	P recycling (subs. of virgin P)	Medium	Low		Typically, small amounts of recovered P	●
	N_2O emissions, effluent	Low	Medium		Not a lot of specific data, but might be significant	●
	Emissions, use of sludge	Variable	Variable		Large variations depending on the use (use on land, incineration, pyrolysis etc.). Significant contribution	●
	Avoided emissions, use of sludge	Variable	Variable		Large variations depending on the use (use on land, incineration, pyrolysis etc.). Significant contribution	●
	CH_4 emissions, effluent	Medium	Medium		Not a lot of specific data, but might be significant	●
	Carbon binding	Medium	Medium		Not a lot of specific data, but might be significant	●
New	CH_4 from sewer systems	Low	Low	Medium	Not a lot of specific data, but might be significant	●
	CH_4 from WW	Low	Low	Medium	Not a lot of specific data, but might be significant	●
	Chemicals, sewer	Good	Low		Typically, low consumption, relatively easy to evaluate	●

Part II – example, climate accounting WWTP

- Utilities from the four Nordic countries have delivered data from:
  - 14 water works
  - 12 sewer systems
  - 16 wastewater treatment plants
- Large variations between utilities and between countries
- All data is available in the final report – Part II



Take home messages

- Start by measuring emissions and avoided emissions (make baseline)
- Start by focusing on the most significant contributors
- Set ambitious targets
- It is possible to calculate the emissions, set targets, and follow progress

- When you are comfortable with climate accounting for the operational phase, you can start with the construction phase

20-9-2022

Climate Neutrality as part of Circularity

Kees Roest (KWR, the Netherlands)
Senior Scientific Researcher - Energy & Circular Systems
Project Manager
Program Manager TKI Water Technology KWR

KWR

Bridging Science to Practice

Definition Circular Economy

- Fysical dimensions (like substance flows)
- Socio-economic values (like efficient, social responsible, quality of life)

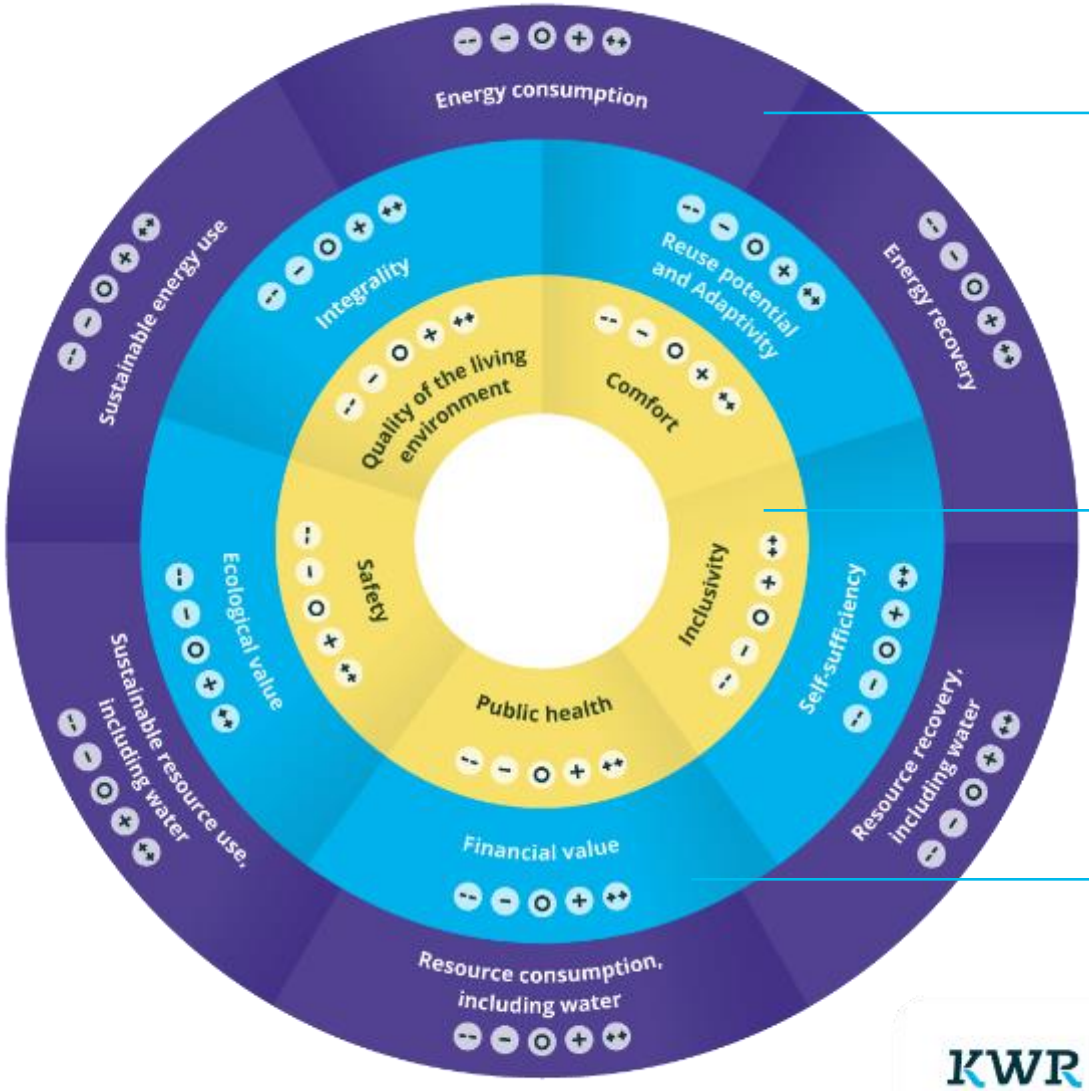
Definition Circular Economy according to the SER*:

An economy that handles products, materials and resources efficiently and in a *socially responsible* manner *within ecological preconditions*, so that future generations also retain access to material prosperity.

*The Social and Economic Council of the Netherlands:

- an advisory body in which employers, employees and independent experts (Crown-appointed members) work together to reach agreement on key social and economic issues. (https://www.ser.nl/en/SER/About-the-SER/What-is-the-SER, Sociaal-Economische Raad (2016) Advies Werken naar een circulaire economie: geen tijd te verliezen, p. 11)

New dashboard model for the water sector



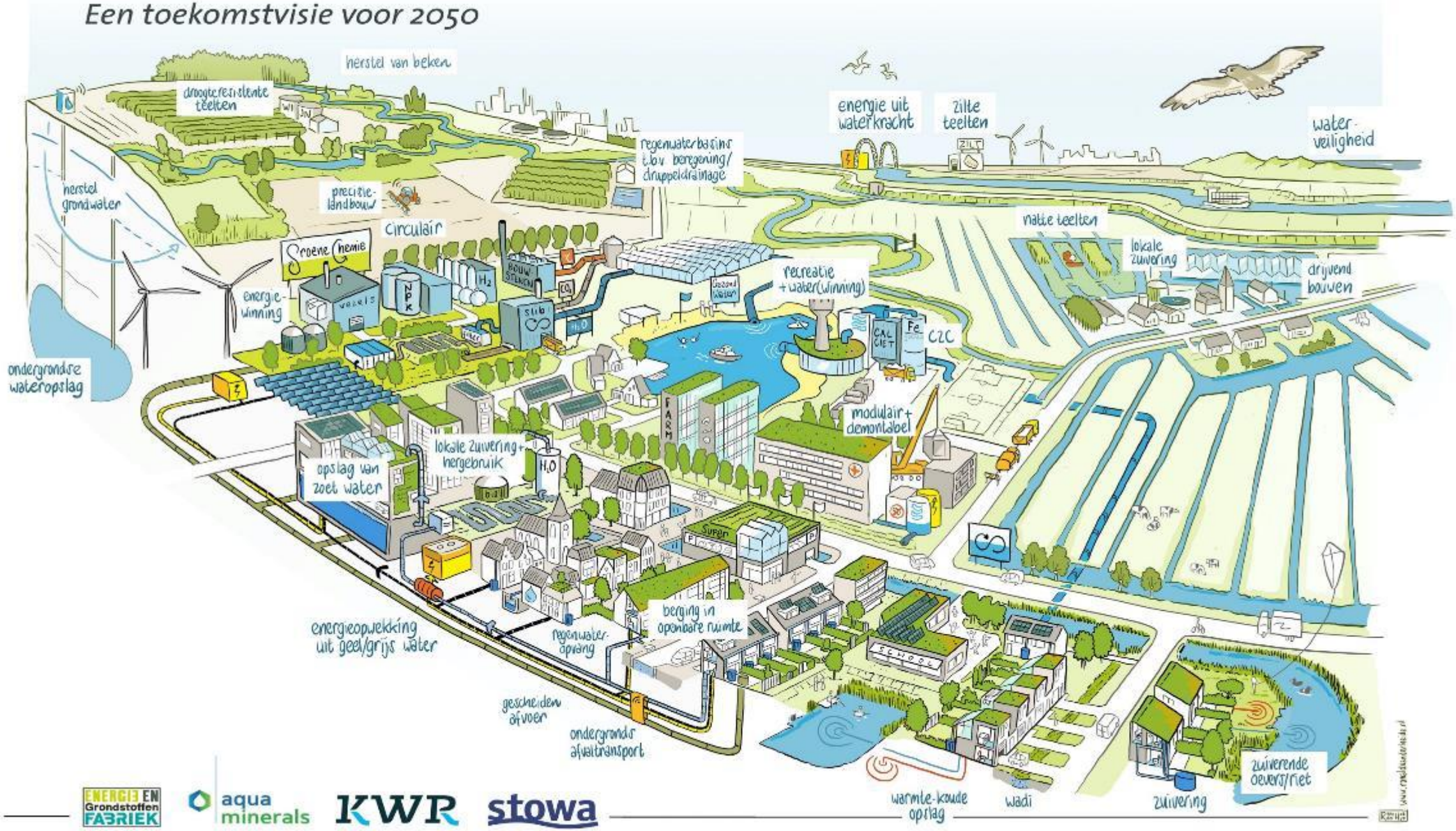
Energy and substance flow: physical characteristics

Values for people: socio-political characteristics

System properties: characteristics at system level

Naar een circulaire waterketen

Een toekomstvisie voor 2050



ENERGIE EN Grondstoffen FABRIEK aqua minerals KWR stowa

KWR

Groningenhaven 7
3433 PE Nieuwegein
The Netherlands

T +31 (0)30 60 69 511
E info@kwrwater.nl
I www.kwrwater.nl

@KWR_Water KWR KWR_Water

Kees Roest KWR
Senior scientific researcher
Energy &Circular Systems
kees.roest@kwrwater.nl
+31 30 606 9531

The collective research programme Water in the Circular Economy (WiCE) involves the joint research of the water companies and of stakeholders in and associated with the water cycle, with the objective of contributing to the societal challenges regarding the circular economy, climate adaptation and the sustainable energy transition.

Jacobs Challenging today. Reinventing tomorrow.

The journey to net zero – experience from the UK and Irish water sector

Amanda Lake

Head of Carbon and Circular Economy – Water Europe

Decarbonisation progress in the UK and Irish sector

c2005

- Sector starts operational GHG reporting

2019

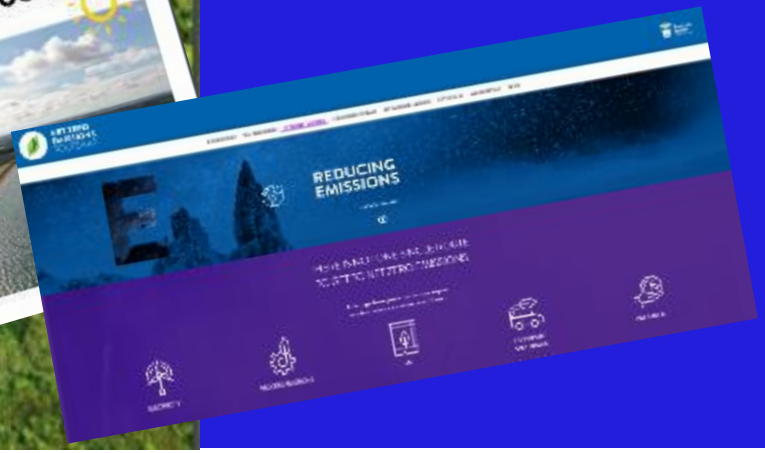
- Pledge to net zero 2030

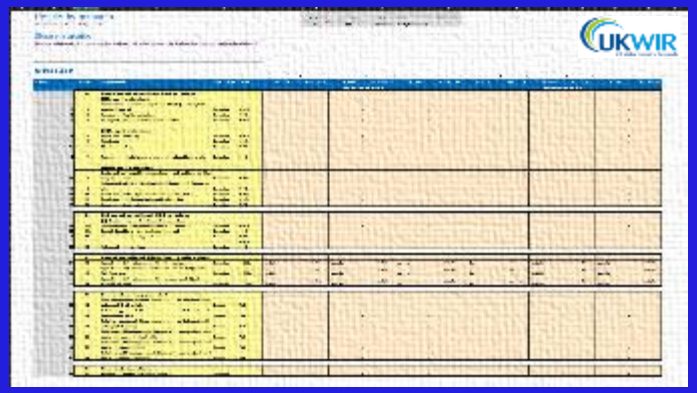
2020

– 2030 Net Zero Routemap

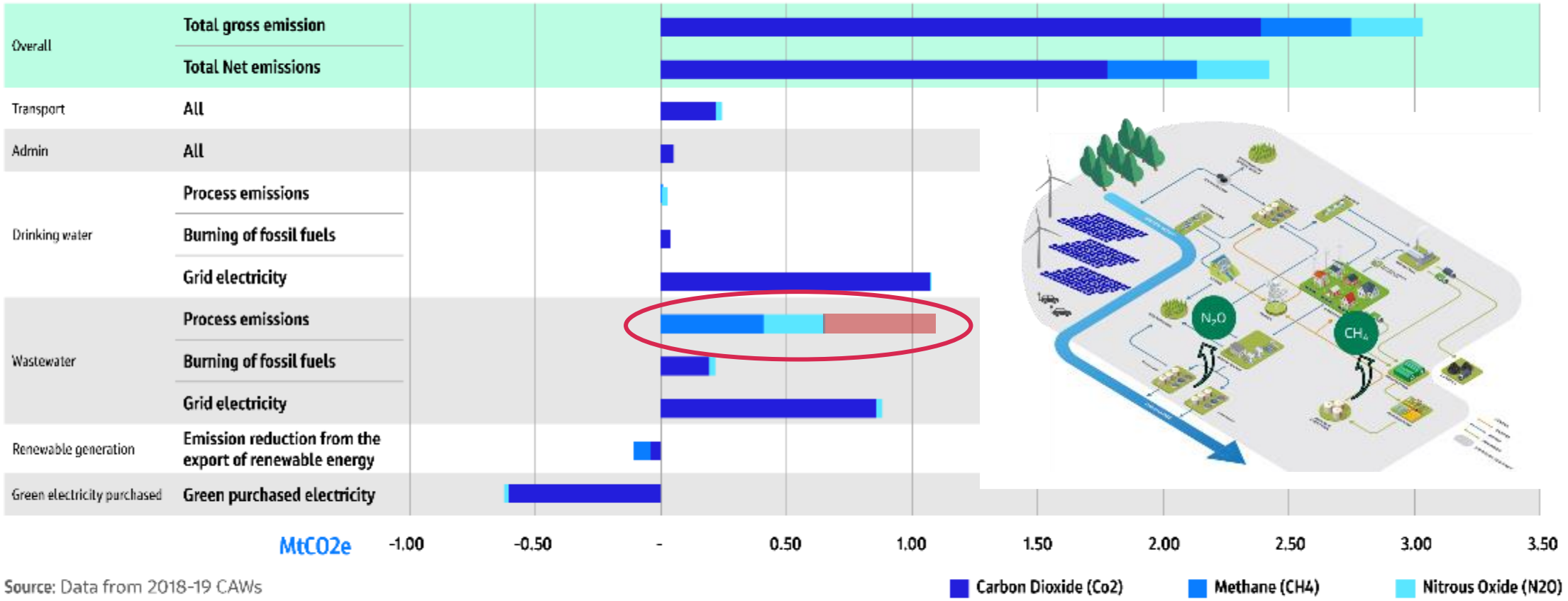
2021 ->

– Individual company efforts





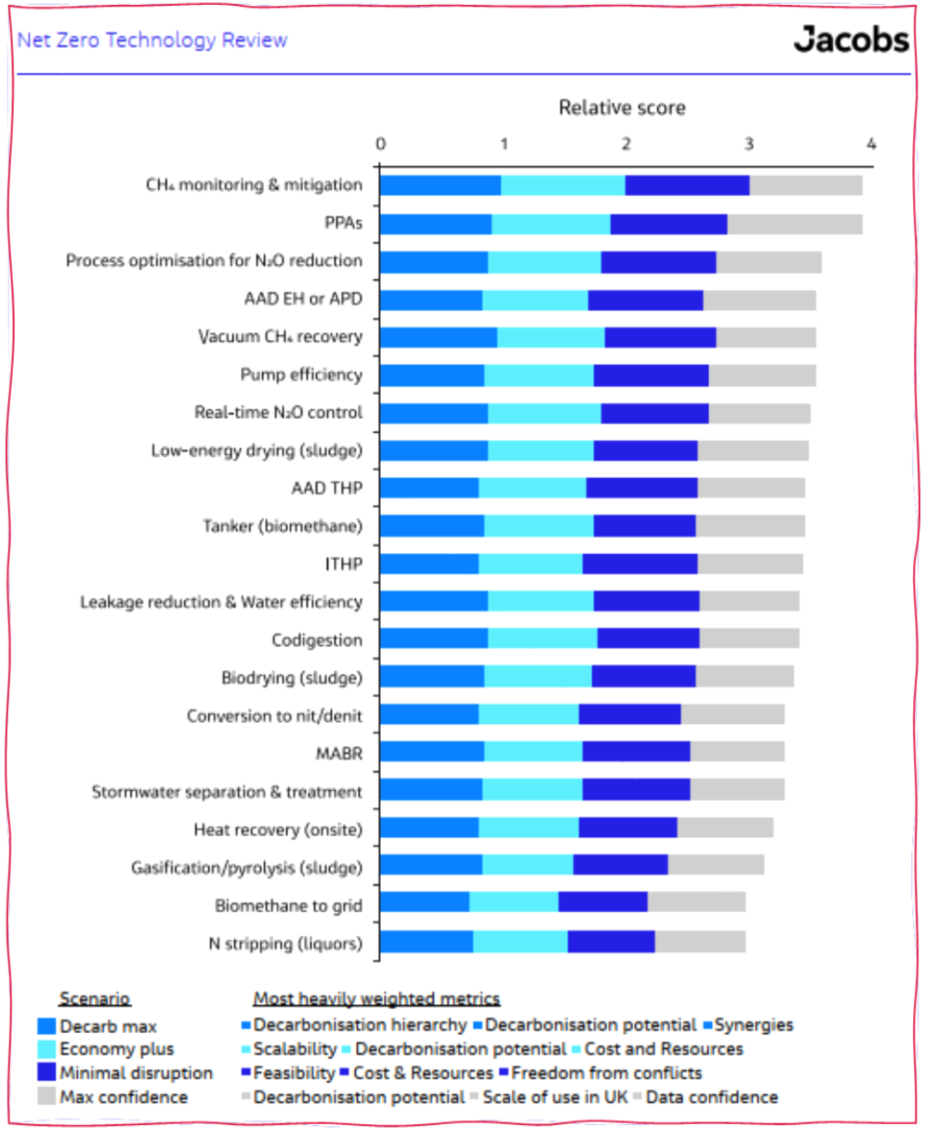
Current industry baseline for *operational GHG emissions*



Likely underestimation of N_2O!

Ongoing net zero work … and challenges

- Process emissions
- *Net zero technologies review*
- Innovation projects
- UK Gov Waste sector inventory improvement
- Circular Economy – soil carbon, N, biochar
- Capital carbon



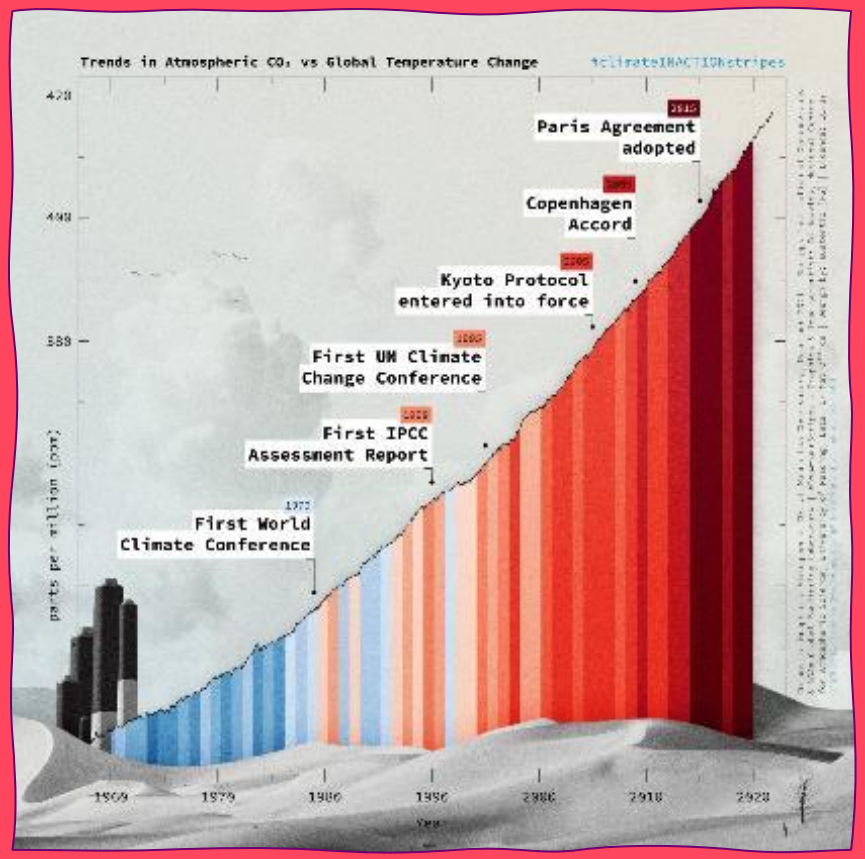
Funding for net zero

Environmental performance issues

PFAS, microplastics and sludge to land

Thank you!

amanda.lake@jacobs.com



GRENOBLE ALPES MÉTROPOLE

Recognised IWA the international water association Climate Smart Utility

Nicolas Lesur
Director for Wastewater Services

Towards “Net Zero” Wastewater Services Grenoble, France

The road towards climate and energy neutral water utilities

IWA the international water association

Presentation

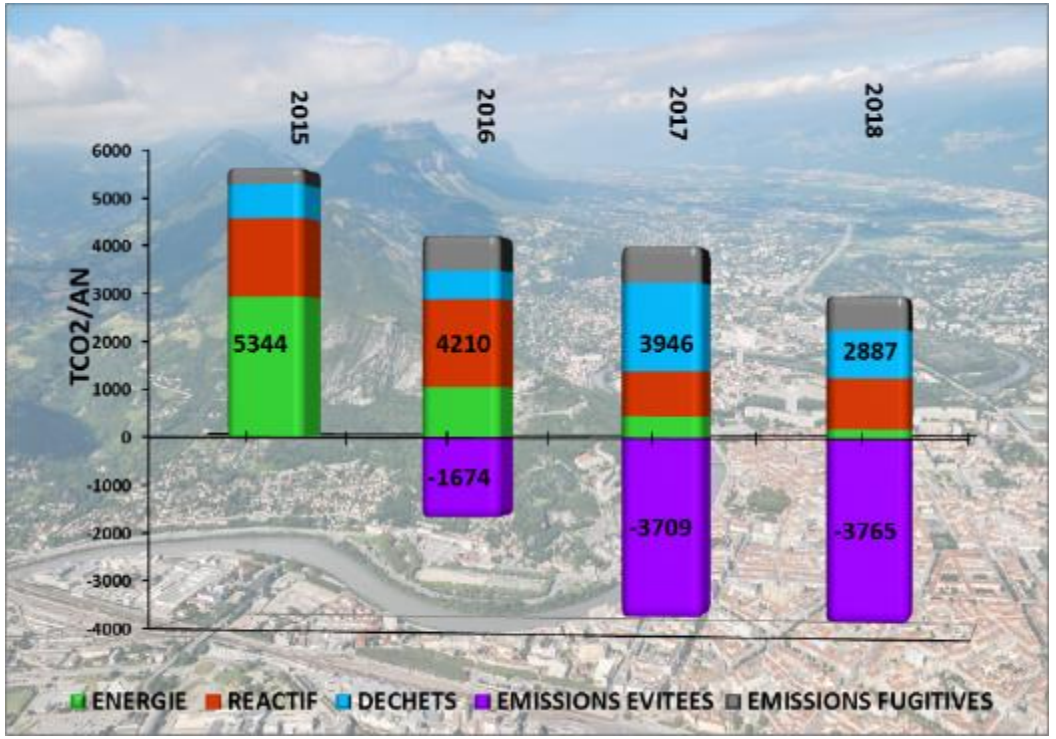
Nicolas LESUR : Director of the Sanitation Board

The community : GRENOBLE ALPES METROPOLE - FRANCE
(49 municipalities – 450 000 inhabitants)

Sanitation utility : 100% public service
2,000 km of networks – 160 lifting stations
AQUAPOLE : Wastewater treatment plant – 650 000 EH (capacity)

Towards “Net Zero” Wastewater Services

Long term support of the governance to set carbon neutrality as a target -> achieved since 2018



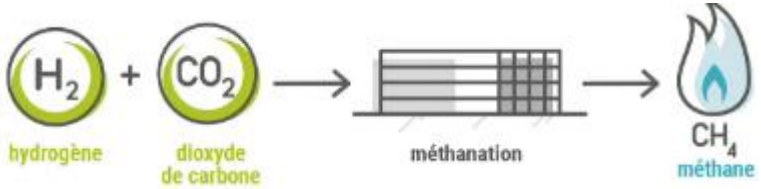
- Heat recovery from incinerator
- Biogas transformation in biomethane for injection in city grid
- Reduction in carbon footprint of purchases
- Reducing chemical consumption (no more foculation on the primary sedimentation tank)

GRENOBLE ALPES MÉTROPOLE

Towards “Net Zero” Wastewater Services

Actions in planning :

- Evaluate the potential to reduce the use of the N-Biofilter
- Oils & fats valorisation
- Selling CO2 to third party; transformation of CO2 in CH4 through methanation



- Reducing our electricity consumption

  Sectorization of our consumption and analysis by artificial intelligence

QUALISTEO
Rethinking Energy Efficiency

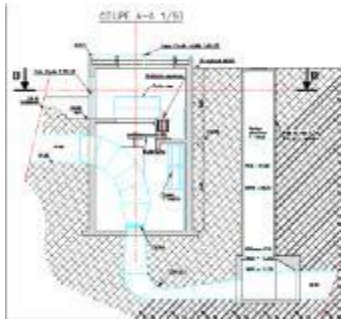
QUALISTEO'S INNOVATIVE TECHNOLOGY ENABLES COMPANIES TO UNDERSTAND THEIR CONSUMPTION AND REDUCE IT BY 15%.

Towards “Net Zero” Wastewater Services

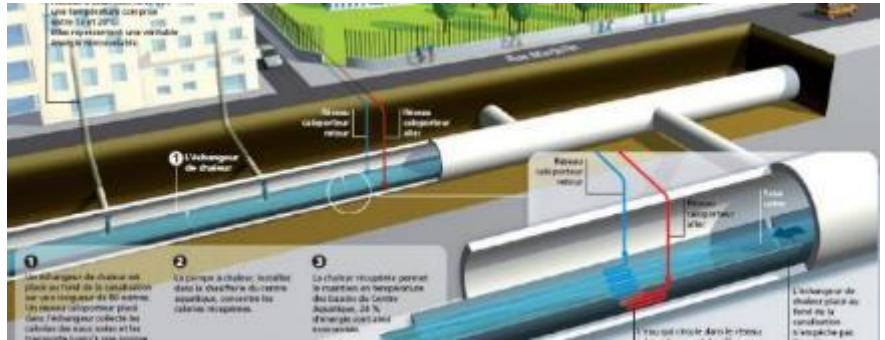
Actions to be initiated :

- Reducing N2O emissions from the process : The N2O emissions were underestimated, and caused the assessed emissions to grow and point the need for further action to be carbon neutral

- Turbine treated water



- Recovering calories from wastewater



GRENOBLE ALPES MÉTROPOLE

THANK YOU FOR YOUR ATTENTION

Recognised

IWA the international water association

Climate Smart Utility

AGUAS andinas

Steps to achieve climate neutrality

Aguas Andinas

Chile

Felipe Sánchez
Head of Rural Services
Climate Action Envoy

September 2022

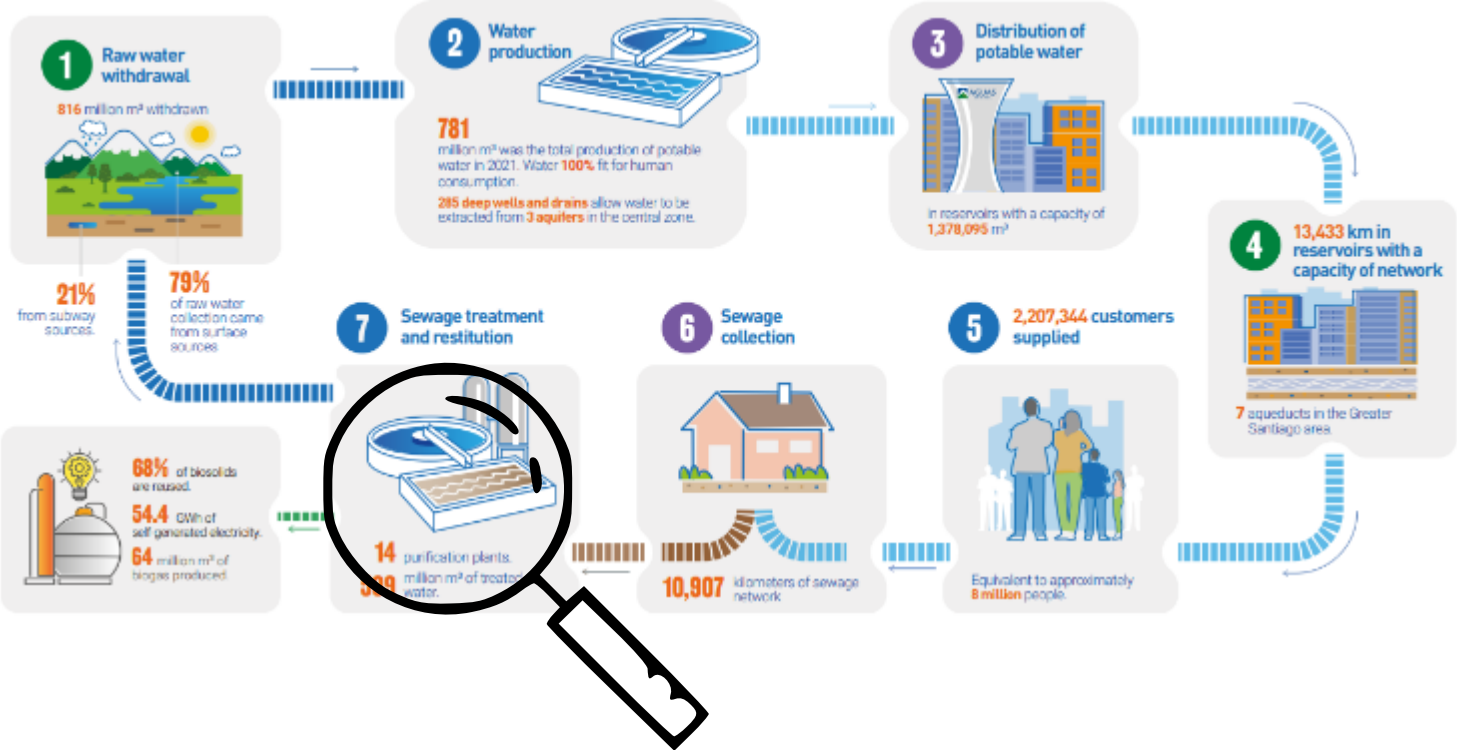
AGUAS andinas

First Act: Estimate

Picture of the current state

Quantify

ISO 14067 standard or other methodology

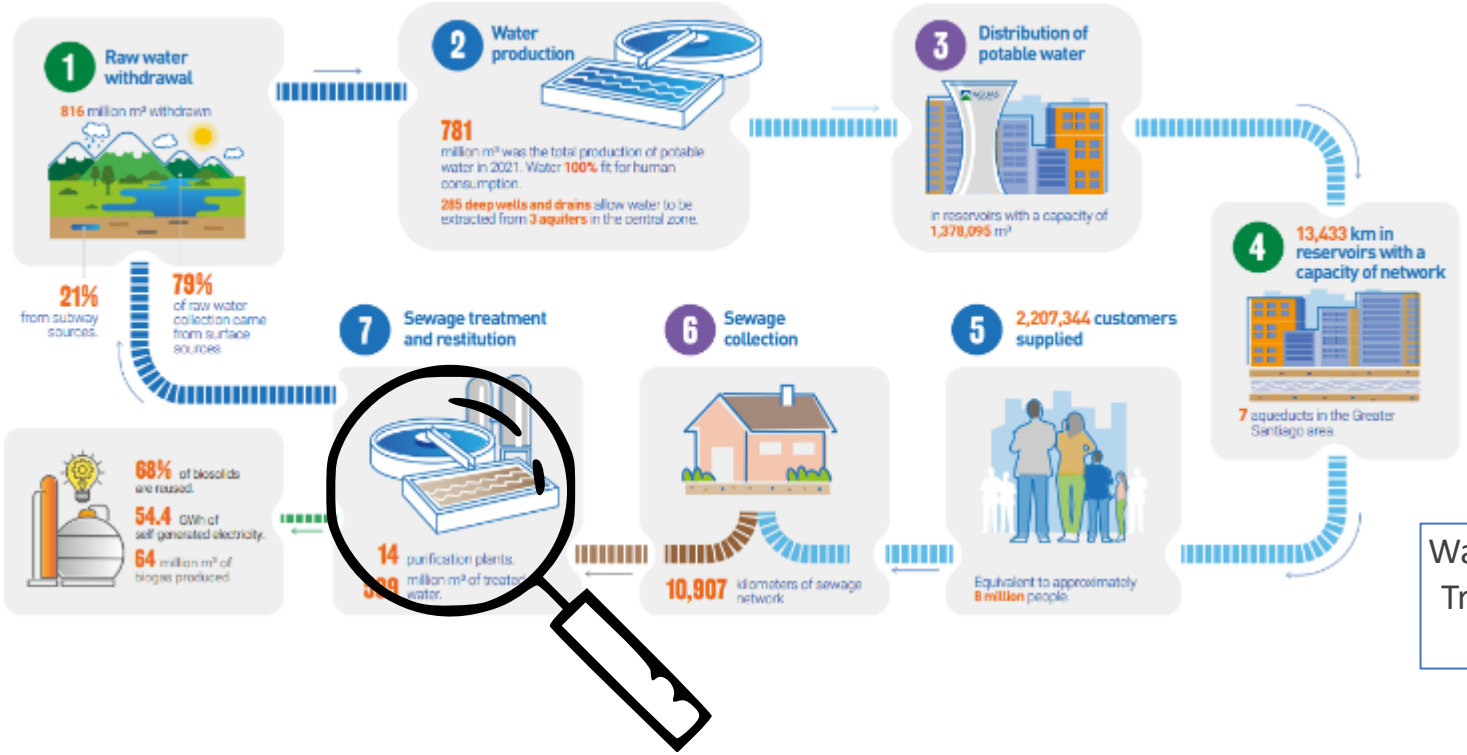


First Act: Estimate

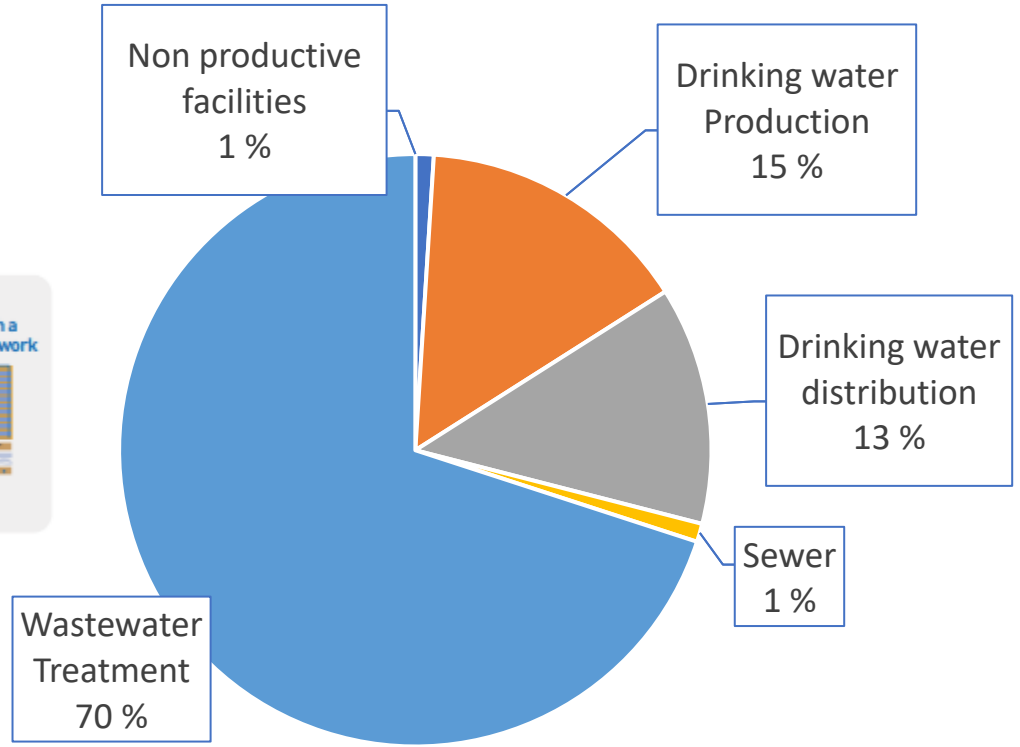
Picture of the current state

Quantify

ISO 14067 standard or other methodology



Current state



2/4

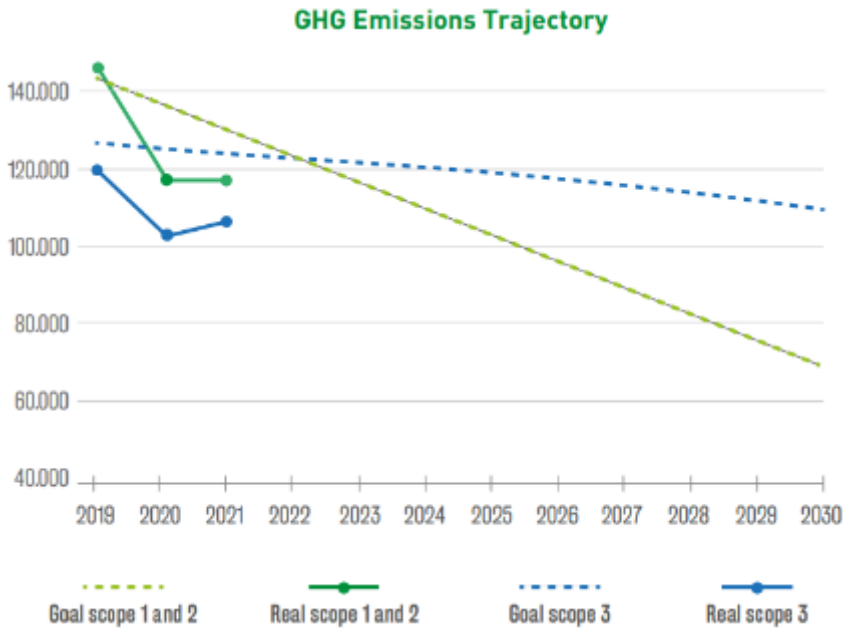
How does the movie end?

Choose your Fight

Trajectory

REDUCE
54%
Scope 1 and 2 CO_2 emissions considering 2017-2018 average as base year.

REDUCE
16%
Scope 3 CO_2 emissions, considering as base year the average of 2017-2018.

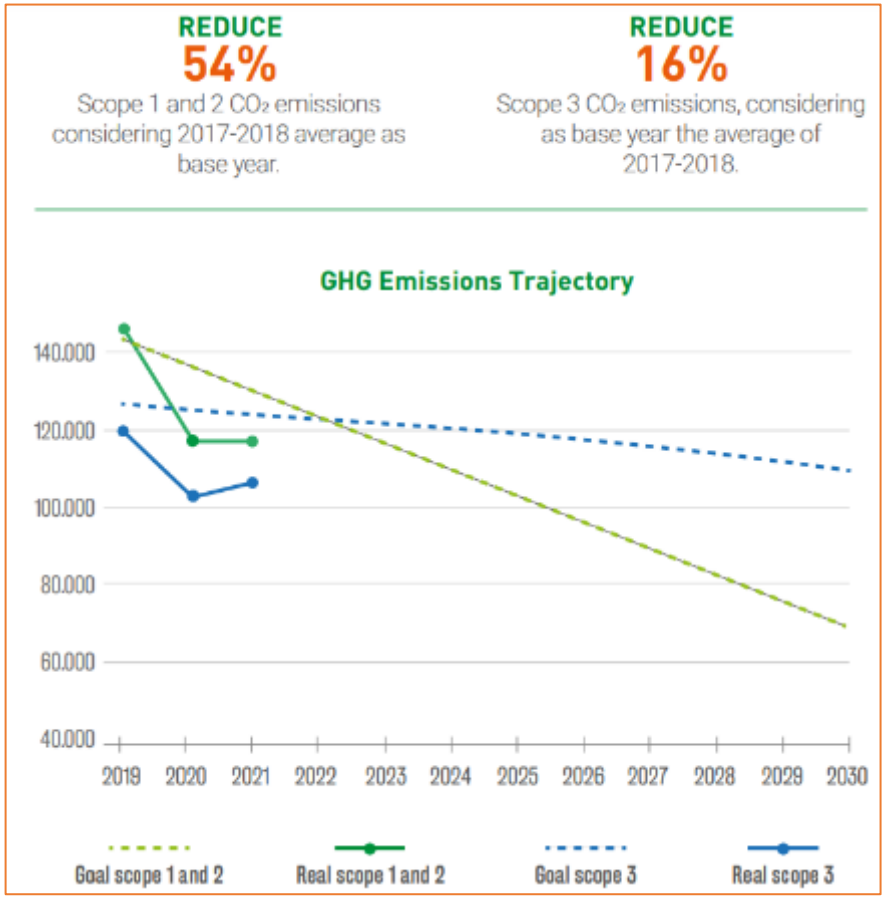


2/4

How does the movie end?

Choose your Fight

Trajectory



Continuous Simulations

Scenario 1

Year 1 •Project 1 •Project 2 → Year … Project … → Year n •Project n •Project n+1

Scenario 2

Year 1 •Project 1' •Project 2' → Year … Project … → Year n •Project n' •Project n'+1

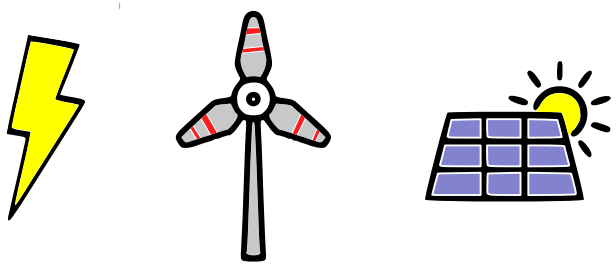
Other scenarios

3/4

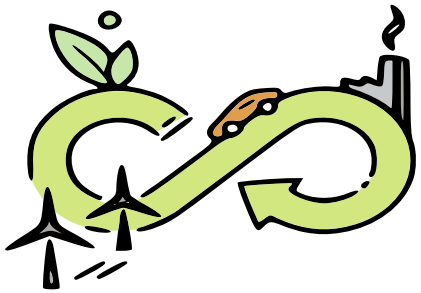
Act

Change patterns and paradigms

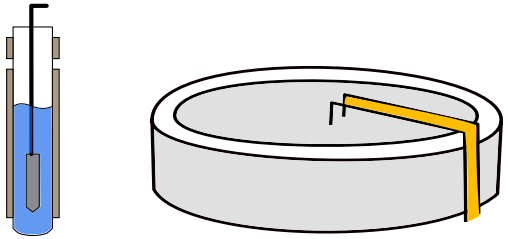
Increasing self-generated energy and prioritizing renewable energy direct purchases



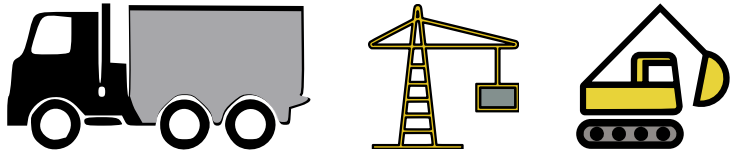
Circular economy vision



Promoting more efficient and lower-impact processes



Involving the supply chain



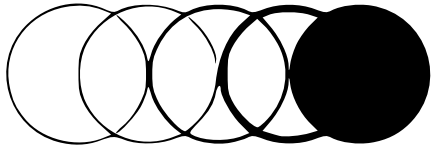
Paradigm Shift

Where Status Quo is the norm

Old company

Low rotation

High momentum



Paradigm Shift

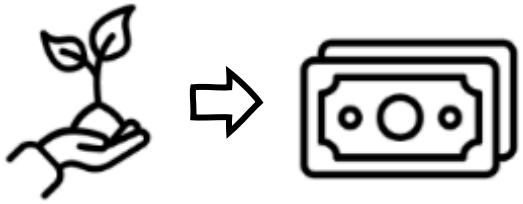
Where Status Quo is the norm

Old company

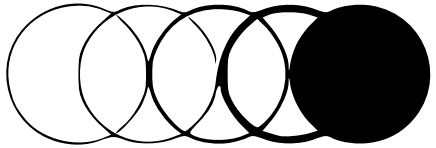
Mitigation and Adaptation pay off

Low rotation

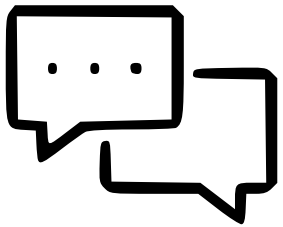
Incentives



High momentum



Communication



Thank you

Recognised

IWA

the international water association

Climate Smart Utility

Picture: www.freepik.com

Developing climate footprint calculations to achieve climate neutrality

Three critical steps for optimizing the benefits of your footprint calculations

bergen vann

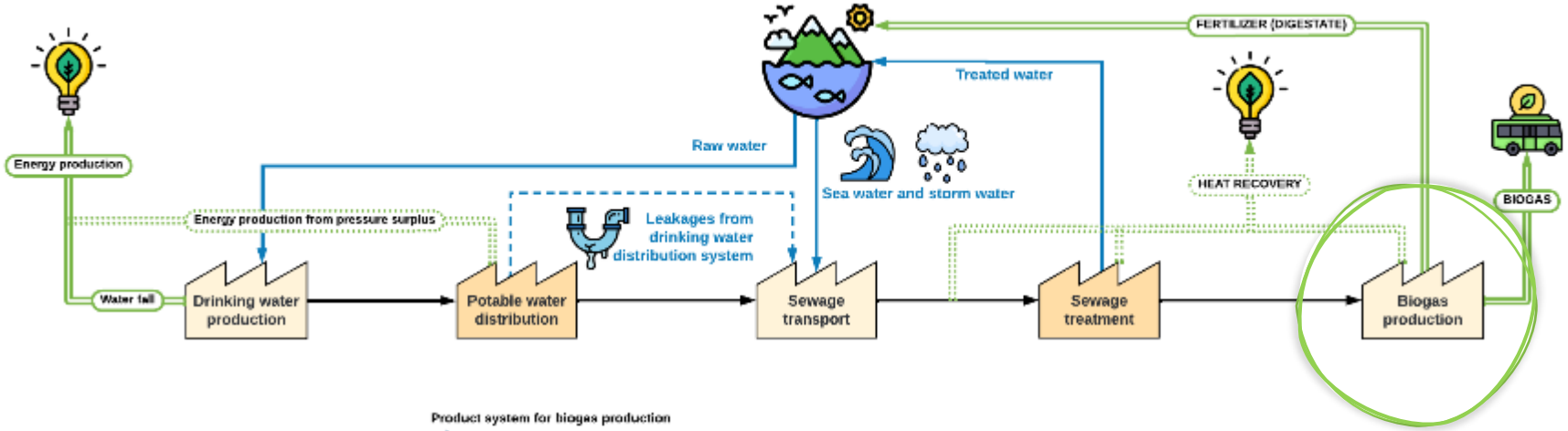
Natalia Adamczyk – Senior Engineer

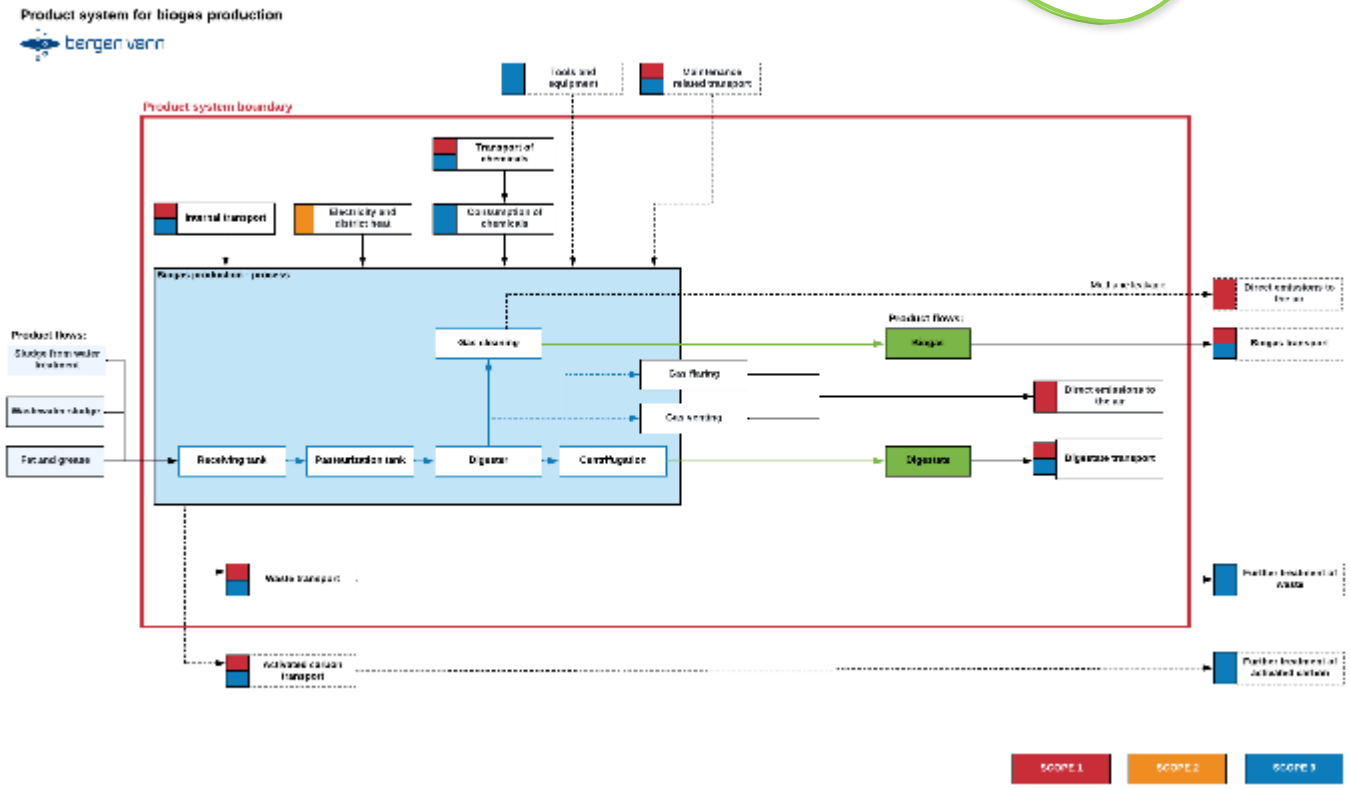
Bergen Vann – Bergen Municipality's

Water, Wastewater and Urban drainage Utility

Norway

STEP 1. KNOW YOUR VALUE CHAIN



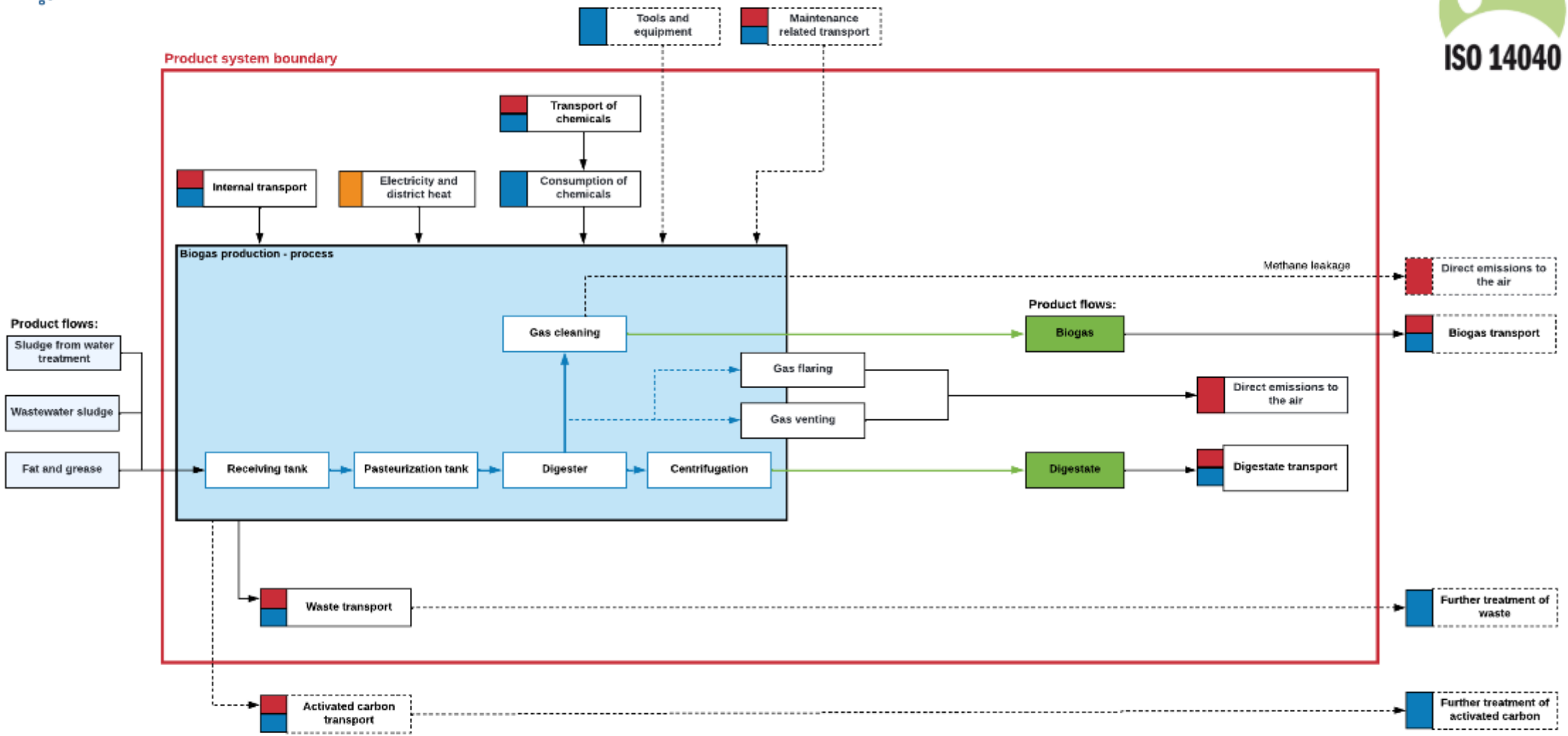


bergen vann

Product system for biogas production

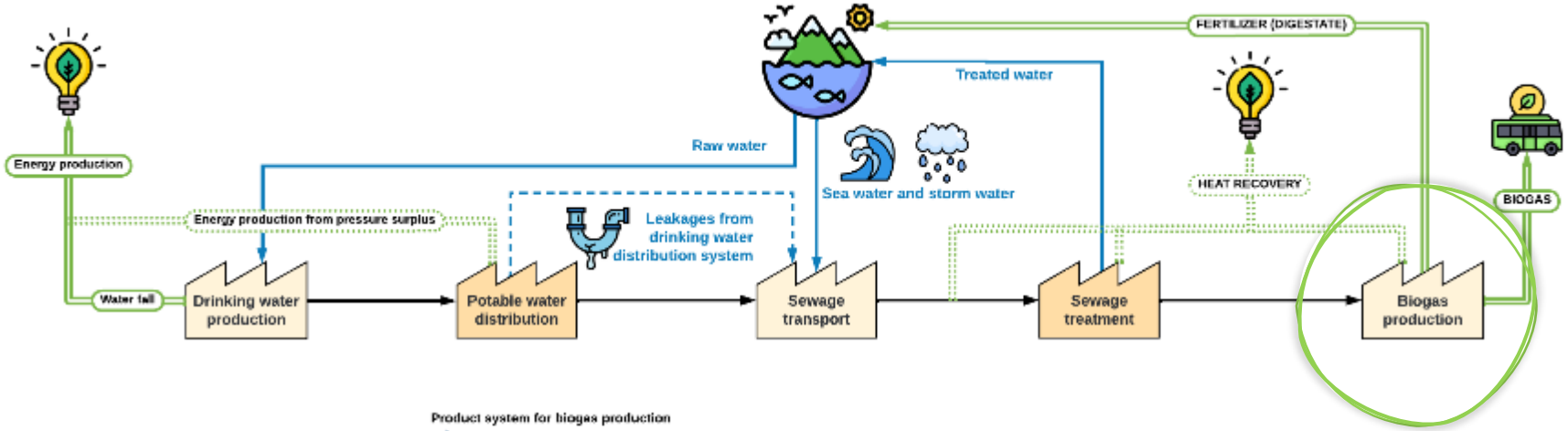
bergen vann

ISO 14040



bergen vann

SCOPE 1 | SCOPE 2 | SCOPE 3



STEP 2. IDENTIFY YOUR EMISSIONS

Energy consumption.

Chemicals consumption.

Direct emissions from flaring.

District heat consumption.

Direct and indirect emissions from transport.

Production of energy.

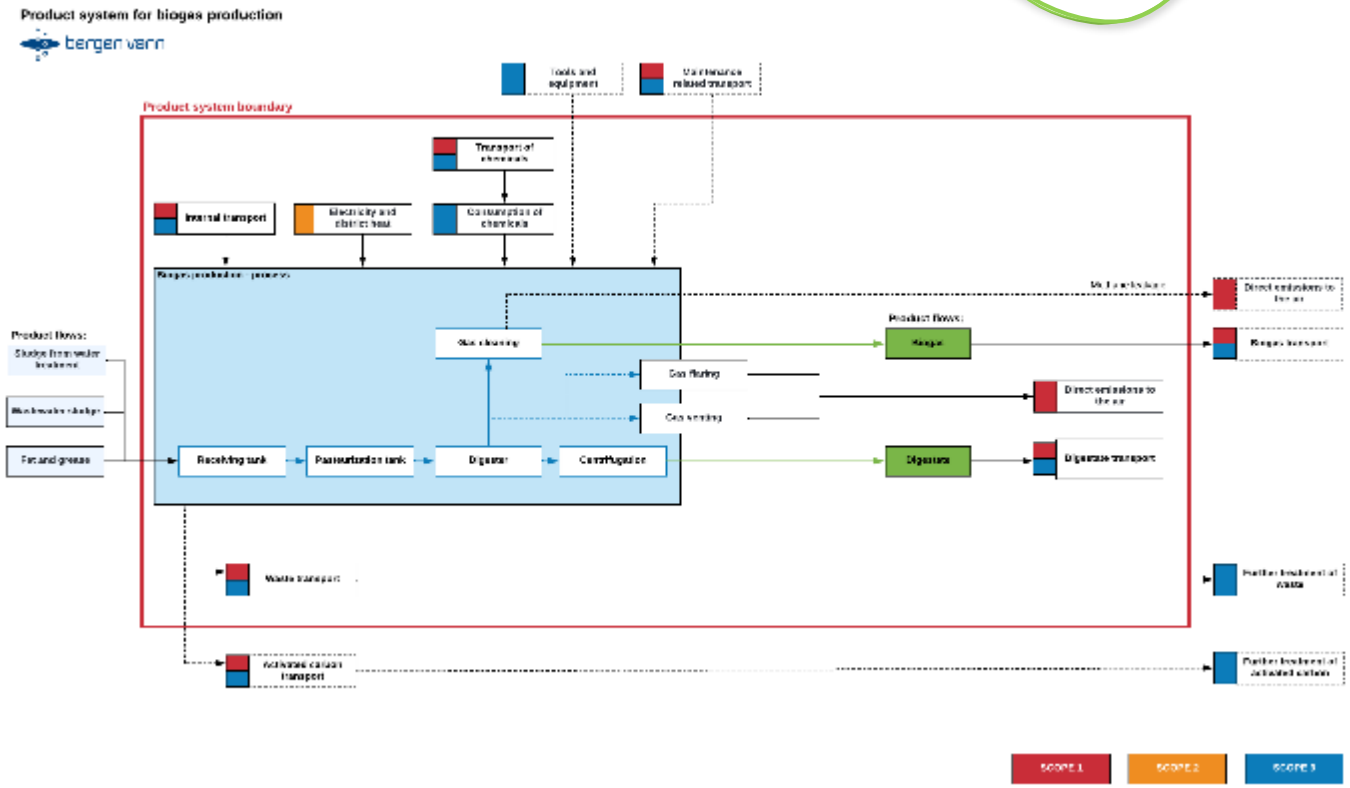
CO_2

CH_4

N_2O

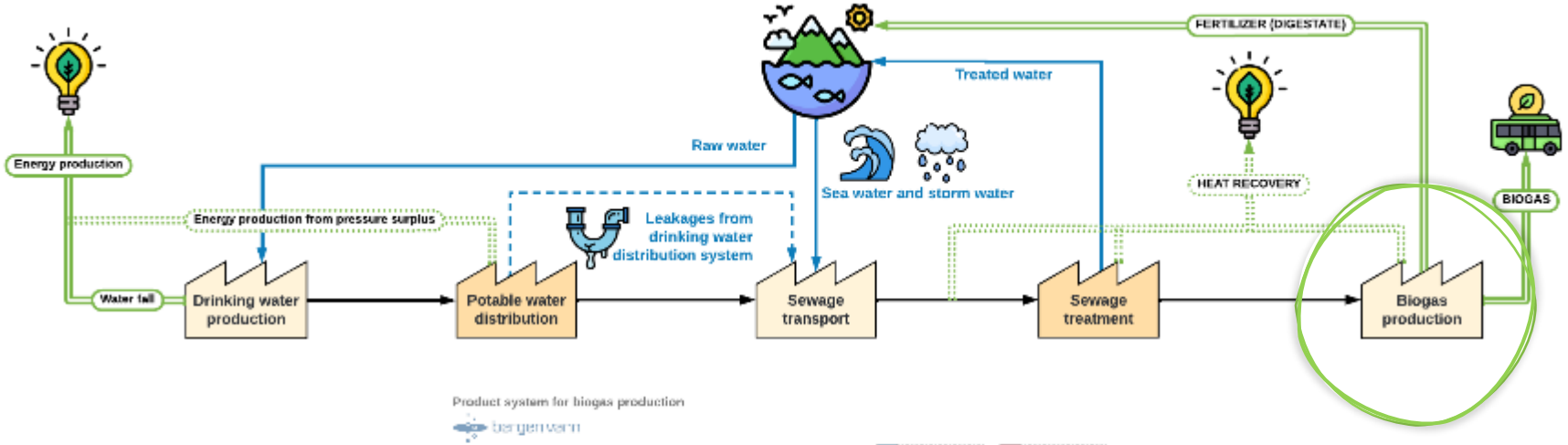
???

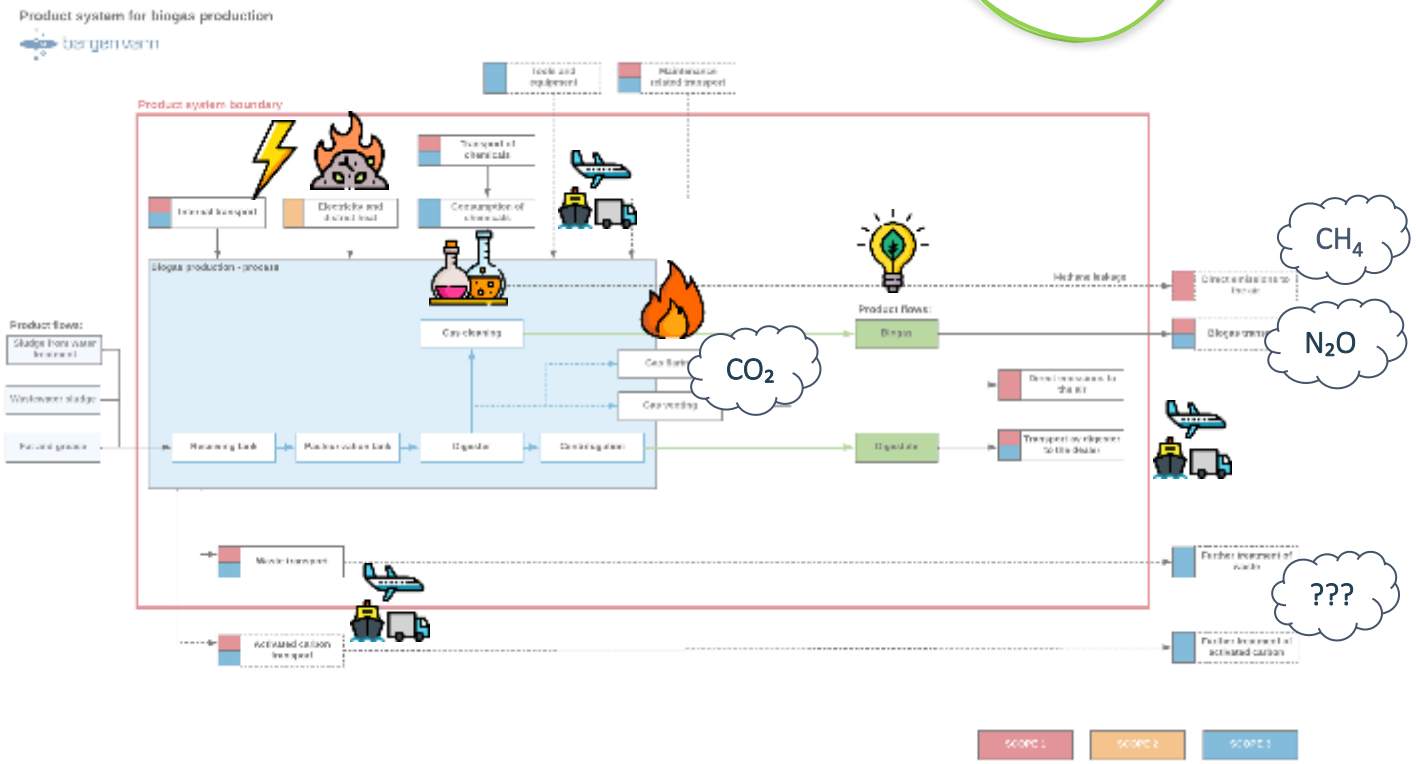
Other sources of a direct greenhouse gas emissions.



bergen vann

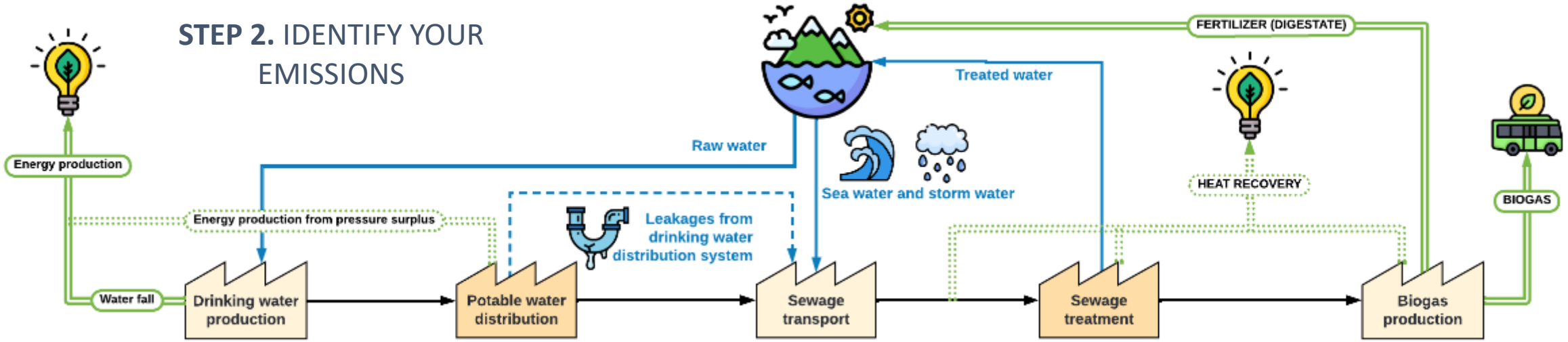
STEP 2. IDENTIFY YOUR EMISSIONS

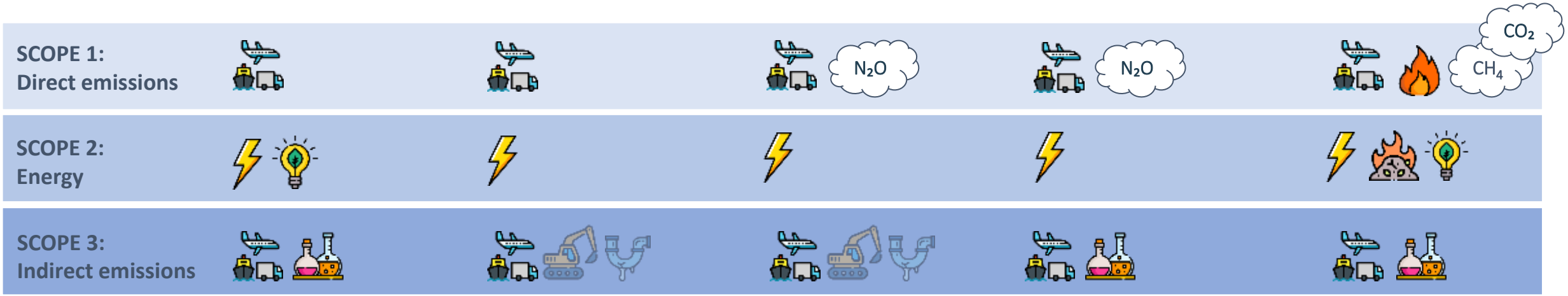




bergen vann

STEP 2. IDENTIFY YOUR EMISSIONS

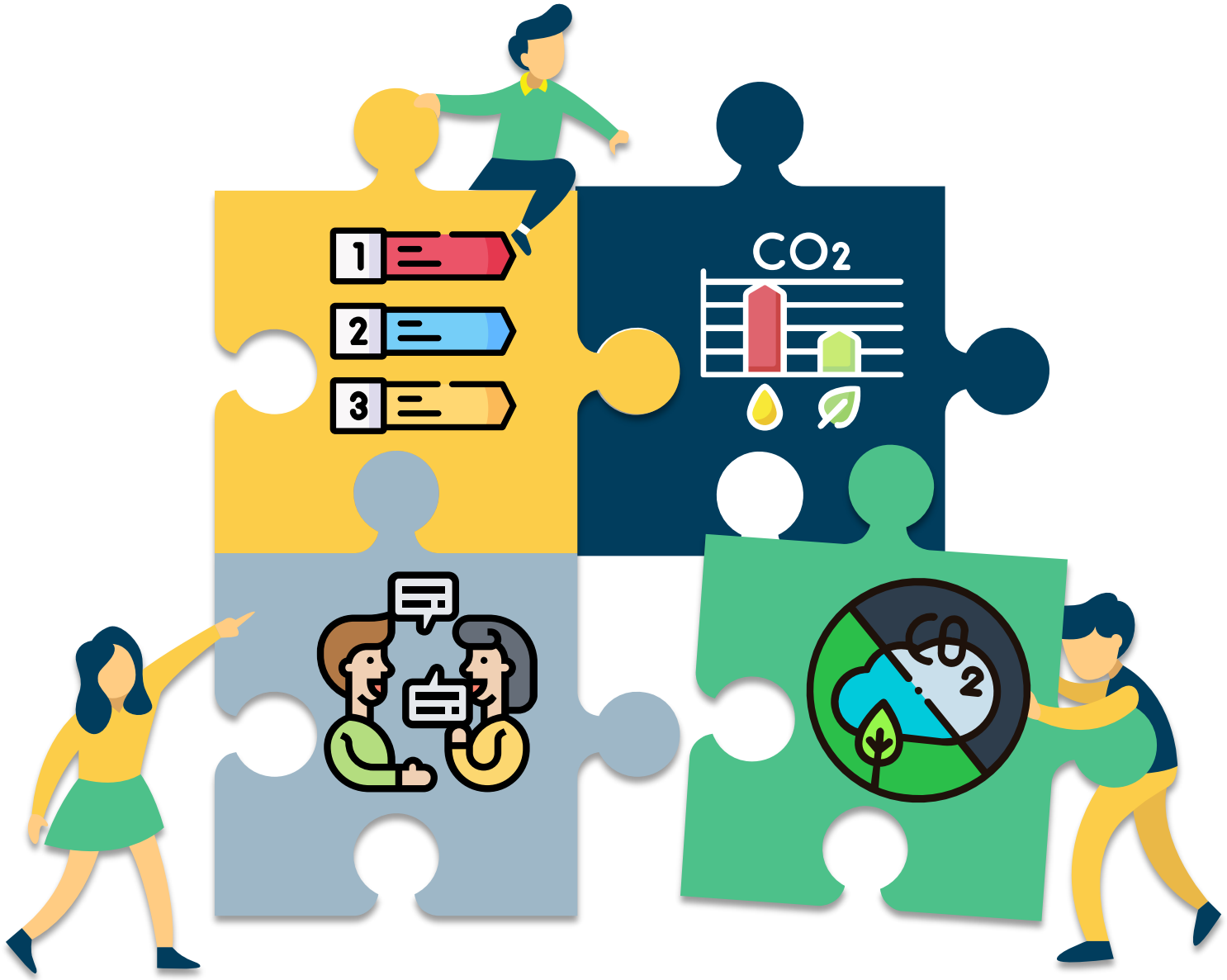




Transparent icons applies to the footprint calculations we plan to start the next couple of years. This also includes nitrous oxide emissions from wastewater direct discharge/ leakages to recipient and methane leakages at the biogas plant.

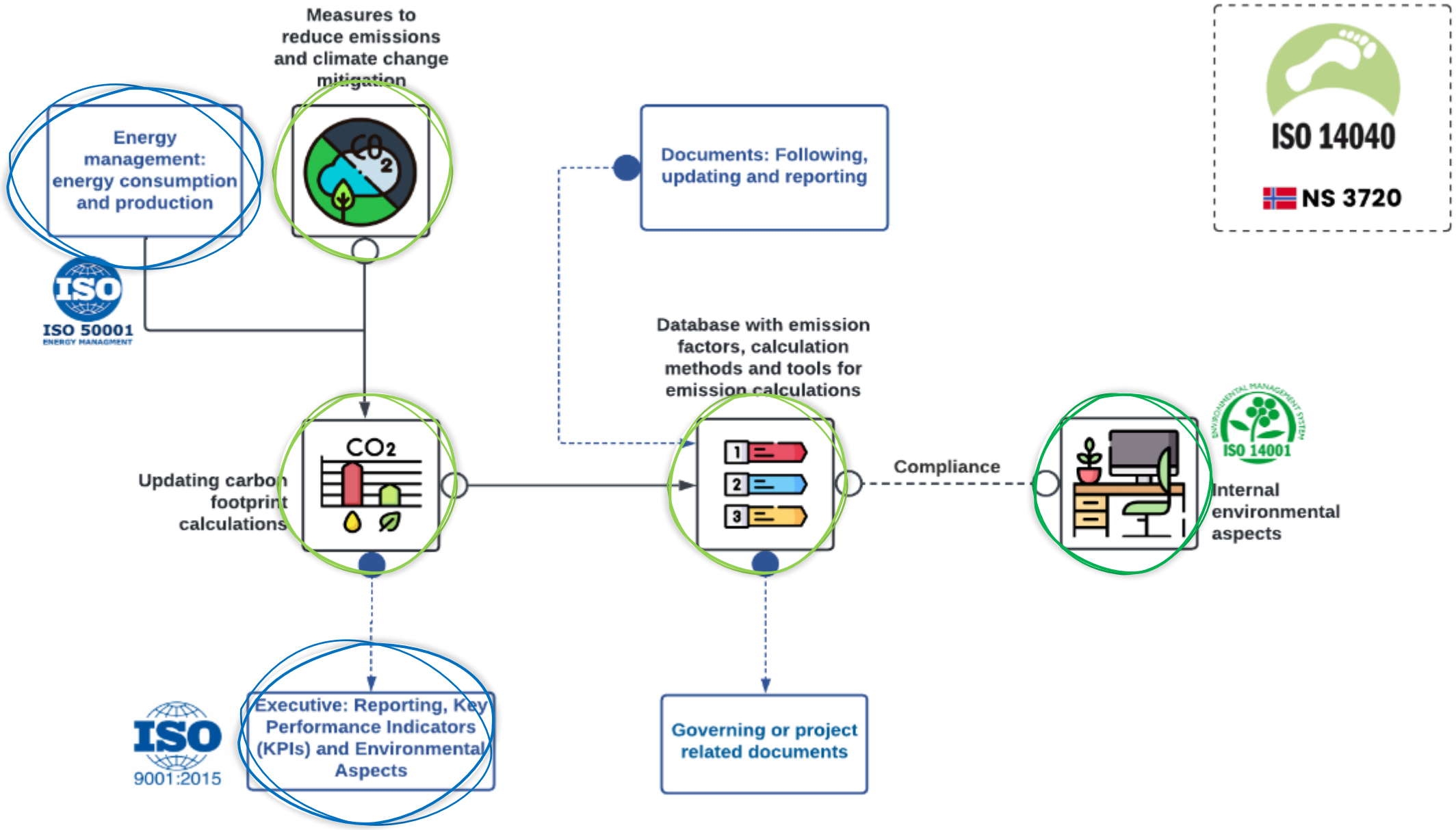
bergen vann

STEP 3. PUT THEM INTO CONTEXT



bergen vann

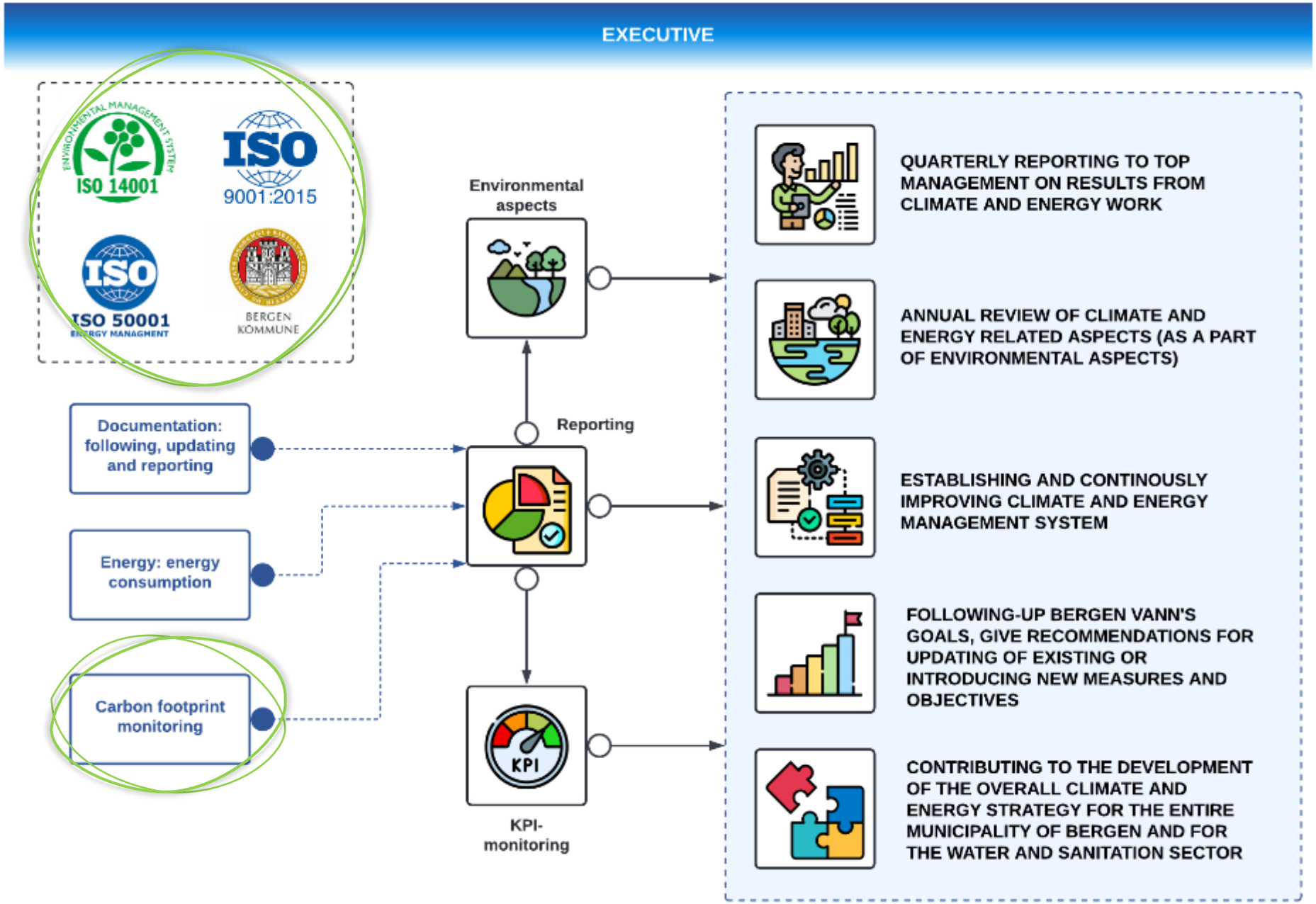
CARBON FOOTPRINT



bergen vann

PART OF THE ENERGY- AND CLIMATE MANAGEMENT SYSTEM IN OUR ORGANIZATION

bergen vann


EXECUTIVE
ISO 14001
ISO 9001:2015
ISO 50001
BERGEN KOMMUNE
Environmental aspects
Reporting
KPI
KPI-monitoring
Documentation: following, updating and reporting
Energy: energy consumption
Carbon footprint monitoring
QUARTERLY REPORTING TO TOP MANAGEMENT ON RESULTS FROM CLIMATE AND ENERGY WORK
ANNUAL REVIEW OF CLIMATE AND ENERGY RELATED ASPECTS (AS A PART OF ENVIRONMENTAL ASPECTS)
ESTABLISHING AND CONTINOUSLY IMPROVING CLIMATE AND ENERGY MANAGEMENT SYSTEM
FOLLOWING-UP BERGEN VANN'S GOALS, GIVE RECOMMENDATIONS FOR UPDATING OF EXISTING OR INTRODUCING NEW MEASURES AND OBJECTIVES
CONTRIBUTING TO THE DEVELOPMENT OF THE OVERALL CLIMATE AND ENERGY STRATEGY FOR THE ENTIRE MUNICIPALITY OF BERGEN AND FOR THE WATER AND SANITATION SECTOR

bergen vann

Picture: www.freepik.com

Thank You!

bergen vann

Natalia Adamczyk – Senior Engineer

natalia.adamczyk@bergen.kommune.no

Bergen Vann – Bergen Municipality's

Water, Wastewater and Urban drainage Utility

Norway

The measurement challenge

Real-life experiences with control of nitrous oxide in full scale

The road towards climate and energy neutral utilities WS 1.4

IWA World Water Congress & Exhibition Copenhagen 2022

Morten Rebsdorf
Senior project manager
Resource facilities
Aarhus Vand A/S
Denmark

Recognised
the international water association
Climate Smart Utility

aarhusvand

GHG in a Danish context

Future regulatory framework covering GHG in Denmark:

- CO_2-tax @ 100 euro/t CO_2 by 2030
- 50 % reduction of N_2O emission by 2025 (WWTP > 30.000 PE)
- Max. 1 % of methane loss pr. biogasengine or biomethane upgrading unit (proposal)

Goals:

- Aarhus Vand CO_2 neutral in 2030 (operational model)
- Aarhus Vand net energy producing in 2030
- System border: 350.000 inhabitants, water supply, transport system, wastewater treatment sludge management. Energy production (electricity/district heating)
- Still need to reduce approx. 8-10.000 t CO_2 (2021) > 90 % from N_2O

What are we aiming at?

”Simply” aiming at finding the ”truth” of the actual emissions of N_2O

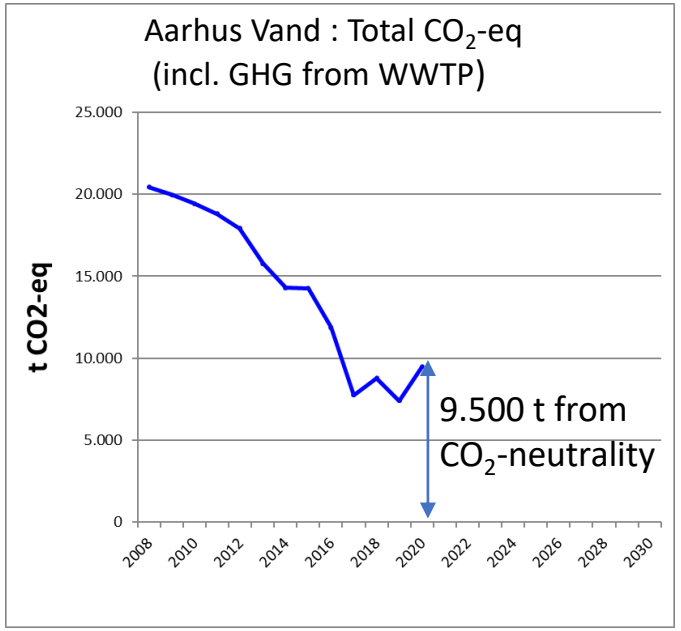
ARES project (Government funded development project)

- Understanding the principles of formation and emission of N_2O
- Validate calculated emission

  liquid phase vs. gas phase (Off-gas) measurements
- Enabling a N_2O control strategy – minimising N_2O emission

Prives and Water Closets; D. J. Eveleigh p. 16, Shire Library 2008

GHG actions at Aarhus Vand



Aarhus Vand CO_2-neutral in 2030:

- GHG emissions from WWTP~ 8.000 t CO_2-eq (>90 % from N_2O)
- Composting of sludge ~ 1.000 t CO_2-eq. (PAH in sludge)

Present measures

- Continued focus on choosing energy efficient solutions, afforestation etc.
- Reduction of methane-loss in the biogas-system
- Understanding the principles of formation AND emissions of N_2O
- Develop measurement- and control strategies

Next measures:

- Develop on-line control to minimise formation and emission of N_2O
- Change sludge disposal from composting/sludge on agriculture to =>
- Develop and choose sludge disposal solutions with CO_2-sequestration
- CO_2-capture, and/or -utilisation of biogenic CO_2

Thanks to the partners of the ARES-project (DTU, VCS, Biofos, EnviDan) and my dear colleagues at Aarhus Vand

Thank you for your attention ☺

mre@aarhusvand.dk

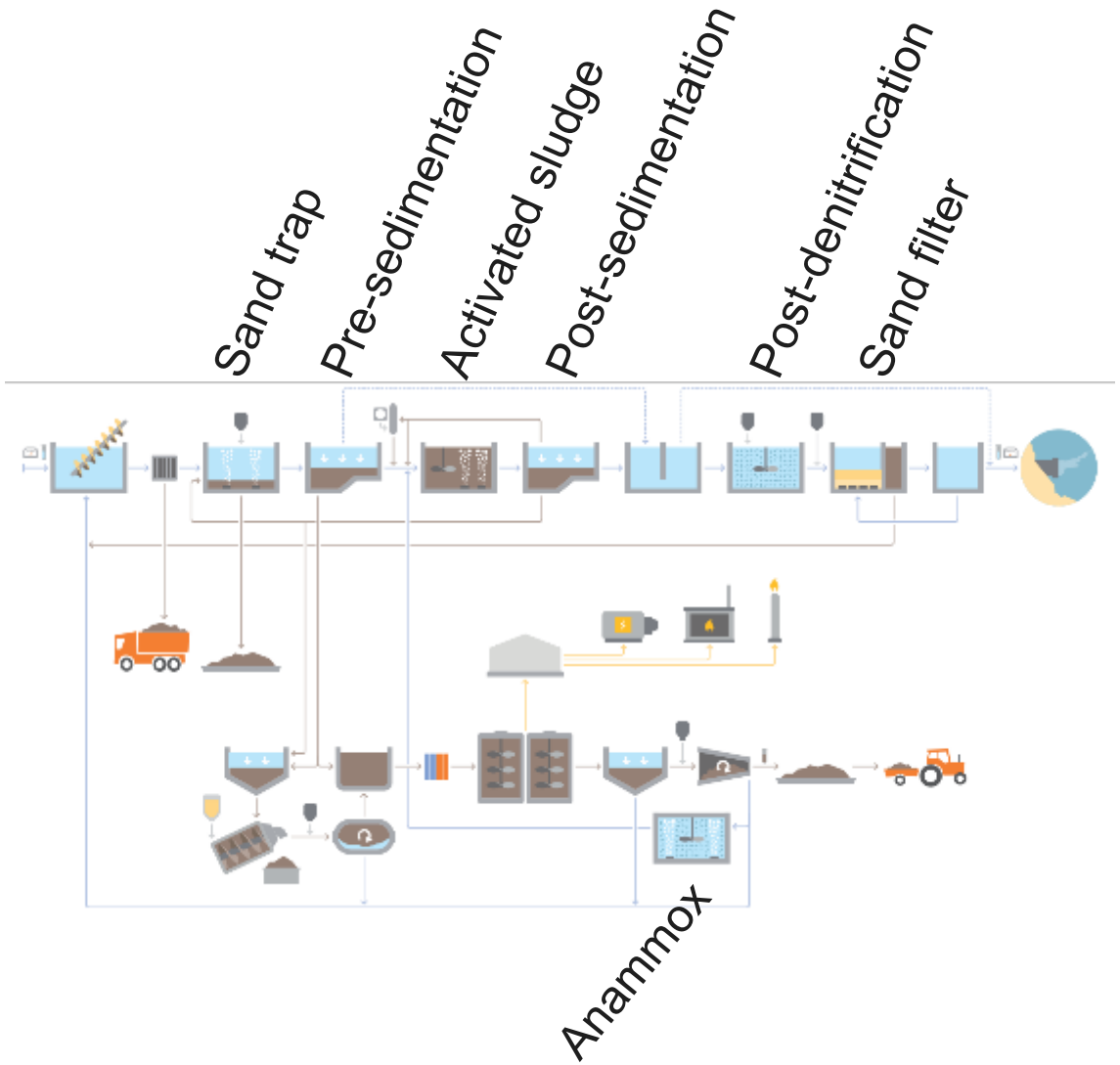
Greenhous gas monitoring from open basins

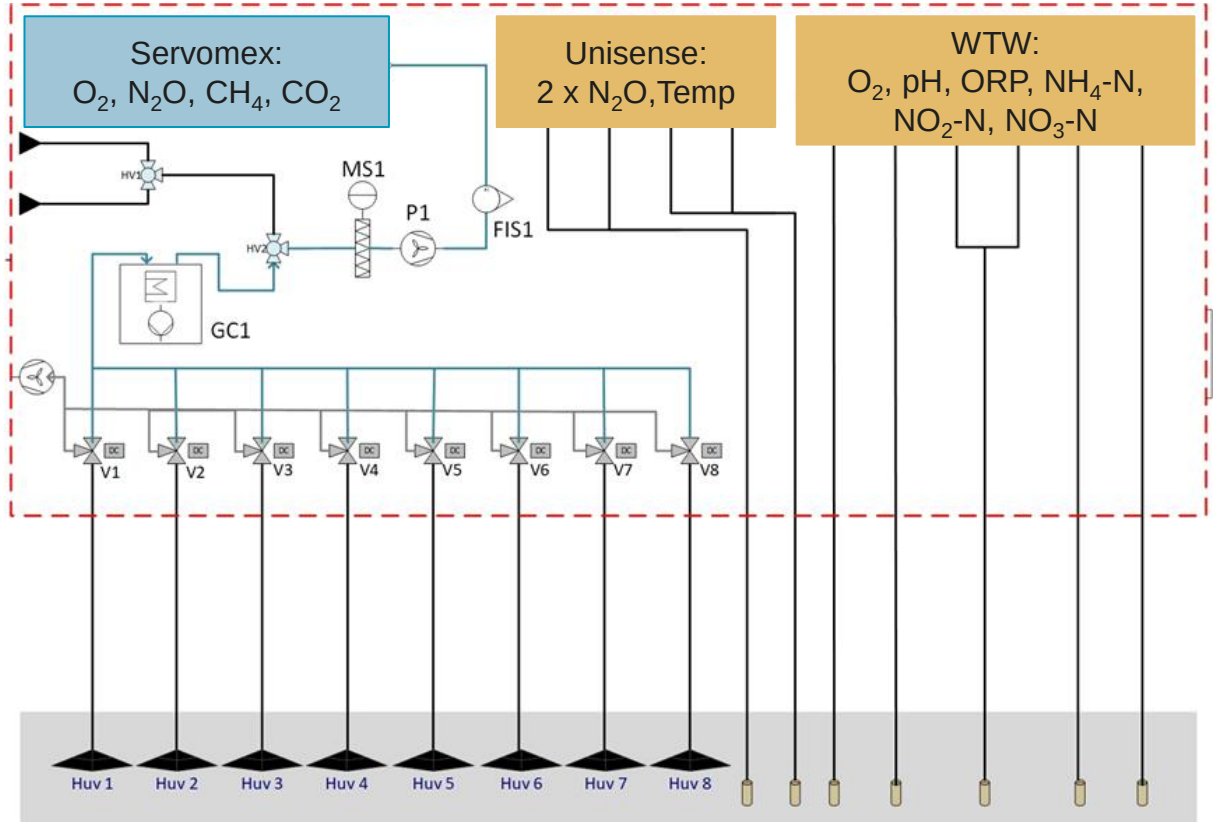
- alteration of carbon footprint due to selection of measurement point

The road towards climate and energy neutral water utilities
14-09-2022

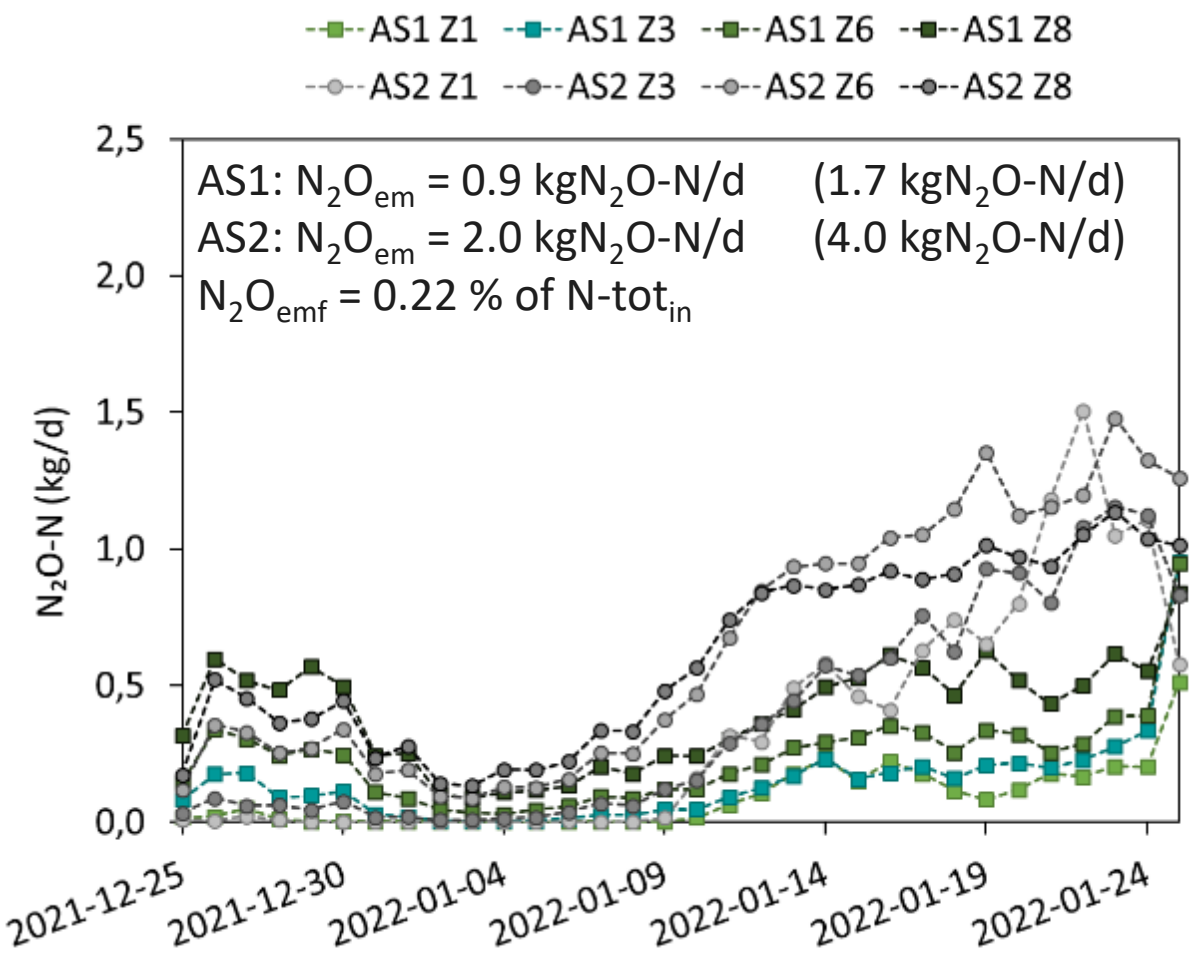
Sara Ekström,
Development engineer
VA SYD
Sweden

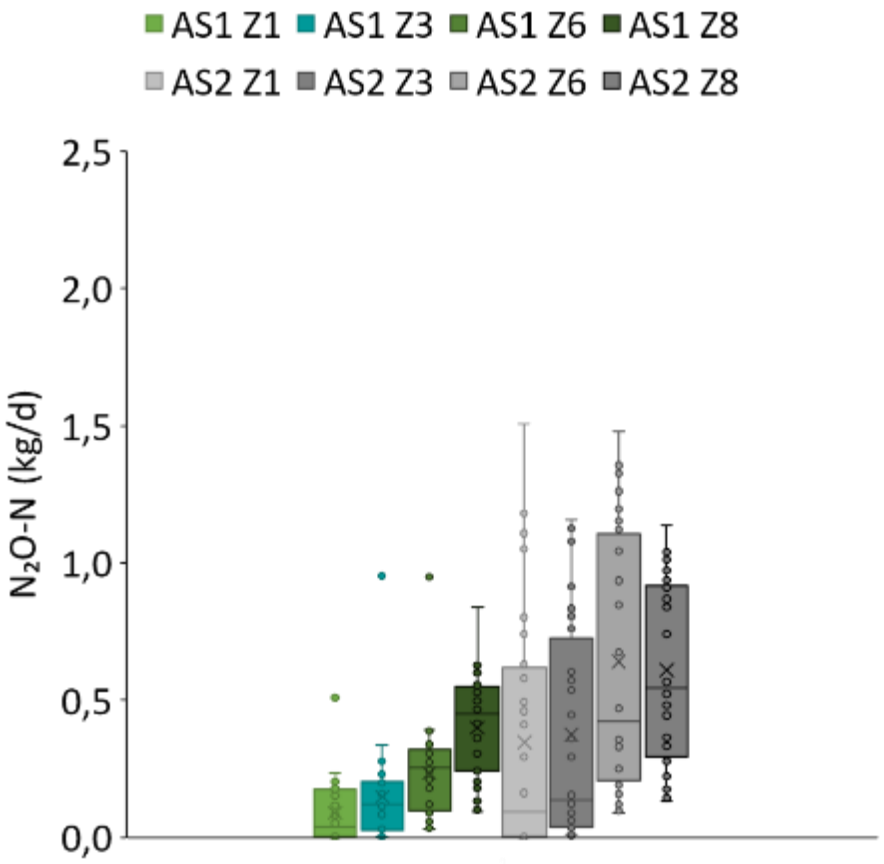
Greenhouse gas monitoring at Klagshamn WWTP



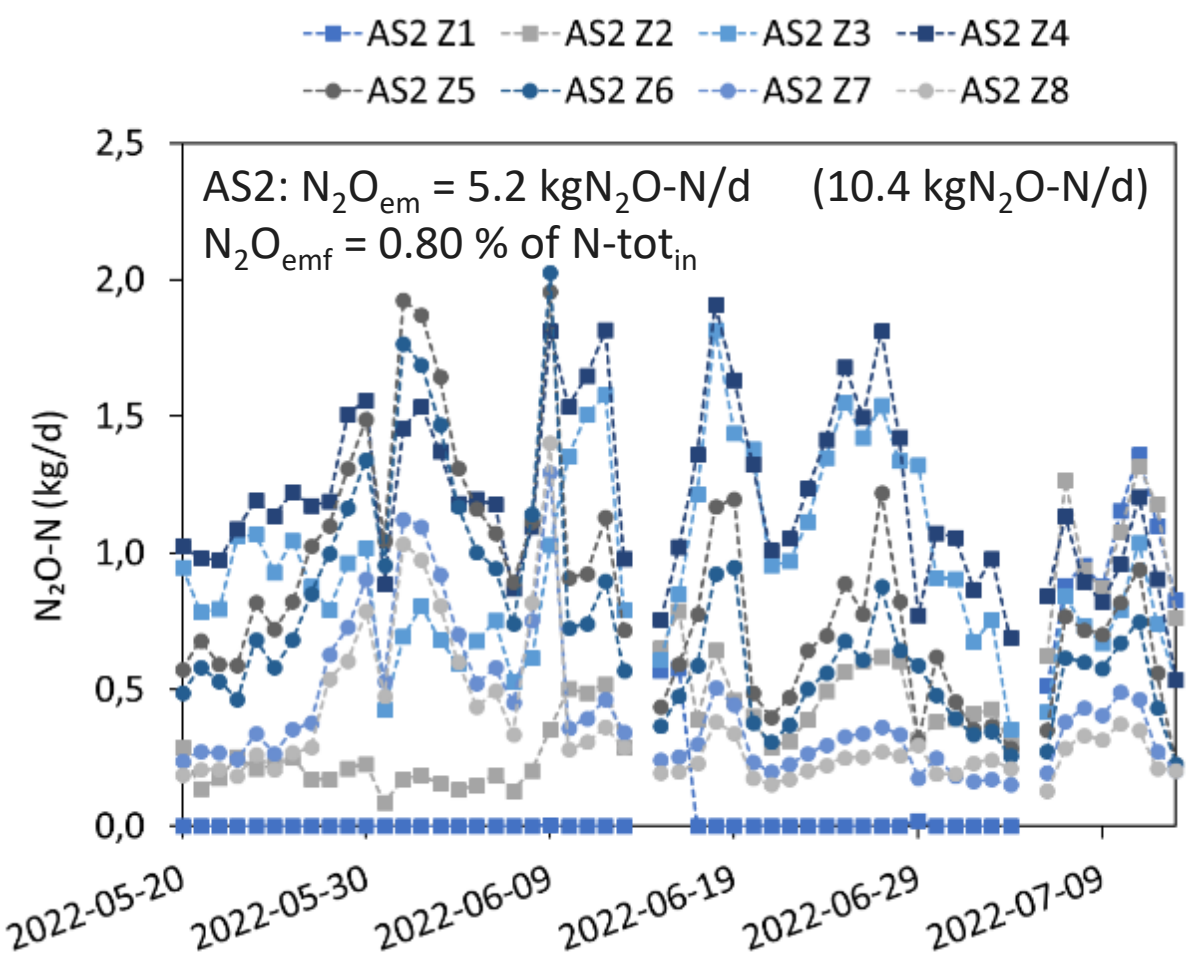


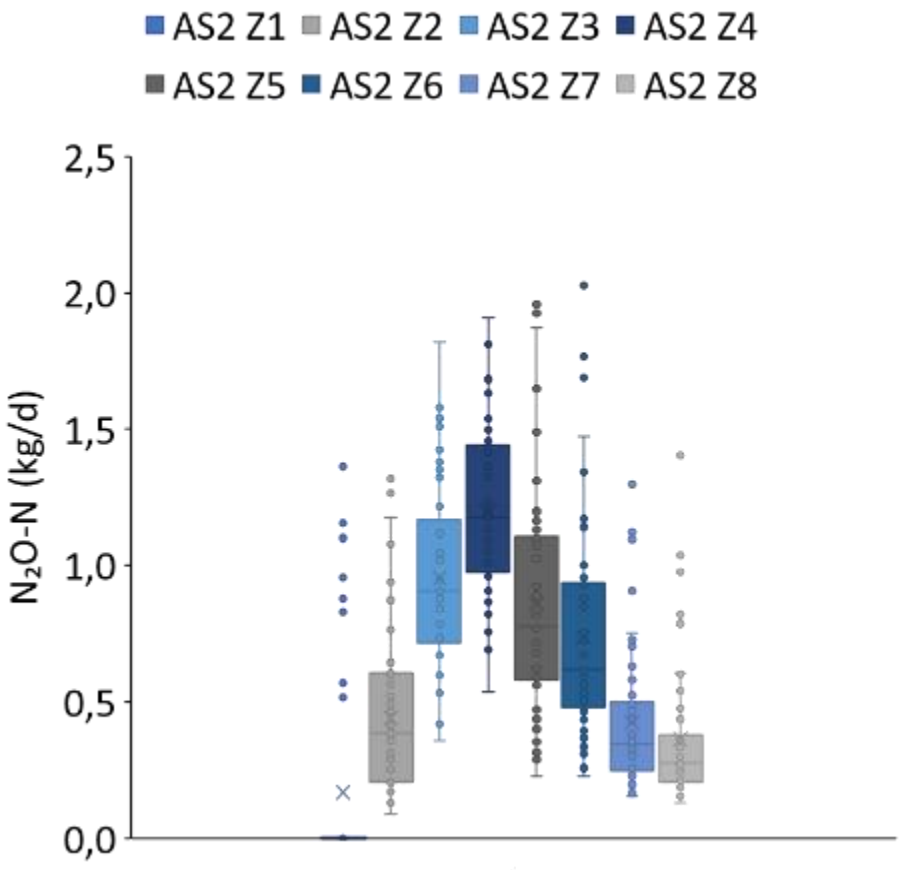
Simultaneous N_2O quantification in parallel AS lines



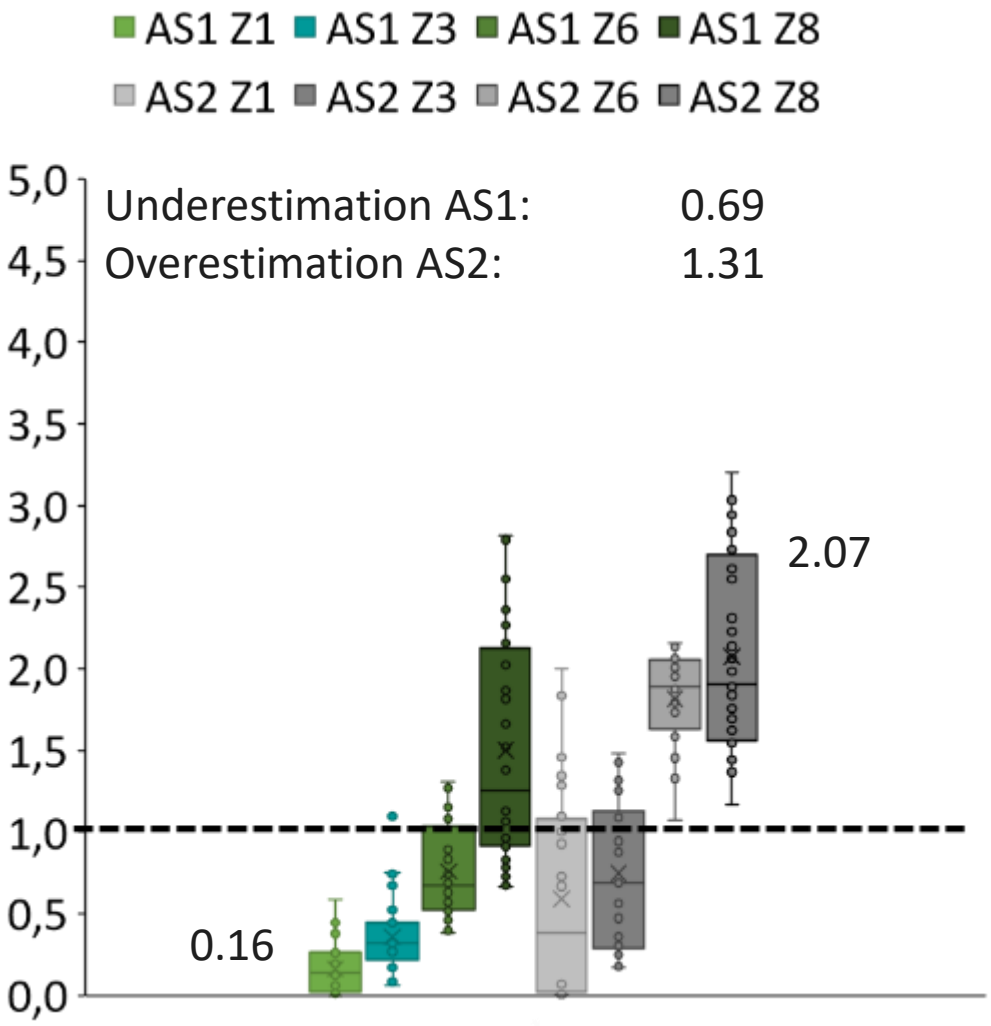


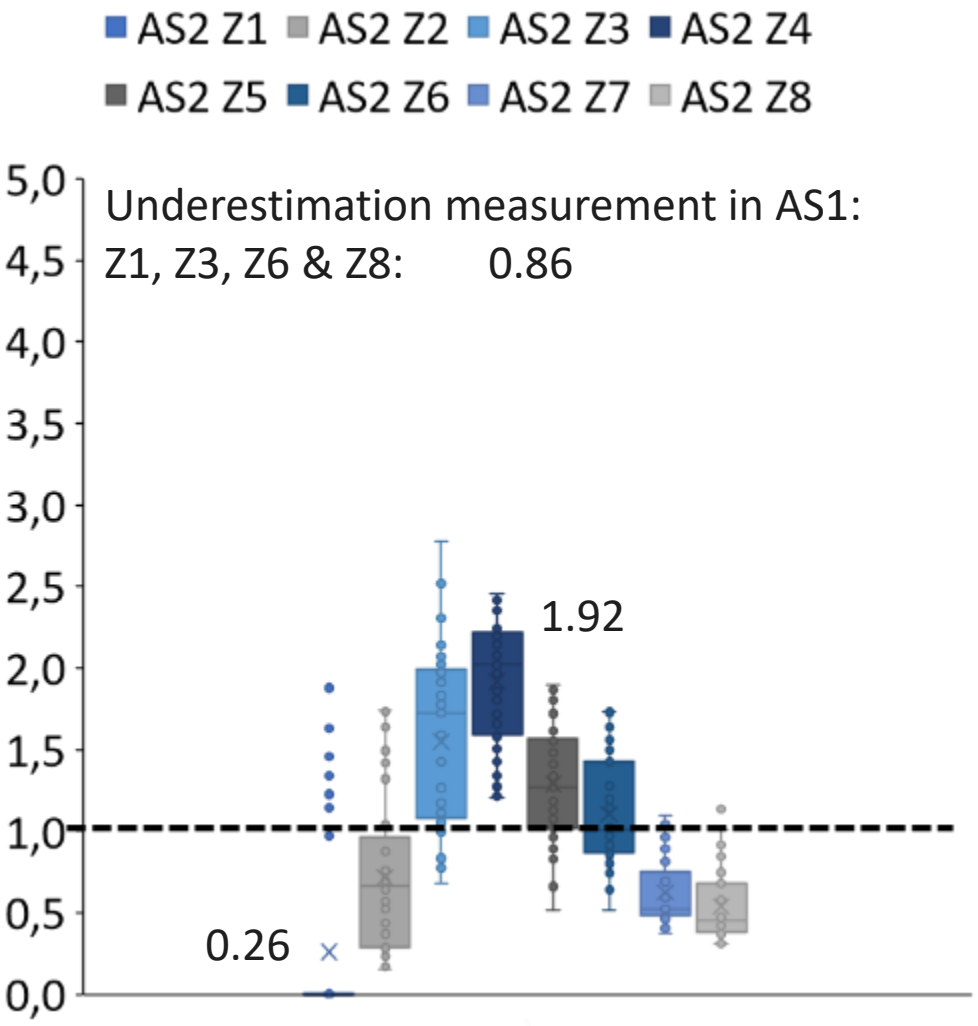
N_2O quantification in AS2



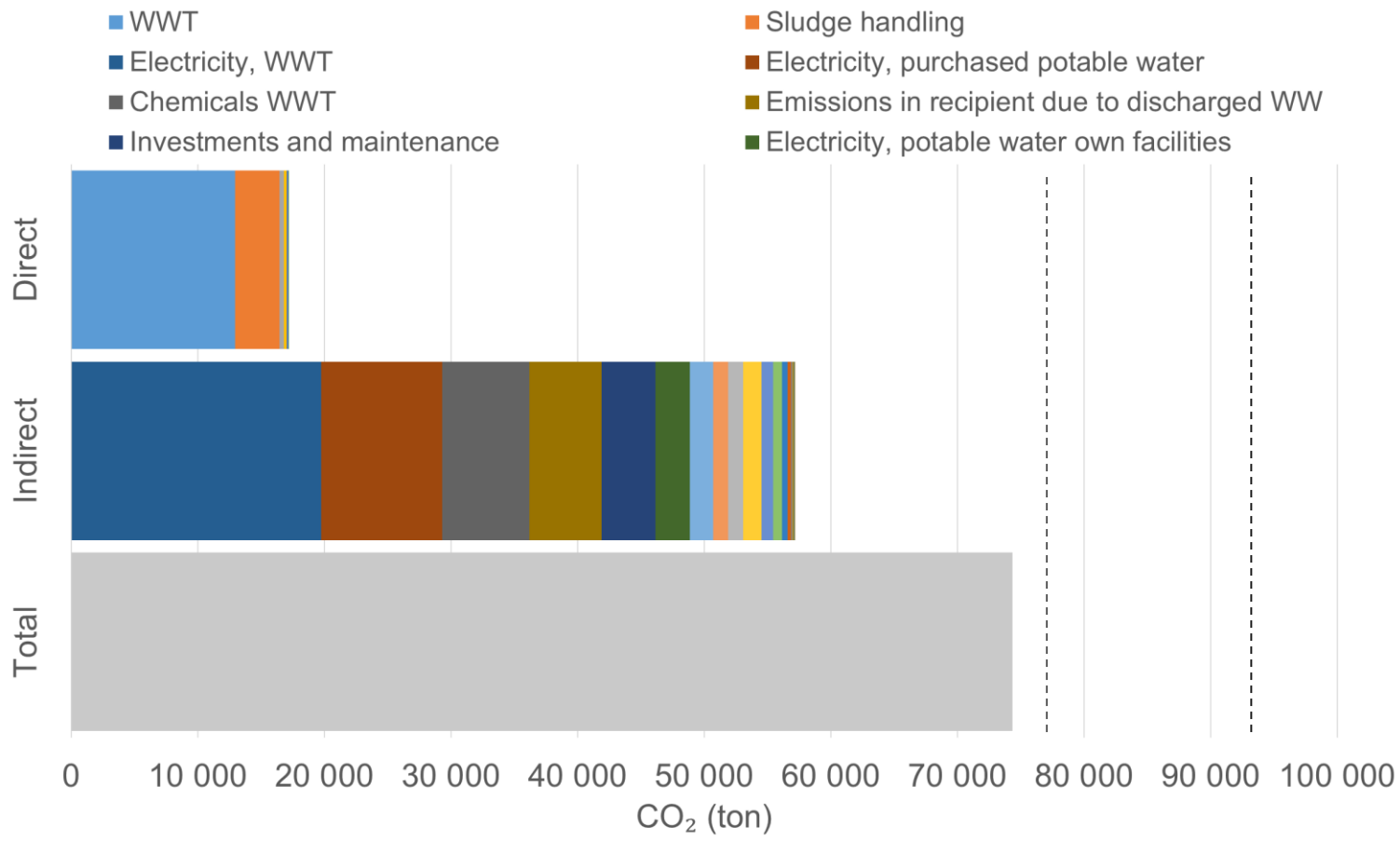


Influence of measurement point selection





Alteration of carbon footprint



Exampel AS2 measurement:

1. IPCC N_2O emission factor of 1,6 % of N-totin exchanged to 0.8 %
2. N_2O emission factor corrected for overestimation of emissions in AS2

Result:

1. Carbon footprint reduced with 15 920 ton CO_2 or 17 %.
2. Carbon footprint reduced with 18 900 ton CO_2 or 20 %.

TACK!

sara.ekström@vasyd.se

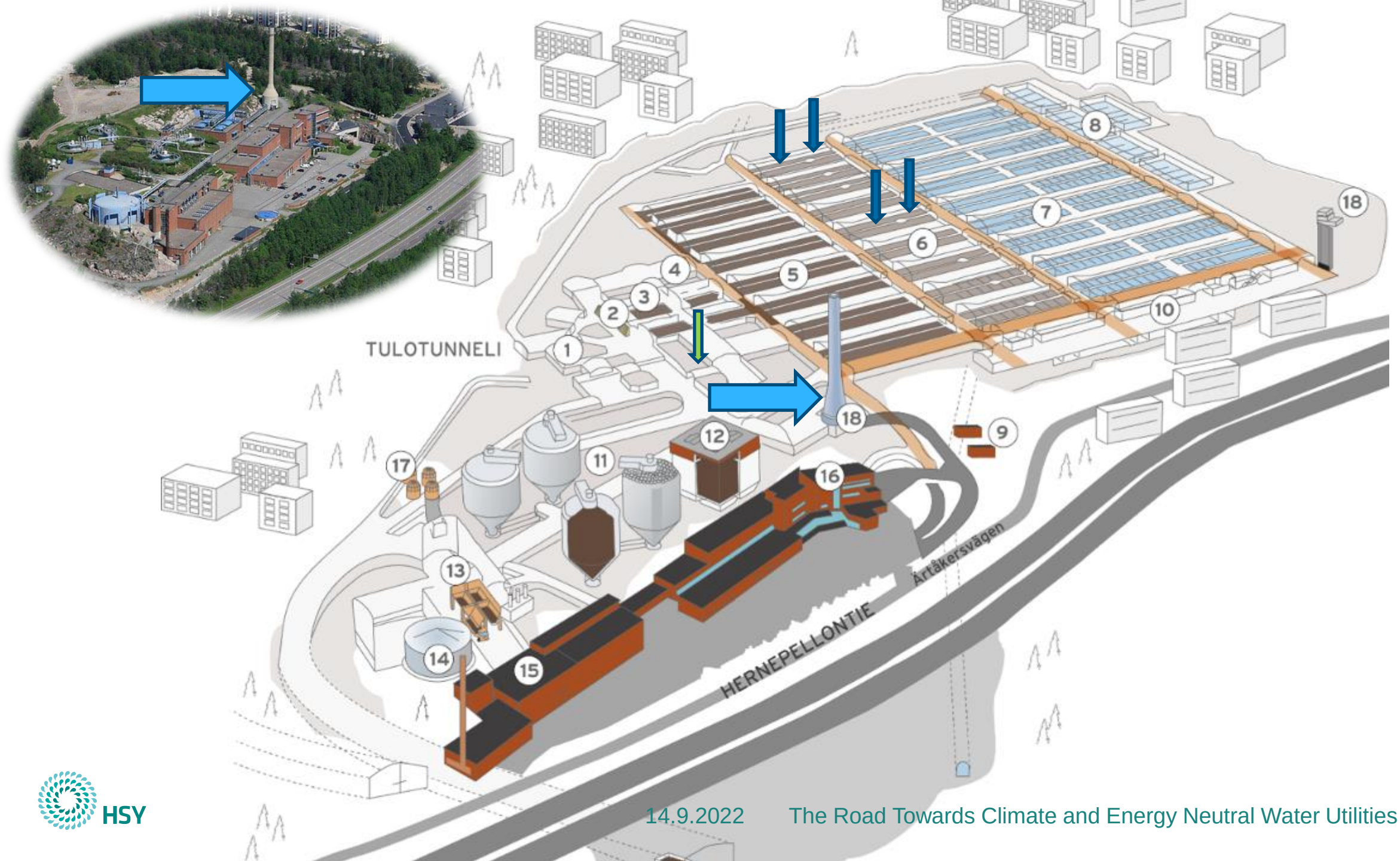
Experience on Long Term Monitoring and Analysis of Total N_2O Emissions at an Underground WWTP

Anna Kuokkanen

Project Manager

Helsinki Region Environmental Services Authority HSY

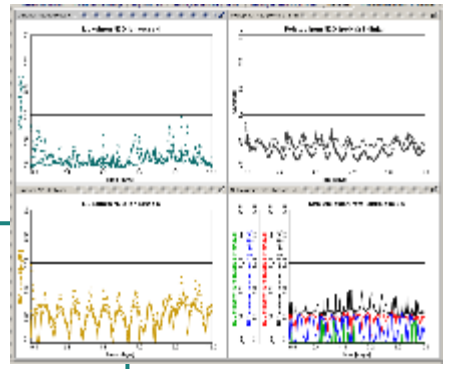
Finland

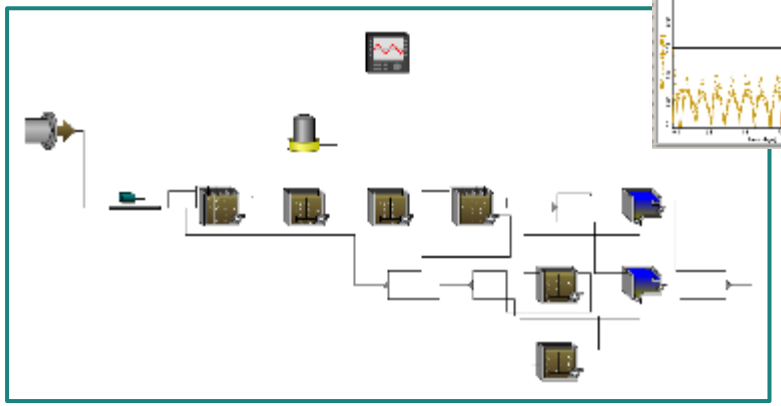

TULOTUNNELI
HERNEPELLONTIE
Ärtåkersvägen
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
18

Use of N_2O measurements in reporting and mitigation studies

Total emissions (exhaust air FT-IR)

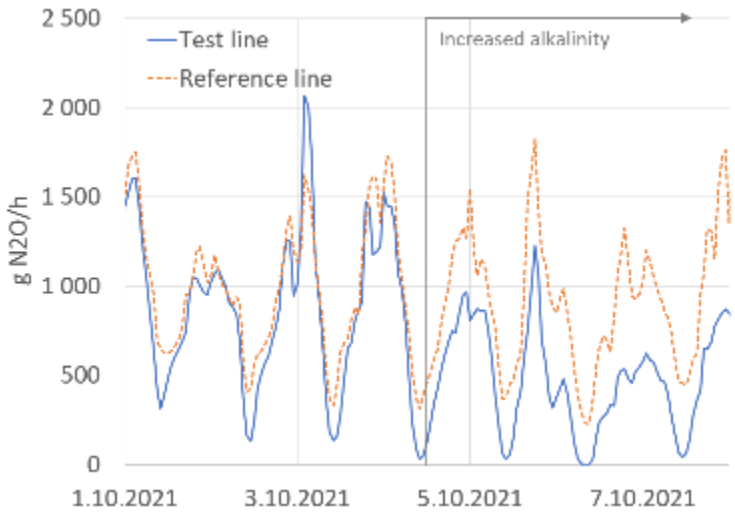
- Reporting yearly emissions
- Correlation studies
  - Seasonal variations
  - Process parameters
- Dynamic modelling



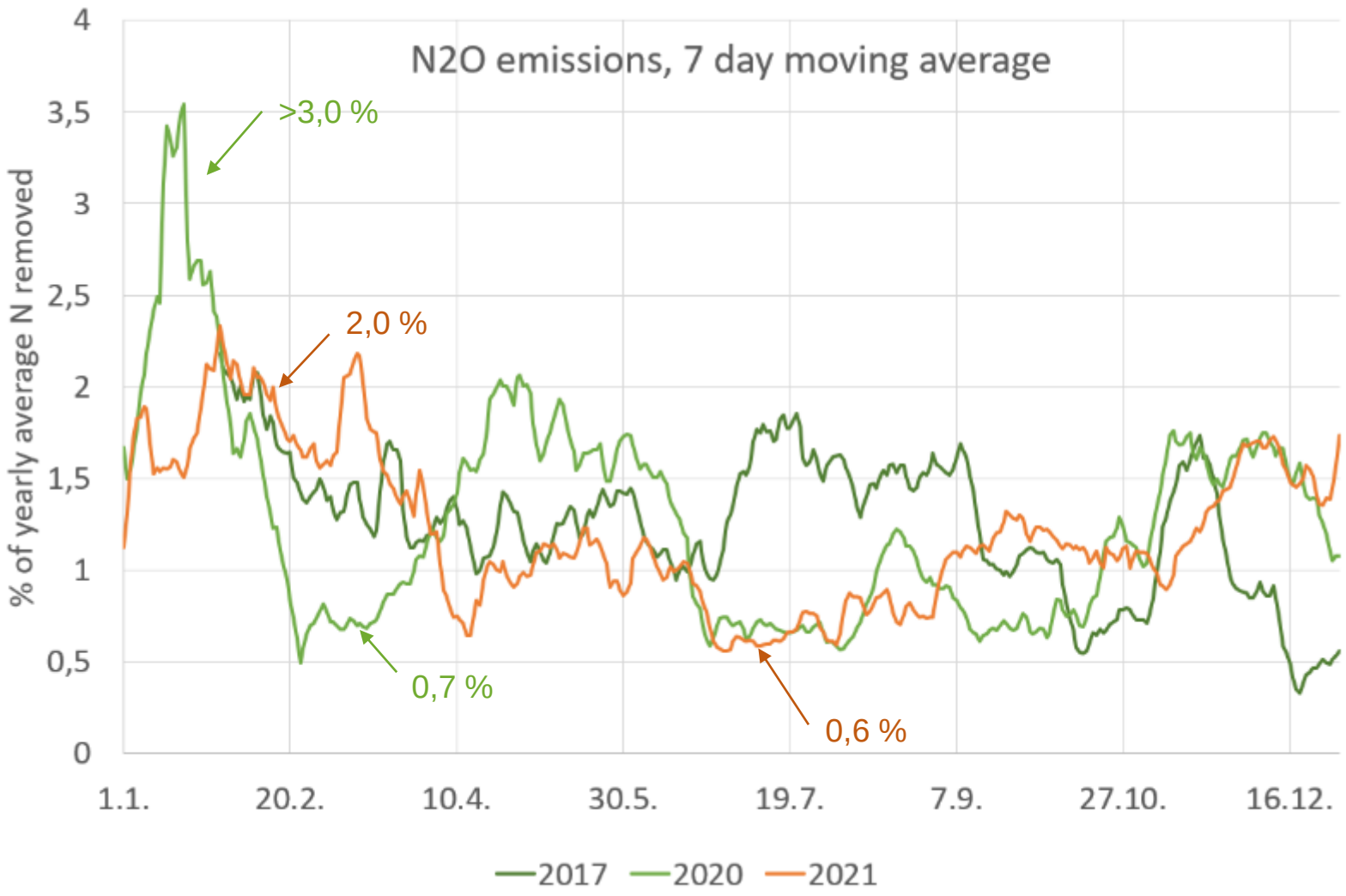


Local emissions (liquid phase sensors)

- Dynamic modelling
- Full scale tests of the impact of process parameters
  - In AS, by comparing two treatment lines
  - In reject water deammonification



Continuous measuring vs. measuring campaigns, “normal” years



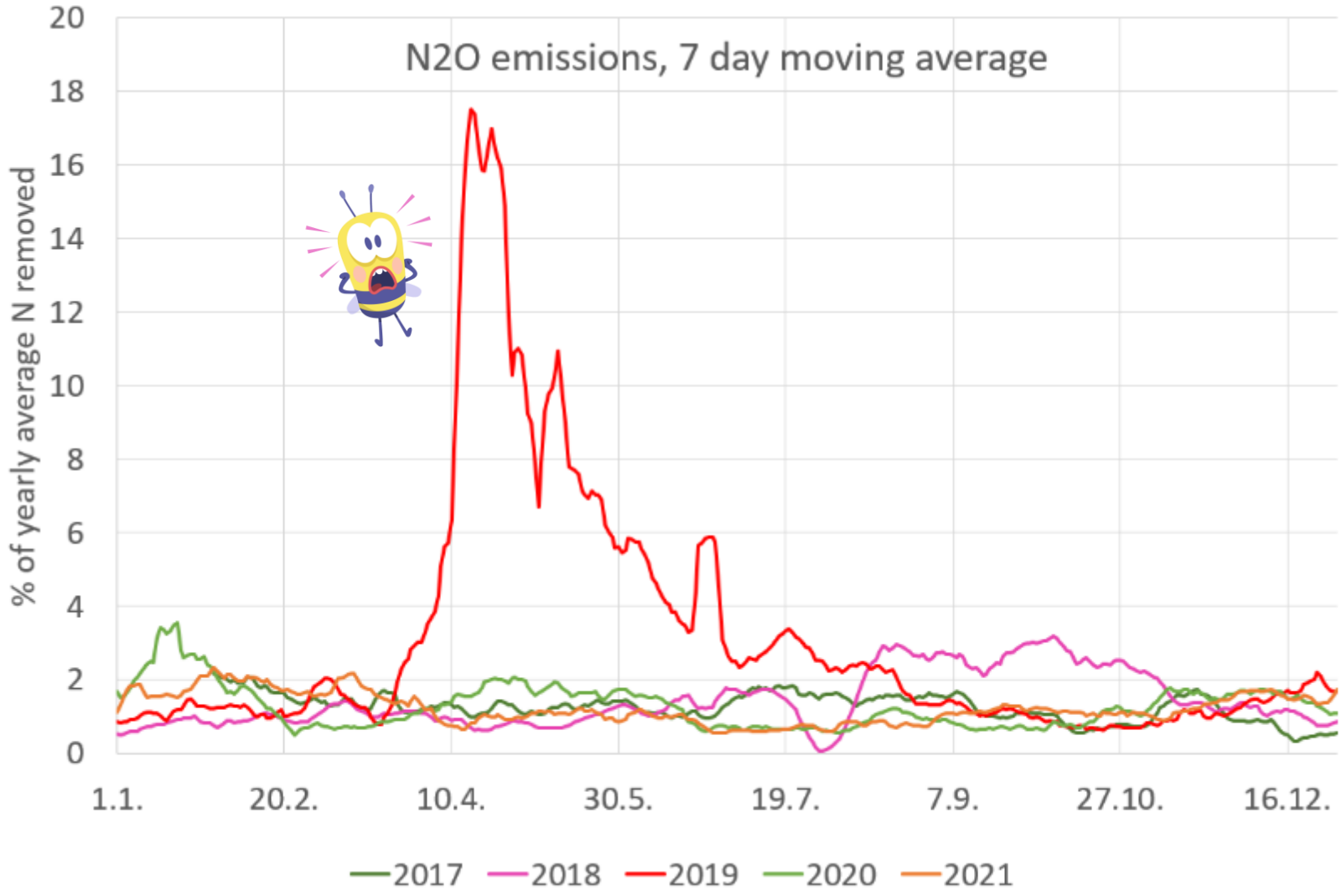
Yearly averages:

2017 1,3 % of N removed
2018 1,4 %
2019 3,1 %
2020 1,3 %
2021 1,2 %

What can be learned?

- Short measuring periods → risk of over- or underestimating emissions
- No guarantee that the seasonal patterns are similar each year

Continuous measuring vs. measuring campaigns, process disturbances



Yearly averages:

2017 1,3 %
2018 1,4 %
2019 3,1 %
2020 1,3 %
2021 1,2 % of N removed

What can be learned?

- 2018: Inhibition and regrowth of nitrifyers can alter the emission factor for a long period
- 2019: Two months can double the year's emissions

Thank you!

anna.kuokkanen@hsy.fi

Helsingin seudun ympäristöpalvelut -kuntayhtymä
Samkommunen Helsingforsregionens miljötjänster
Helsinki Region Environmental Services Authority

1. **Climate Neutrality as part of Circularity -** *Kees Roest*, KWR, Netherlands

2. **The journey to net zero – experience from the UK and Irish Water sector -** *Amanda Lake*, Jacobs, UK

3. **The roadmap to a carbon neutral wastewater treatment in Grenoble, France -** *Corinne Trommsdorf & Nicolas Lesur*, Grenoble Utility, France

4. **Steps to achieve climate neutrality -** *Felipe Andres Sanchez* Ihl, Aguas Andinas, Chile

5. **Developing climate footprint calculations to achieve climate neutrality -** *Natalia Adamczyk*, Bergen Water, Norway

6. **Real-life experiences with control of nitrous oxide in full scale -** *Morten Rebsdorf*, Aarhus Vand, Denmark

7. **GHG monitoring from open-basins -** *Sara Ekström*, VA Syd, Malmö, Sweden

8. **Experience on long term monitoring and analysis of total N2O emissions at an underground WWTP -** *Anna Kuokkanen*, Helsinki Region Environmental Services HSY, Finland

Road ahead:

- Report launch **Nordic principles for a climate neutral water sector**
  - Today afternoon coffe break. 15:10
  - Nordic pavilion, C2-249
- **IWA Climate Smart Utilities**
  - iwa-network.org/projects/climate-smart-water-utilities/
- **NORDIWA**
  - 5-7 september Gothenburg,
  - wastewater management, urban drainage and climate adaptation www.nordiwa.org/