the international water association
CLIMATE SMART UTILITIES

Towards a Climate Neutral Water Sector: the Nordic Experience

02/05/2023

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WEBINAR INFORMATION

- This webinar will be **recorded and made available "on-demand"** on the IWA Connect Plus platform, with presentation slides, and other information.
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- The opinions, hypothesis, conclusions or recommendations contained in the presentations and other materials are the **sole responsibility of the speaker(s)** and do not necessarily reflect IWA opinion.

WEBINAR INFORMATION

- **‘Chat’ box**: please use this for general requests and for interactive activities.
- **‘Q&A’ box**: please use this to send questions to the panelists.

(We will answer these during the discussions and in post-webinar materials.)

Please Note: *Attendees’ microphones are muted. We cannot respond to ‘Raise Hand’.*

THE SEED WAS PLANTED IN COPENHAGEN!

- IWA World Water Congress & Exhibition, Copenhagen 2022
  - Workshop: The road to a climate and energy neutral water sector
  - Launch: Report: The Road towards a Nordic climate neutral water sector

ORGANISATION

Name	Title	Affiliation
Brenda Ampomah-Ankrah	Strategic Programmes Officer	IWA
Charles Joseph	Strategy and Insights Manager	IWA
Amanda Lake	Head of Carbon and Circular Economy	Jacobs
Anna Katrine Vangsgaard	Senior Process Engineer	Envidan
Jacob Kragh Andersen	Innovation Manager, Sustainability	Envidan

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CLIMATE SMART UTILITIES

DRIVERS IN DENMARK

- Target in Denmark: energy and climate neutral water sector by 2030
- Cooperation between legislators, technology providers, consultants, etc.
- Legislation is founded on real data (studies funded by Danish EPA and EA)
  - 0,84 % N_2O-N/TN inlet (9 WWTPs) – new Danish EF
  - 7,7 % CH_4 loss (24 WWTPs)
- Legislation
  - N_2O limit implemented no later than 2025 for WWTPs > 30.000 PE
  - CH_4 internal protocol and annual check by third party


Miljø- og Fødevareministeriet
Miljøstyrelsen

MUDP Lattergaspulje
Dataopsamling på måling og reduktion af lattergasemissioner fra renseanlæg

Til
Energistyrelsen
Dokumenttype
Rapport
Dato
August, 2021

MÅLRETTET INDSATS FOR AT MINDSKE METANTAB FRA DANSKE BIOGASANLÆG

RAMBOLL Bright ideas. Sustainable change.
DTU
FORCE TECHNOLOGY
TEKNOLOGISK INSTITUT

AGENDA

- Welcome and introductions

  Jacob Kragh Andersson (moderator)
- Greenhouse gas emissions from EU wastewaters

  Alberto Pistocchi/Vanessa Parravicini

Q&A

- Nordic principles for a climate neutral water sector

  Miriam Feilberg

Q&A

- Case study, Bergen Vann

  Natalia Liliana Adamczyk

Q&A

- Q&A Discussion
- Final remarks and conclusion

WHAT NEXT: 3 FURTHER WEBINARS

the international water association CLIMATE SMART UTILITIES

Monitoring and mitigating methane: Danish lessons for global action- Amanda, Jacobs

- 26 June

Monitoring and mitigating nitrous oxide: Danish lessons for global action- Anna Katrine, Envidan

- 12 September

Climate Smart Water Futures within Planetary Boundaries- IWA GHG working group

- 12 October

MODERATORS & PANELISTS

Jacob Kragh Andersen
Envidan,
Denmark

Alberto Pistocchi
DG Joint Research Center,
Italy

Miriam Feilberg
DANVA
Denmark

Natalia Liliana Adamczyk
Bergen Vann
Norway

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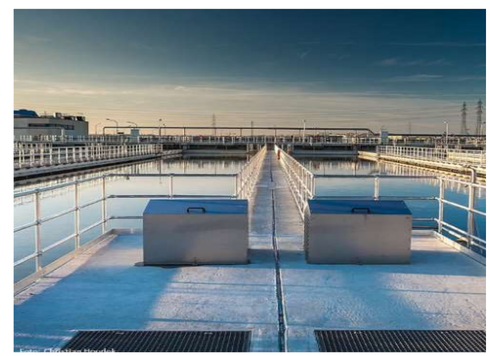
Greenhouse gas emissions from the EU urban wastewater sector

ALBERTO PISTOCCHI (PRESENTING)
EC JRC

VANESSA PARRAVICINI
TU WIEN

FACULTY OF CIVIL AND ENVIRONMENTAL ENGINEERING
INSTITUTE OF WATER QUALITY AND RESOURCE MANAGEMENT



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REDUCTION OF GHG EMISSION IN EU

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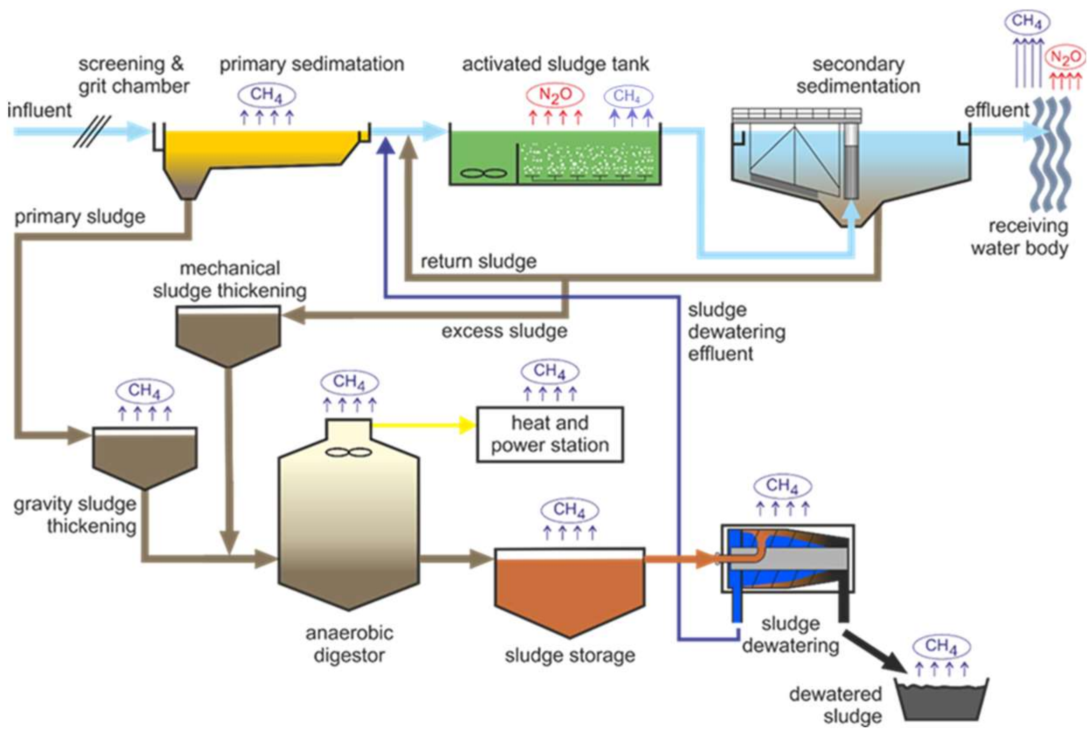
- European Green Deal 2019 → the EU has adopted ambitious goals for the reduction of greenhouse gas emissions along with pollution reduction and circular economy.
- Wastewater collection and treatment is a contributor to the overall GHG emissions of the EU, and is reported as such under the UN Framework Convention on Climate Change.
- Goal of the study:
  - estimate of GHG emissions from wastewater collection and treatment at the European scale, including indirect emissions (scope 2 and 3)
  - examine possibilities and limitations for reducing wastewater related GHG emissions
  - discuss the respective burdens and benefits of selected scenarios in order to support the design of policies in the sector

SOURCES OF GHG EMISSIONS IN WASTEWATER COLLECTION AND TREATMENT

- Direct Emissions
  - all sources addressed by the IPCC guidelines (2006 and 2019)
- Indirect Emissions (construction and operation, electricity and P reagents)
- CO_2e burdens and credits

Burdens	Direct	Indirect
Construction	CO_2e from fuel consumption, etc.	- CO_2e from use of electricity, manufactured goods, etc.
Operation	- Fugitive N_2O, CH_4 - Fugitive CO_2 mostly biogenic in origin (carbon neutral)	- CO_2e from use of electricity, manufactured goods, etc. - N_2O, CH_4 from receiving water bodies
Credits		
Operation	avoided CO_2e emissions by production of net energy (e.g. electricity) or resources (e.g. biomethane)	

SOURCES OF DIRECT GHG EMISSIONS IN WASTEWATER TREATMENT



- N_2O from biological stage (nitrification/ denitrification)
- CH_4 from sludge line (e.g. fugitive biogas emissions, slip in CHP units)
- N_2O and CH_4 in the effluent (IPCC, 2019)

https://www.sciencedirect.com/science/article/pii/S0048969722034192

METHODOLOGICAL APPROACH OF THE ESTIMATION AT EU LEVEL

- Set of plant design/operational typologies encompassing

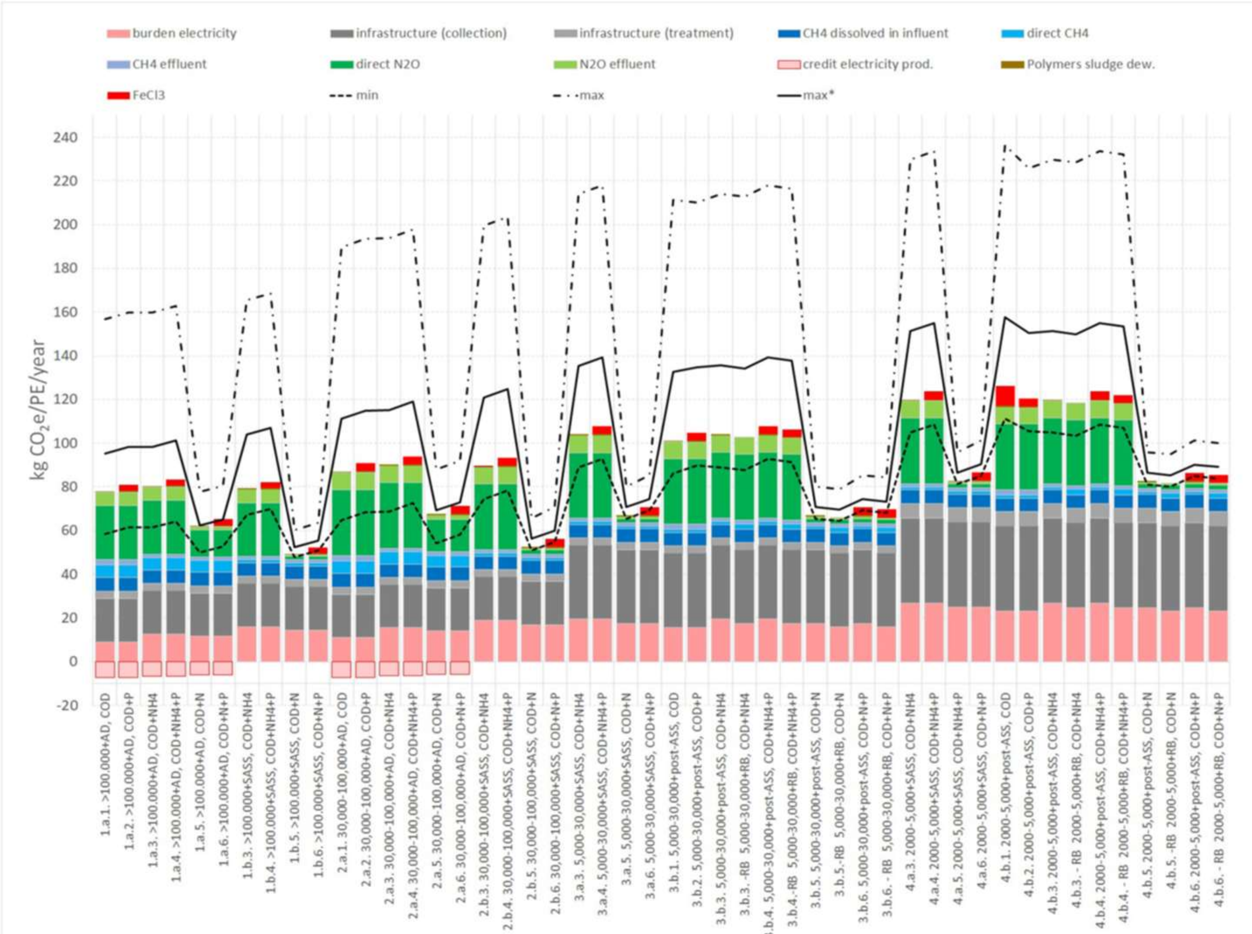
Treatment specifications
- COD removal only
- COD + NH_4^+ removal
- COD + N removal
- with/without P removal

EF-N_2O for the biological stage was set lower at plants targeting N-removal over denitrification

Plant size
- pollutant loads
- energy consumption
- type of sludge stabilisation (e.g. AD, SASS)

- Emission for sludge transport and disposal not included
- Operation and infrastructure included

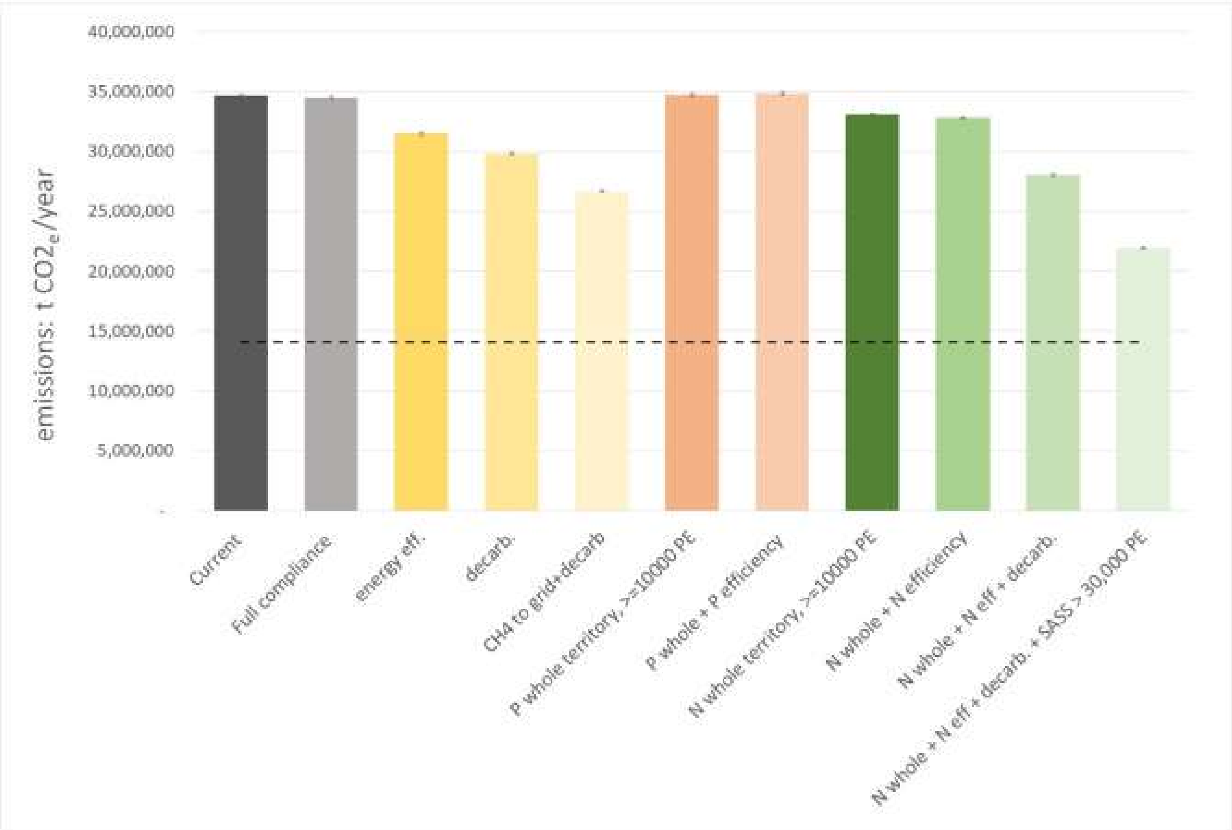
ESTIMATED ANNUAL CO_2e-EMISSION PER PE



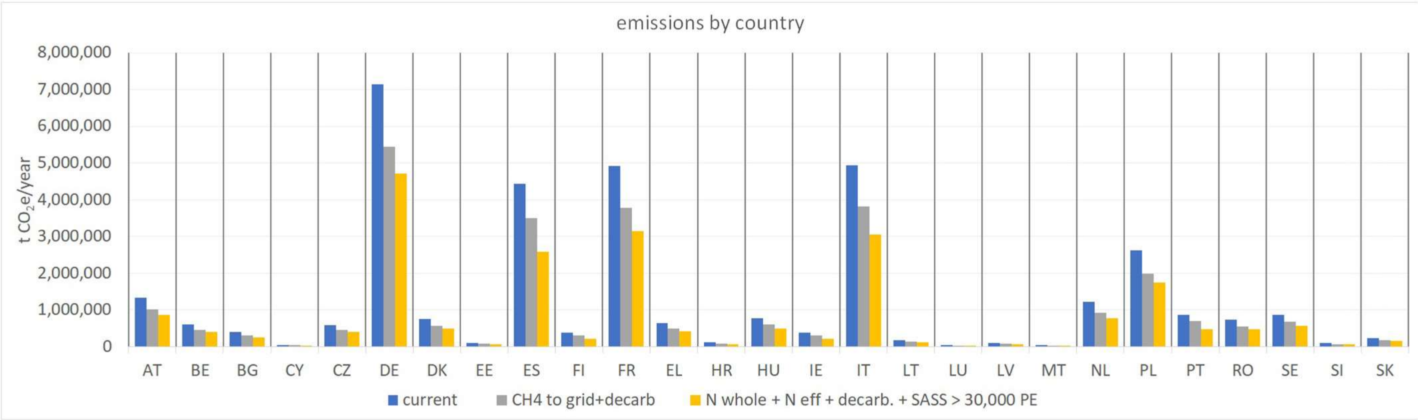
Relevant sources:

- Infrastructure of sewer system
- Electricity consumption in operation
- Level of treatment impacts direct N_2O emission
- Positive scale impact at bigger plants

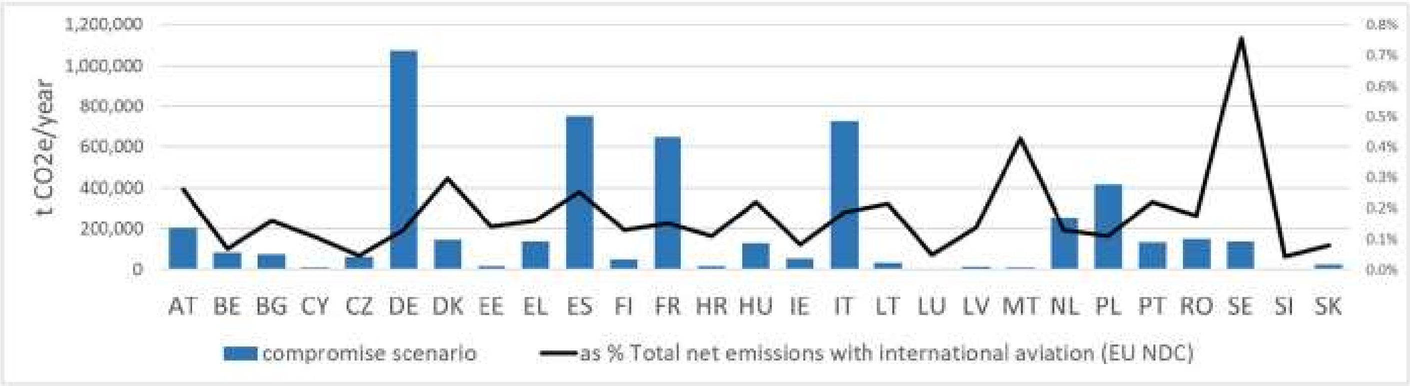
SCENARIOS OF GHG EMISSIONS EU LEVEL



SCENARIOS OF GHG EMISSIONS BY COUNTRY



ADVANCED WASTEWATER TREATMENT



KEY MESSAGES

- Emissions of European wastewater treatment

  50-125 kg CO_2e/PE/year (20-40 embedded in infrastructure)
- Mainly direct N_2O emissions and electricity in operation, then direct CH_4 emissions
- Extrapolating to the EU, cumulative emission ca. 35 million t CO_2e/year (14 in infrastructure)
- Efficient electricity use and decarbonization significantly help reduce emissions
- Denitrification decreases direct nitrous oxide emissions

Q&A

MODERATOR: JACOB KRAGH ANDERSEN

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Nordic Principles
- for a climate neutral water sector

MIRIAM FEILBERG, DANVA

DANVA
The Danish Water and Wastewater Association

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THE NORDICS

- Climate change – our responsibility
- EU Green Deal and climate goals
- UWWTD
- Stronger voice in Europe
- Strength in domestic policymaking

OUR PROJECT

- What do we need to become climate neutral?
- Is it possible?

Table 1. Overview of GHG emissions estimates for the four Nordic countries for the entire water sector.

Parameter	Denmark	Sweden	Norway	Finland
Estimated for year:	**2017**	**2019**	**2019**	**2007**
Total emission estimates	218.000 t CO_2	*228.000 t CO_2	**185.000 t CO_2	310-400.000 t CO_2
Inhabitants	5,8 mio. inh.	10,1 mio. inh.	5,4 mio. inh.	5,5 mio. inh.
Inhabitants connected to municipal and/or public water & wastewater systems	5,6 mio. inh. (water) 5,2 mio. inh. (wastewater)	9 mio inh.	4,8 mio. inh. (water) 4,7 mio.inh. (wastewater)	4,8 mio inh. (water) 4,5 mio inh. (waste water)
Emission estimate/inhabitant	38 kg CO_2/inh.	23 kg CO_2/inh.	34 kg CO_2/inh.	56-73 kg CO_2/inh.
Total national emissions***	61 mio. t CO_2/år (2020)	51 mio. t CO_2/år (2019)	49 mio. t CO_2/år (2020)	48 mio. t CO_2/år (2020)
Total national emissions, 1990	77 mio. t CO_2/år	71 mio. t CO_2/år	41 mio. t CO_2/år	71 mio. t CO_2/år
Contribution from water sector of national emission	0,4 %	0,4 %	0,4 %	0,6-0,8 %

*Covers only sludge handling and wastewater treatment
**Calculated based on a 2019 estimate of 740.000 t CO_2, which included buildings and infrastructure (estimated at 75 % of total emissions).
**(Energistyrelsen, 2021a) / (Naturvårdsverket, 2019) / (Energi og Klima, 2020) / (Tilastokeskus, 2020)

NORDIC WATER SECTOR TARGETS

- Denmark: Climate and energy neutral in 2030, operations
- Finland: Roadmap -> carbon neutral water sector by 2028-2030
- Norway: Reduce GHG-emissions by 50-55% in 2030
- Sweden: Climate neutral in 2030, operations

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).

Table 2. Overview of the parameters that are included in the Nordic countries' water sectors' climate models or future climate models. Red marked parameters indicate emissions, Green marked parameters indicate avoided emissions. Green dots (•) = included; Red dots (•) = not included.

	Parameter	DK	SE (SVU) ***	N	FI
WW	Consumption of electricity and heat	green	red	green	National work has not been initiated yet
	Consumption of chemicals	red	red	green	
	Handling of residues	red	red	red	
	Transportation	red	red	green	
	Afforestation (to protect groundwater)	green	red	red	
	Other CO_2 reducing activities*	green	red	red	
Sewers	Consumption of electricity and heat	green	red	green	
	Production of pipes	red	red	green	
	Construction	red	red	green	
	Handling of filter materials	red	red	green	
WWTP	Consumption of electricity and heat	green	green	green	
	Consumption of fuel (diesel)	red	green	red	
	Sold energy (electricity, heat, biogas)	green	green	green	
	Consumption of chemicals	red	green	green	
	Consumption of filter materials	red	red	green	
	Sludge handling	red	green	red	
	Transportation	red	green	green	
	CH_4 emissions (biogas)	green	green	red	
	N_2O emissions (process)	green	green	green	
	N_2O emissions avoided**	green	red	red	
	CH_4 from septic tanks	green	red	green	
	P recycling (subs. of virgin P)	red	green	red	
	N_2O emissions, effluent	green	green	green	
	Emissions, use of sludge	red	green	red	
	Avoided emissions, use of sludge	red	green	red	
	CH_4 emissions, effluent	red	green	red	
	Carbon binding	red	green	red	

*: e.g. further new reduction measures in relation to N_2O emissions from WWTP, wetlands in connection with tariff-financed climate adjustment, technologies for carbon storage, collaboration with external partners on installation of heat pumps.
**: this is a theoretical calculation on the emission that is avoided by having the WWTP.
***: New simplified model under development

	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 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 – the 85% model
- Start by selecting contributors where data availability and significance is high

Table 5. Overview of parameters included for climate accounting in relation to Water works / drinking water

Selected sum-emissions:	Scope	Sweden	Norway	Finland	Denmark
1. Consumption of electricity (Purchased)	2	Yes	Yes	Yes	Yes
2. Consumption of heat/energy (purchased)	2	Yes	Yes	Yes	Yes
3. Consumption of chemicals	3	Yes	Yes	Yes	No
4. CO_2 reducing activities – substitution of products, production of electricity/heat or Carbon Capture	3	Yes	Yes	Yes	Yes
5. List of emissions not included					*

*CH_4 in groundwater (Scope 1)

Table 6. Overview of parameters included for climate accounting in relation to Transportation / sewer system

Selected sum-emissions:	Scope	Sweden	Norway	Finland	Denmark
1. Consumption of electricity (Purchased)	2	Yes	Yes	Yes	Yes
2. Consumption of heat/energy (purchased)	2	Yes	Yes	No	Yes
3. List of emissions not included					*

*Avoided N_2O to nature based on the removed nitrogen at WWTP

Table 7. Overview of parameters included for climate accounting in relation to Wastewater Treatment Plants

Selected sum-emissions:	Scope	Sweden	Norway	Finland	Denmark
1. Consumption of electricity (purchased)	2	Yes	Yes	Yes	Yes
2. Consumption of heat/energy (purchased)	2	Yes	Yes	Yes	Yes
3. Sold Electricity	2	Yes	Yes	Yes	Yes
4. Sold heat/energy	2	Yes	Yes	Yes	Yes
5. Consumption of fuel for cars/vans/trucks	3	Yes	Yes	Yes	No
6. Consumption of chemicals	3	Yes	Yes	Yes	No
7. CH_4 - emissions – biogas plants	1	Yes	Yes	Yes	Yes
8. CH_4 - emissions - from aerations tanks/processes	1	Yes	No	Yes	(Yes)
9. N_2O - emissions - processes	1	Yes	Yes	Yes	Yes
10. N_2O - emission in effluent from WWTP	1	Yes	Yes	Yes	Yes
11. Emissions from sludge	?	Yes	No	Yes	no
12. CO_2 reducing activities - substitution of products	?	No	No	Yes	Yes
13. CO_2 - carbon capture	?	No	No	No	No
14. List of emissions not included	3				

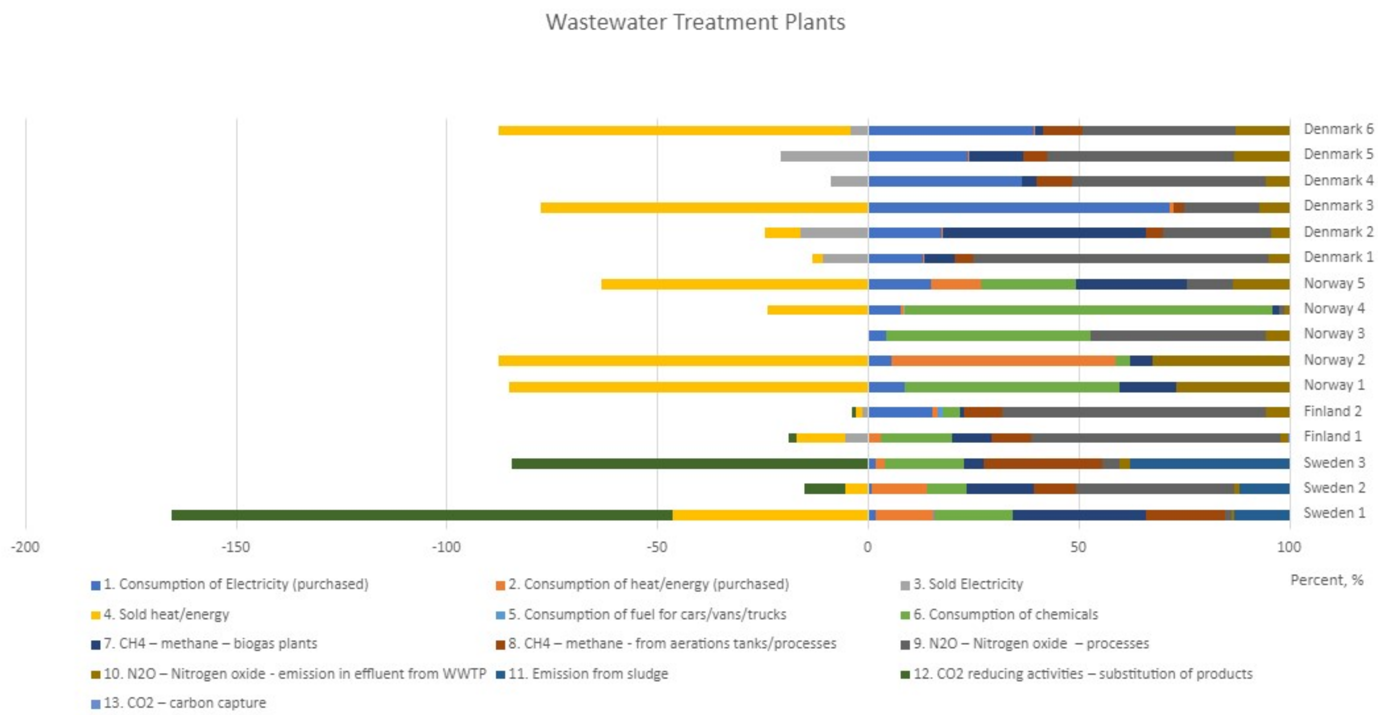
PART II - IS IT POSSIBLE?

CAN WE MEASURE AND TRACK PROGRESS?

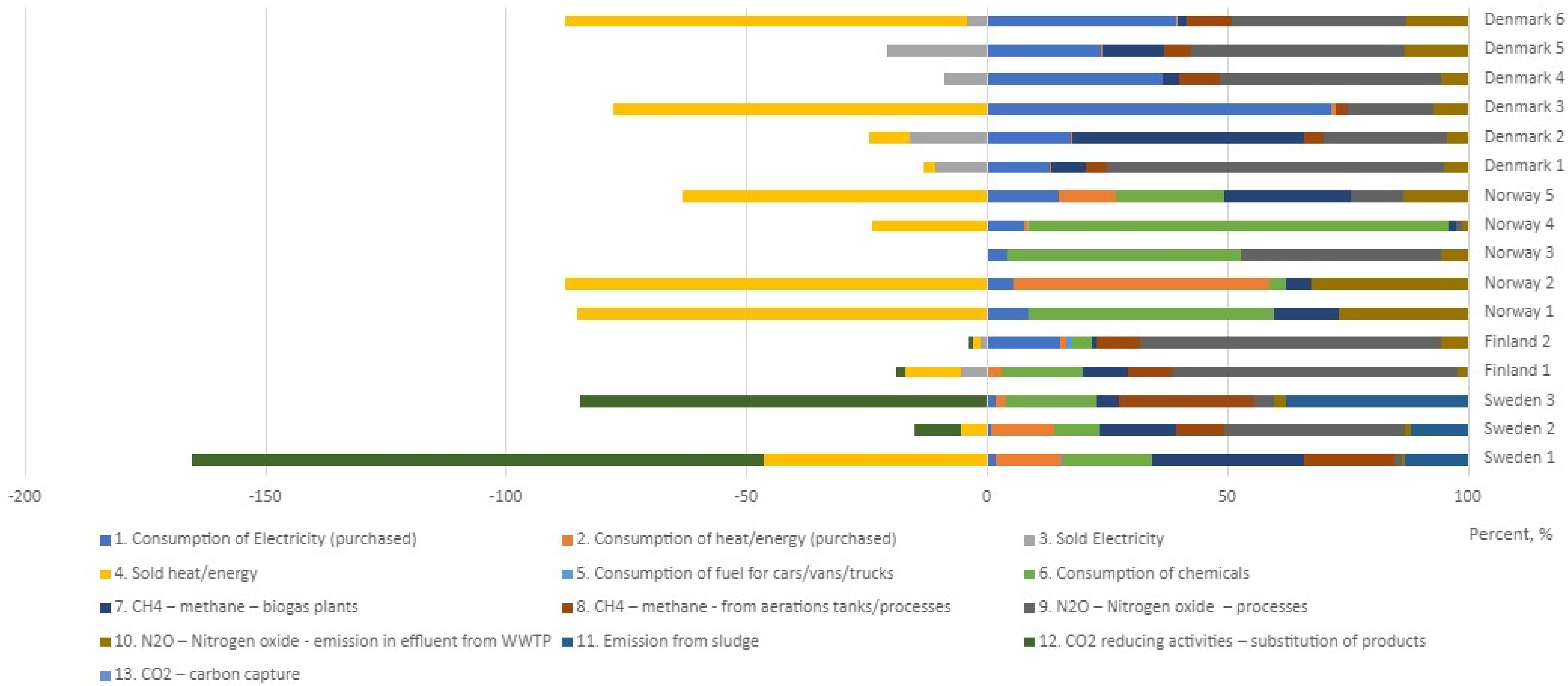
PART II – EXAMPLE, CLIMATE ACCOUNTING WWTP

DANVA | IWA the international water association | CLIMATE SMART UTILITIES

- 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



Wastewater Treatment Plants

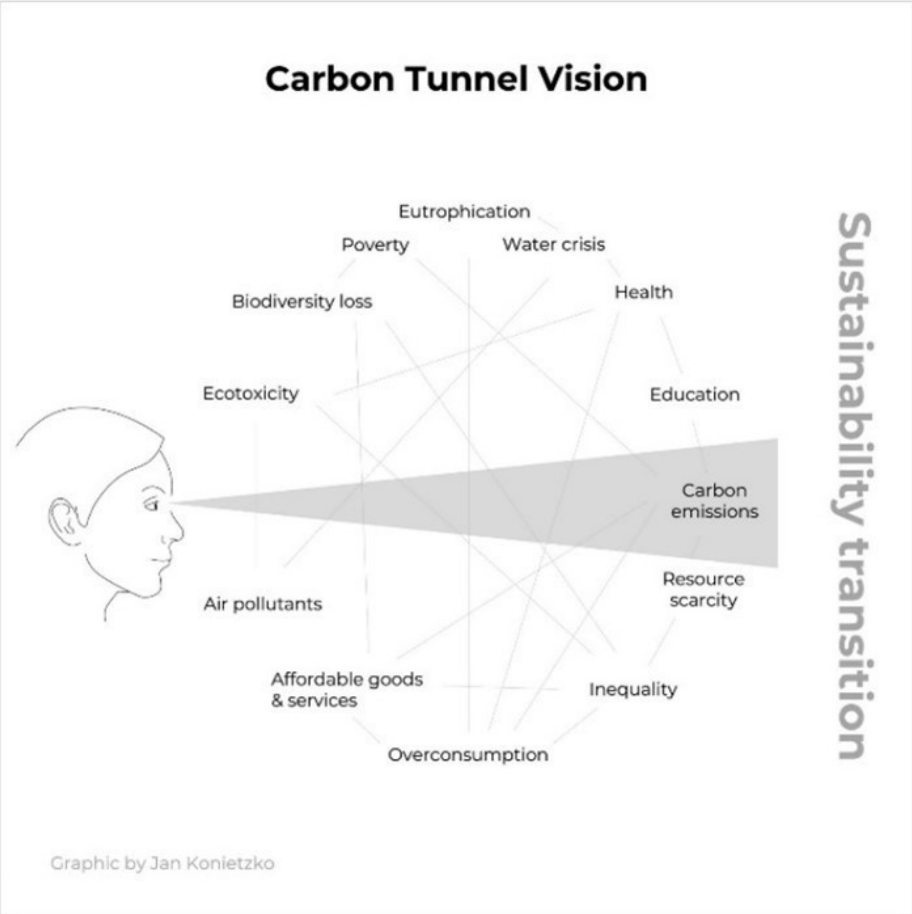


TAKE HOME MESSAGES

- 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

REMEMBER…

- Water utilities need to consider simultaneously various goals (e.g. energy and CO_2 neutrality)
- There is often a trade-off between different environmental targets, costs, and quality!
- GHG emissions are not the only area of focus for sustainability



DANVA

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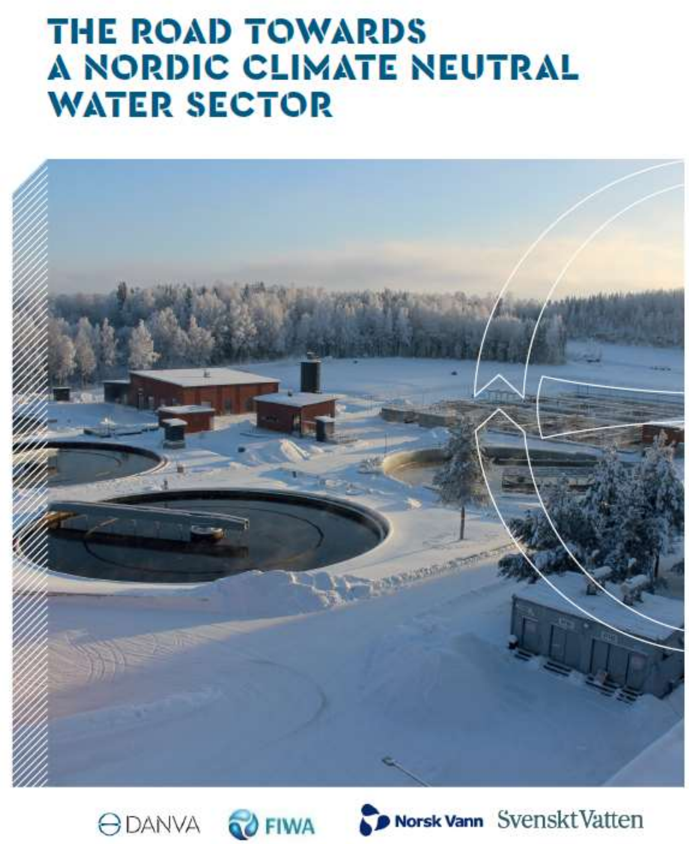
QUESTIONS?



https://www.danva.dk/media/8868/14-09-2022-the-road-towards-a-nordic-climate-neutral-water-sector.pdf

Q&A

MODERATOR: JACOB KRAGH ANDERSEN

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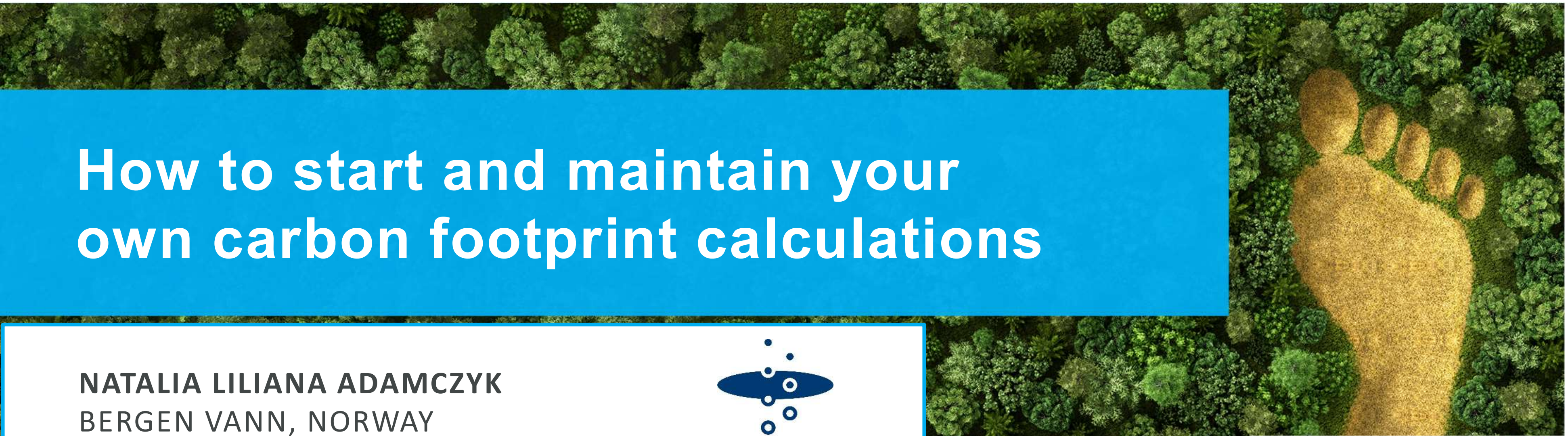
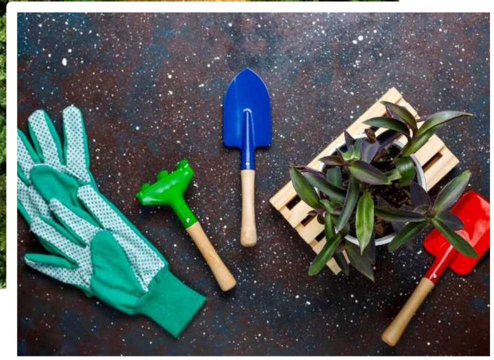


How to start and maintain your own carbon footprint calculations

NATALIA LILIANA ADAMCZYK
BERGEN VANN, NORWAY

bergen vann



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SOME BACKGROUND

- World Water Congress & Exhibition 2022

Picture: www.freepik.com

Developing climate footprint calculations to achieve climate neutrality

Or how to start your own footprint calculations in ~~three~~ Five "easy" steps

bergen vann

Natalia Adamczyk

Bergen Vann – Bergen Municipality's

Water, Wastewater and Urban drainage Utility

Norway

1. KNOW YOUR VALUE CHAIN

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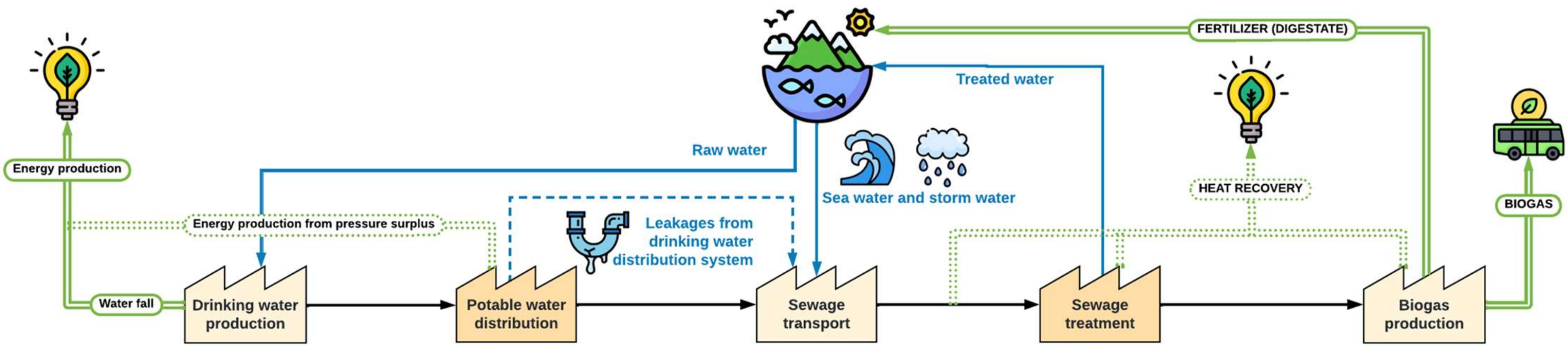
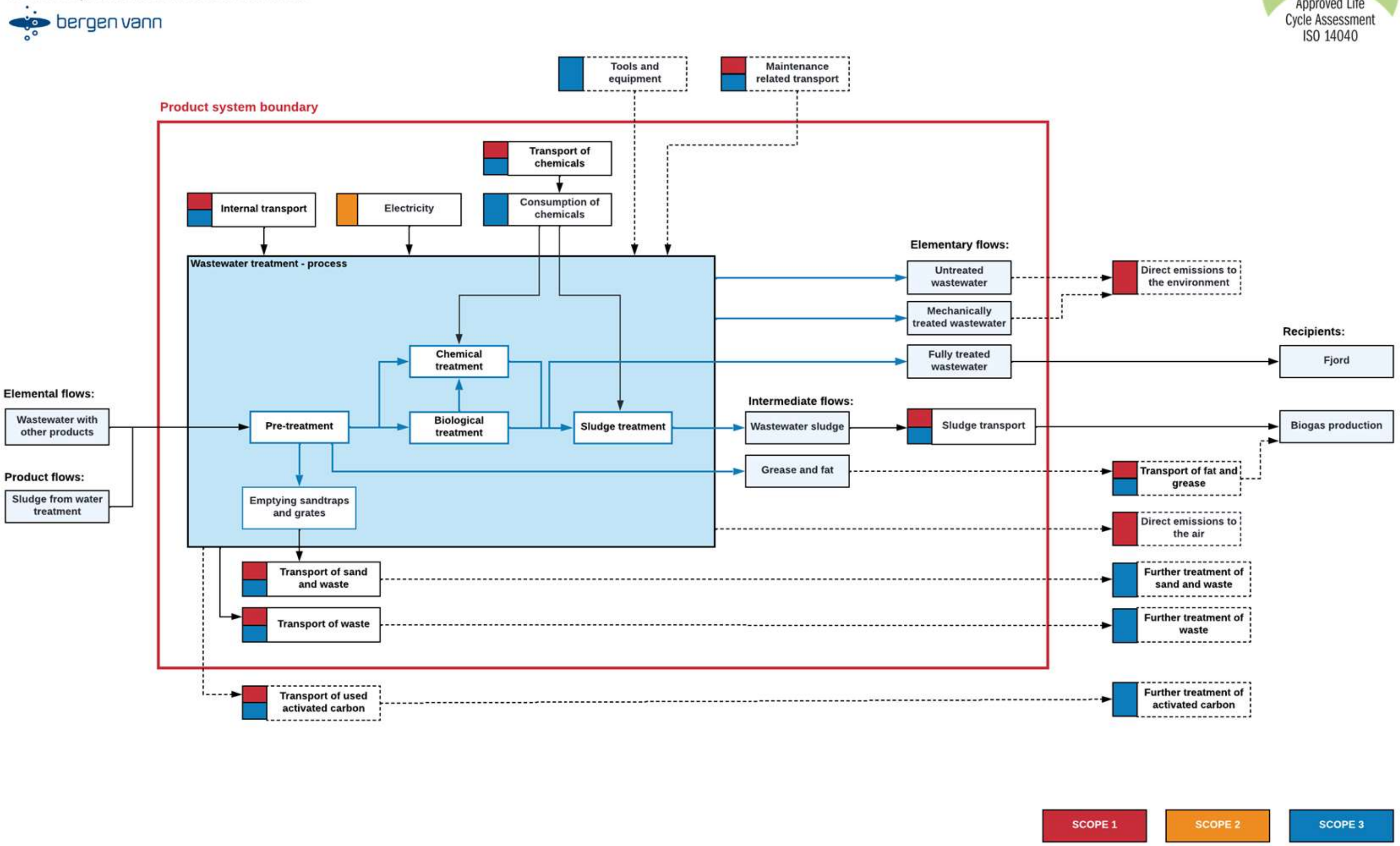


1. KNOW YOUR VALUE CHAIN

Product system for wastewater treatment



More at: [Bergen Water - International Water Association (iwa-network.org)]

1. KNOW YOUR VALUE CHAIN

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NS 3720:2018 - Method for greenhouse gas calculations for buildings

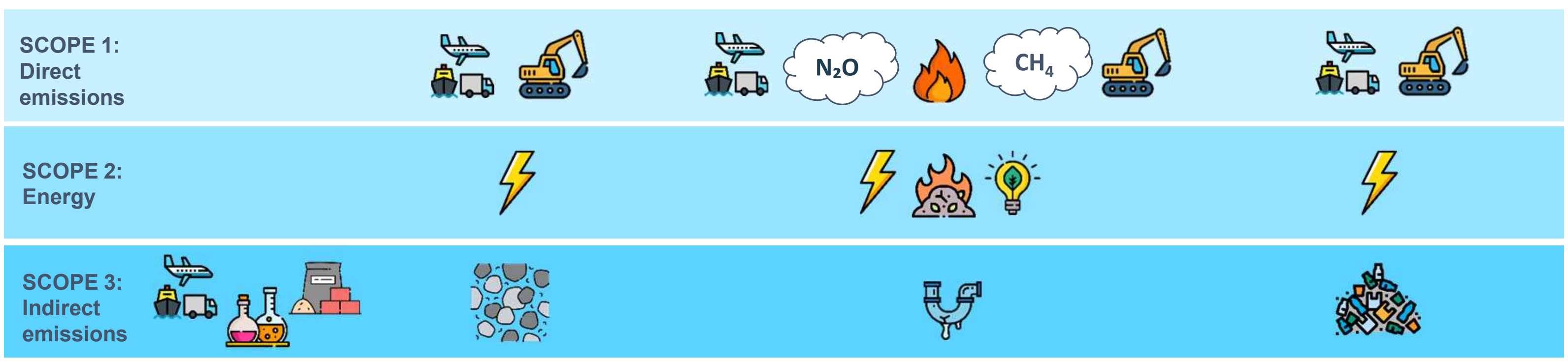
EN 15978:2011 - Sustainability of construction works - Assessment of environmental performance of buildings - Calculation method

Project							Operations								Project			
Product stage			Construction process stage				Use stage								End of life stage			
A1	A2	A3	A4	A5	A6	A7	B1	B2	B3	B4	B5	B6	B7	B8	C1	C2	C3	C4
Raw material supply	Transport	Manufacturing	Transport	Construction and installation process	Mass management	Impact on ecosystems and organisms	Use	Maintanance	Repair	Replacaement	Refurbishment	Operation energy use	Operational water use	Transport	De-construction	Transport	Waste processing	Disposal

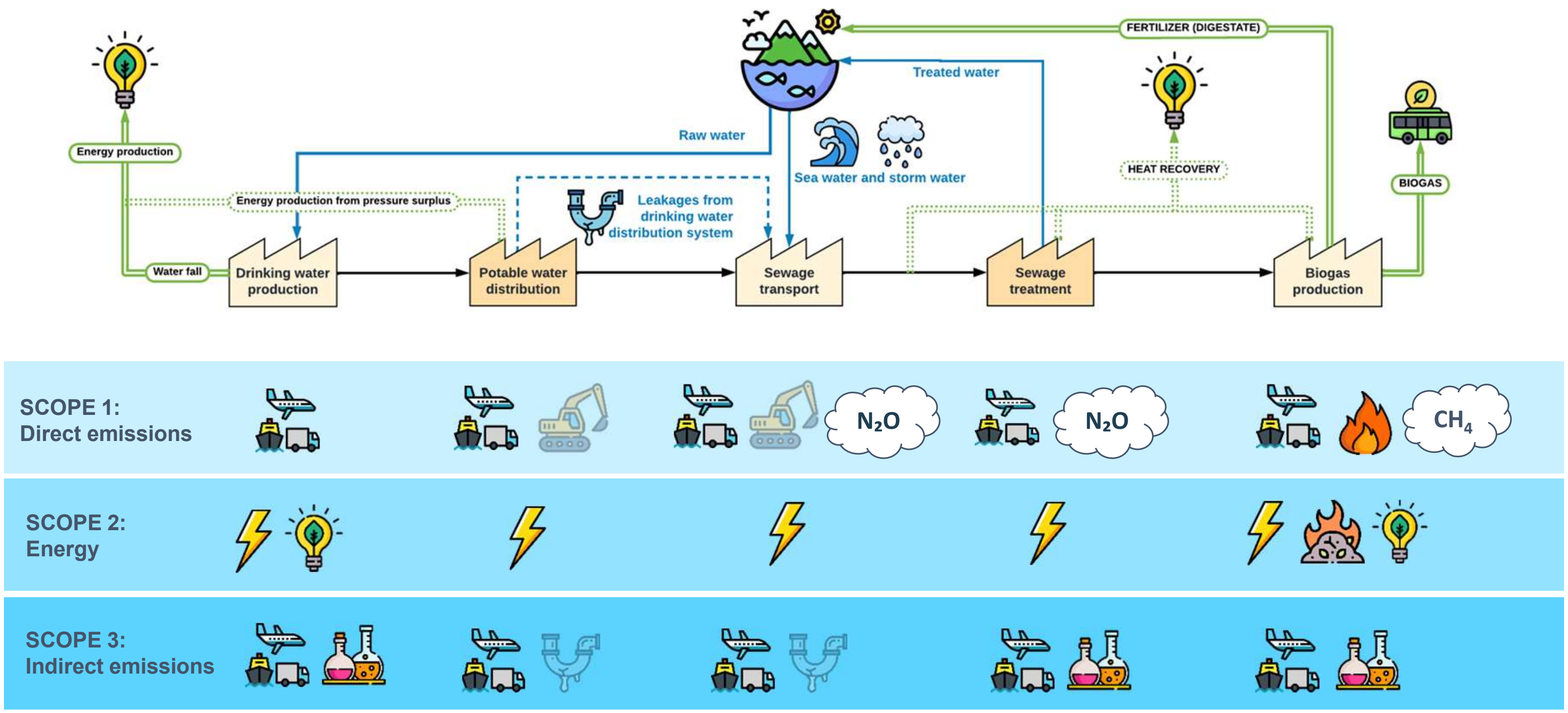
bergen vann

2. ORGANIZE YOUR EMISSIONS

Product stage			Construction process stage				Use stage								End of life stage			
A1	A2	A3	A4	A5	A6	A7	B1	B2	B3	B4	B5	B6	B7	B8	C1	C2	C3	C4
Raw material supply	Transport	Manufacturing	Transport	Construction and installation process	Mass management	Impact on ecosystems and organisms	Use	Maintanance	Repair	Replacaement	Refurbishment	Operation energy use	Operational water use	Transport	De-construction	Transport	Waste processing	Disposal



2. ORGANIZE 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.

3. UNDERSTAND YOUR DATA (AND ITS PURPOSE)

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ÅRLIG ENERGIFORBRUK FOR AVLØPSRENS

Basert på energiforbruk fra strømleverandør.

Energy supplier
- Oversikt
- Avløpstransport - årlig
- Avløpsrens - årlig
- Avløpstransport - månedlig
- Avløpsrens - månedlig
- Sensordata - sammenligning

Sensors
- Sensordata - oversikt
- Sensordata - Ytre Sandviken
- Sensordata - Holen
- Sensordata - Flesland
- Sensordata - Kvernevik
- Sensordata - Knappen

Velg anleggstype
- Velg alt
- Administrasjonsbygg
- Biogassanlegg fjernvarme
- Biogassanlegg strøm
- Mekaniske renseanlegg
- Store renseanlegg

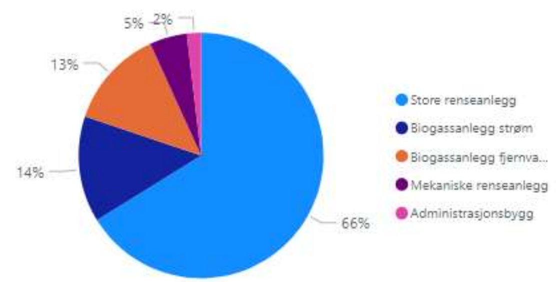
Velg anlegg
- Søk
- Velg alt
- Alvøen RA
- Biogassanlegg
- Drotningsvik RA
- Eikeviken RA
- Fagerdalen RA
- Flesland RA
- Garnes RA
- Godvik RA
- Hellenseset RA

ÅRLIG ENERGIFORBRUK (KWT)

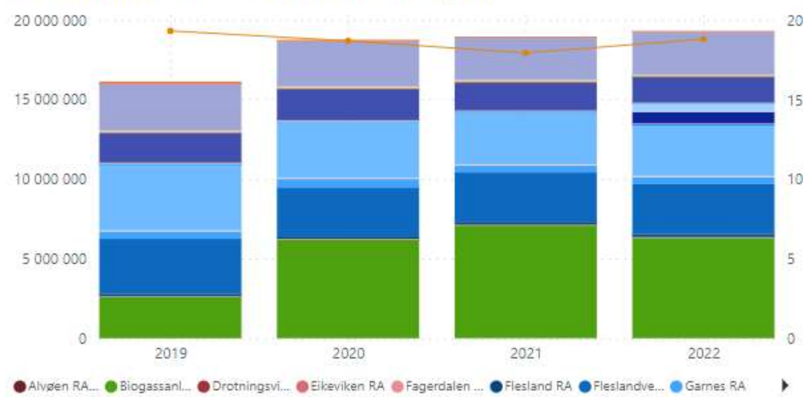
Navn	2019	2020	2021	2022
Biogassanlegg	2 581 578	6 186 649	7 060 022	6 294 627
Holen RA	4 188 272	3 568 865	3 322 894	3 247 501
Flesland RA	3 607 578	3 242 743	3 292 072	3 321 512
Ytre Sandviken RA	3 074 013	2 925 979	2 709 241	2 707 883
Kvernevik RA	1 825 512	1 928 232	1 706 062	1 573 753
Garnes RA	459 801	515 408	424 436	440 387
Knappen RA	10 523	4 599	22 942	1 327 511
Sagstad RA	56 927	66 187	63 974	66 277
Totalt	**16 123 665**	**18 746 522**	**18 942 286**	**19 307 422**

Velg værparameter: Maks temp (oC)

ENERGIFORBRUK FORDELING (%)



ÅRLIG ENERGIFORBRUK - TRENDER VÆR OG ENERGI (KWT)



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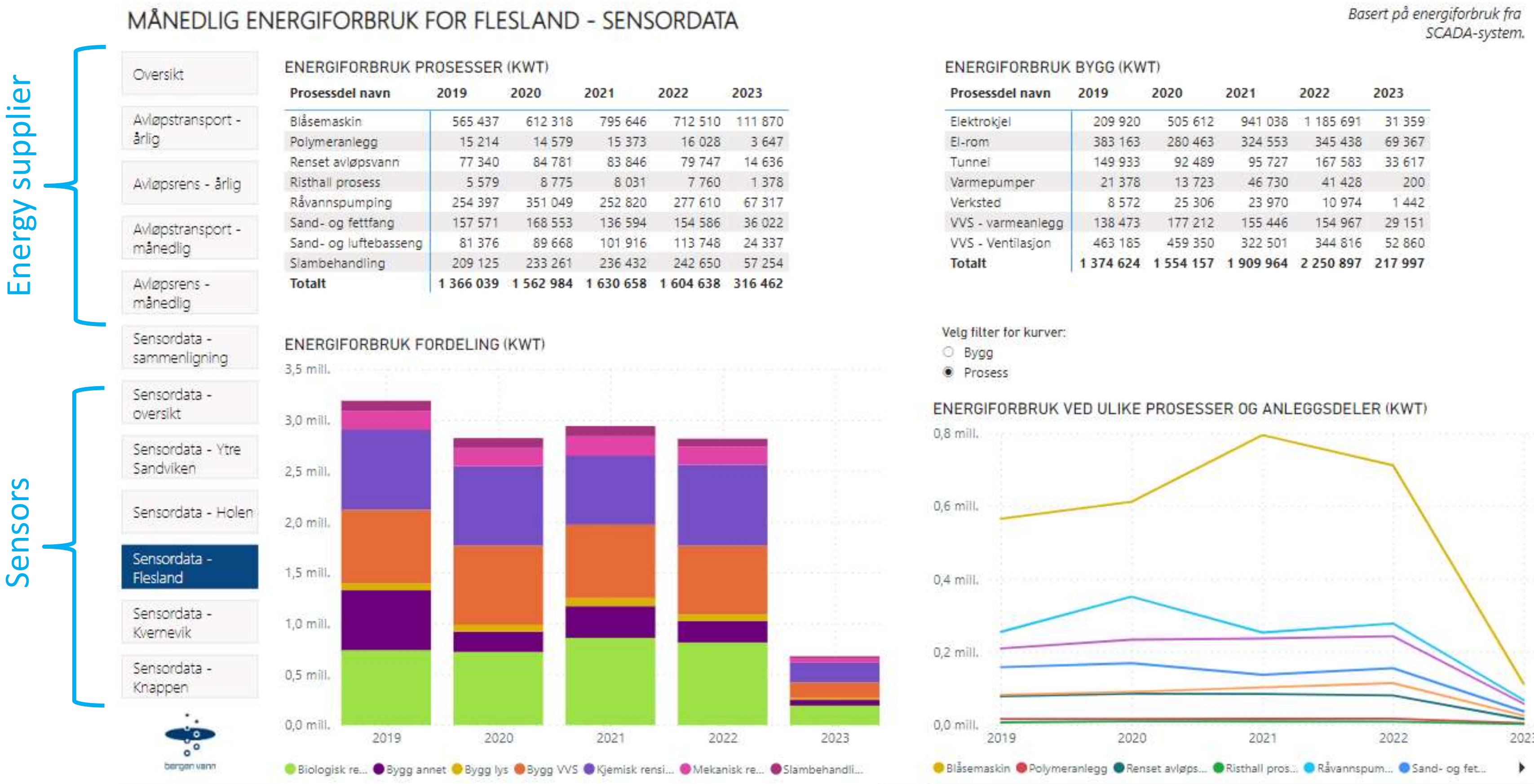
3. UNDERSTAND YOUR DATA (AND ITS PURPOSE)

CLIMATE SMART UTILITIES



ENERGIFORBRUK PROSESSER (KWT)

Prosessdel navn	2019	2020	2021	2022	2023
Blåsemaskin	565 437	612 318	795 646	712 510	111 870
Polymeranlegg	15 214	14 579	15 373	16 028	3 647
Renset avløpsvann	77 340	84 781	83 846	79 747	14 636
Risthall prosess	5 579	8 775	8 031	7 760	1 378
Råvannspumping	254 397	351 049	252 820	277 610	67 317
Sand- og fettfang	157 571	168 553	136 594	154 586	36 022
Sand- og luftebasseng	81 376	89 668	101 916	113 748	24 337
Slambehandling	209 125	233 261	236 432	242 650	57 254
Totalt	**1 366 039**	**1 562 984**	**1 630 658**	**1 604 638**	**316 462**

ENERGIFORBRUK BYGG (KWT)

Prosessdel navn	2019	2020	2021	2022	2023
Elektrokjel	209 920	505 612	941 038	1 185 691	31 359
El-rom	383 163	280 463	324 553	345 438	69 367
Tunnel	149 933	92 489	95 727	167 583	33 617
Varmepumper	21 378	13 723	46 730	41 428	200
Verksted	8 572	25 306	23 970	10 974	1 442
VVS - varmeanlegg	138 473	177 212	155 446	154 967	29 151
VVS - Ventilasjon	463 185	459 350	322 501	344 816	52 860
Totalt	**1 374 624**	**1 554 157**	**1 909 964**	**2 250 897**	**217 997**

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3. UNDERSTAND YOUR DATA (AND ITS PURPOSE)

CLIMATE SMART UTILITIES

MÅNEDLIG ENERGIFORBRUK FOR AVLØPSTRANSPORT

- Oversikt
- Avløpstransport - årlig
- Avløpsrens - årlig
- Avløpstransport - månedlig
- Avløpsrens - månedlig
- Sensordata - sammenligning
- Sensordata - oversikt
- Sensordata - Ytre Sandviken
- Sensordata - Holen
- Sensordata - Flesland
- Sensordata - Kvernevik
- Sensordata - Knappen

Basert på energiforbruk fra strømleverandør og data fra SCADA-system.

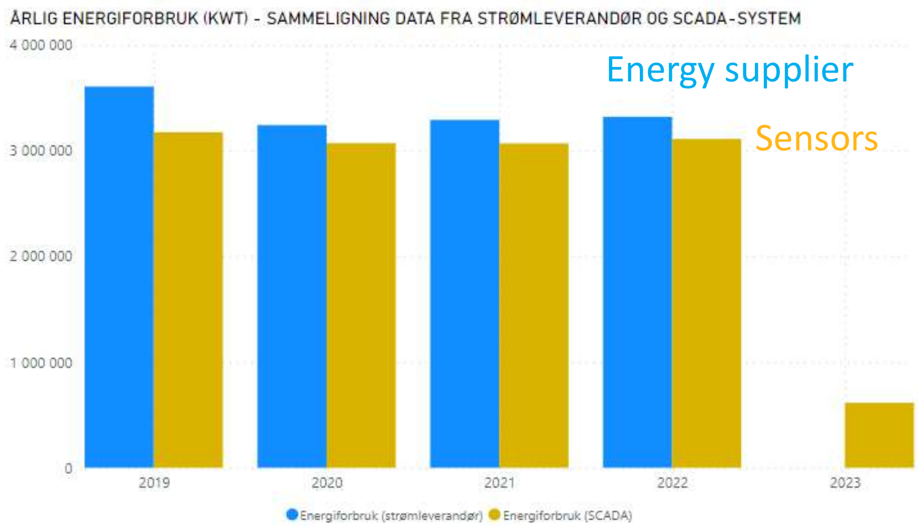
STRØMLEVERANDØR - ÅRLIG ENERGIFORBRUK (KWT)

Navn	2019	2020	2021	2022
Flesland RA	3 607 578	3 242 743	3 292 072	3 321 512
Totalt	**3 607 578**	**3 242 743**	**3 292 072**	**3 321 512**

SCADA-SYSTEM - ÅRLIG ENERGIFORBRUK (KWT)

Anlegg	2019	2020	2021	2022	2023
Flesland RA	3 175 932	3 072 212	3 069 715	3 111 292	614 702
Totalt	**3 175 932**	**3 072 212**	**3 069 715**	**3 111 292**	**614 702**

Navn
- Velg alt
- Flesland RA
- Holen RA
- Knappen RA
- Kvernevik RA
- Ytre Sandviken RA



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3. UNDERSTAND YOUR DATA (AND YOUR CALCULATIONS)

IWA the international water association CLIMATE SMART UTILITIES

RAW DATA

Kilometers

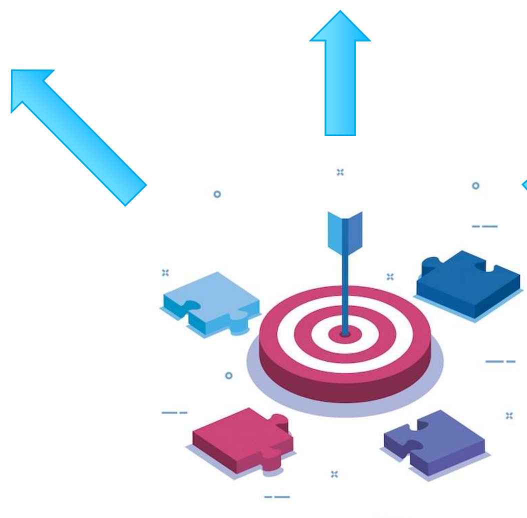
Working hours

EMISSION FACTORS

- *Databases*
- *Standards*
- *Suppliers*
- *Authorities*

CALCULATIONS

- *One way*
- *Both ways*
- *Sigle vehicle*
- *Vehicle fleet*



OUTPUT

- *Kg CO2e. / km*
- *Kg CO2e. / MJ*
- *Kg CO2e. / t*km*

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4. CHOOSE YOUR TOOLS WISELY

IWA the international water association CLIMATE SMART UTILITIES

KJEMIKALIEFORBRUK

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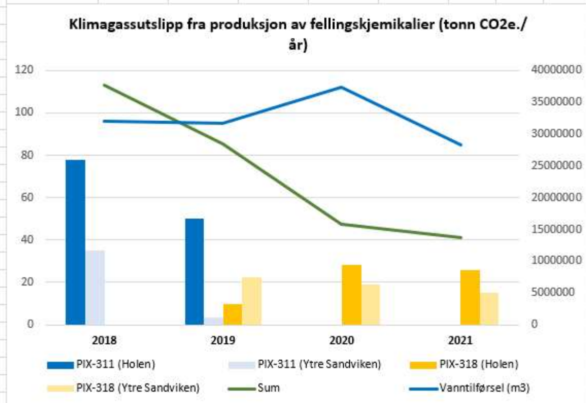
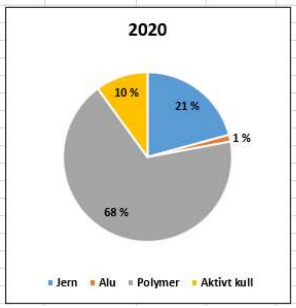
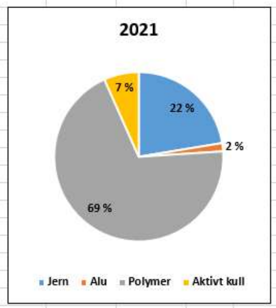
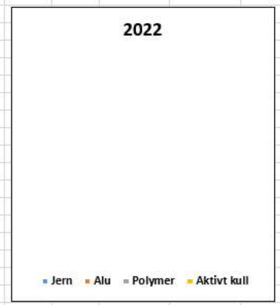
Parameter	Kjemikalie	Enhet	2018	2019	2020	2021	2022
	Sand	*tonn årlig*	121	145	85	56	0
Forbruk Kvernevik	Zetag 4105, 4145, 7557, 8140, 8180	*tonn årlig*	6	7	7	5	0
Forbruk Flesland	Zetag 4105, 4145, 7557, 8140, 8180	*tonn årlig*	2	21	24	26	0
Forbruk Biogassanleg	Zetag 4105, 4145, 7557, 8140, 8180	*tonn årlig*	18	18	29	20	0
Utslippsfaktorer							
Jern	PIX-318 (jern)	*kg CO2/ tonn produkt*	40	40	40	40	40
Jern	PIX-311 (jern)	*kg CO2/ tonn produkt*	145	145	145	145	145
Alu	Ekoflock-90 (alu.)	*kg CO2/ tonn produkt*	483	483	483	483	483
Polymer	Zetag 4105, 4145, 7557, 8140, 8180	*kg CO2/ tonn produkt*	2700	2700	2700	2700	2700
Polymer	Flopam AN 934 (pol.)	*kg CO2/ tonn produkt*	2700	2700	2700	2700	2700
Annet	Sand	*kg CO2/ tonn produkt*	0	0	0	0	0
Klimagassutslipp fra produksjon							
Forbruk Knappen	PIX-318 (jern)	*tonn årlig*	32	34	38	38	0
	Ekoflock-90 (alu.)	*tonn årlig*	4	5	5	6	0
	Zetag 4105, 4145, 7557, 8140, 8180	*tonn årlig*	0	0	0	0	0
Forbruk Holen	PIX-311 (jern)	*tonn årlig*	78	50	0	0	0
	Zetag 4105, 4145, 7557, 8140, 8180	*tonn årlig*	28	25	47	72	0
	Flopam AN 934 (pol.)	*tonn årlig*	50	52	34	0	0
	PIX-318 (jern)	*tonn årlig*	0	10	28	26	0
	Sand	*tonn årlig*	0	0	0	0	0
Forbruk Ytre Sandviken	PIX-318 (jern)	*tonn årlig*	0	22	19	15	0
	PIX-311 (jern)	*tonn årlig*	35	3	0	0	0
	Zetag 4105, 4145, 7557, 8140, 8180	*tonn årlig*	32	38	37	35	0
	Sand	*tonn årlig*	0	0	0	0	0
Forbruk Kvernevik	Zetag 4105, 4145, 7557, 8140, 8180	*tonn årlig*	18	19	19	13	0
Forbruk Flesland	Zetag 4105, 4145, 7557, 8140, 8180	*tonn årlig*	5	56	65	71	0
Forbruk Biogassanleg	Zetag 4105, 4145, 7557, 8140, 8180	*tonn årlig*	49	50	78	53	0
Utslipp fra produksjon etter kjemikaliegruppe							
Jern	PIX-318 (jern)	*tonn CO2 e. årlig*	32	66	86	79	0
Jern	PIX-311 (jern)	*tonn CO2 e. årlig*	113	53	0	0	0
Alu	Ekoflock-90 (alu.)	*tonn CO2 e. årlig*	4	5	5	6	0
Polymer	Zetag 4105, 4145, 7557, 8140, 8180	*tonn CO2 e. årlig*	132	187	245	245	0
Polymer	Flopam AN 934 (pol.)	*tonn CO2 e. årlig*	50	52	34	0	0
Aktivt kull	Aktivt kull - fossil opprinnelse	*tonn CO2 e. årlig*	25	43	41	24	0
	Jern	*tonn CO2 e. årlig*	145	120	86	79	0
	Alu	*tonn CO2 e. årlig*	4	5	5	6	0
	Polymer	*tonn CO2 e. årlig*	182	239	280	245	0
	Aktivt kull	*tonn CO2 e. årlig*	25	43	41	24	0









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4. CHOOSE YOUR TOOLS WISELY

IWA the international water association — CLIMATE SMART UTILITIES

ENERGIFORBRUK OG ENERGIPRODUKSJON - AVLØP OG MILJØ

Resultater basert på energiforbruk fra strømleverandør og energiproduksjon fra drift-system på Biogassanlegget.

- Oversikt
- Avløpstransport - årlig
- Avløpsrens - årlig
- Avløpstransport - månedlig
- Avløpsrens - månedlig
- Sensordata - sammenligning
- Sensordata - oversikt
- Sensordata - Ytre Sandviken
- Sensordata - Holen
- Sensordata - Flesland
- Sensordata - Kvernevik
- Sensordata - Knappen

ÅRLIG ENERGIFORBRUK (KWT)

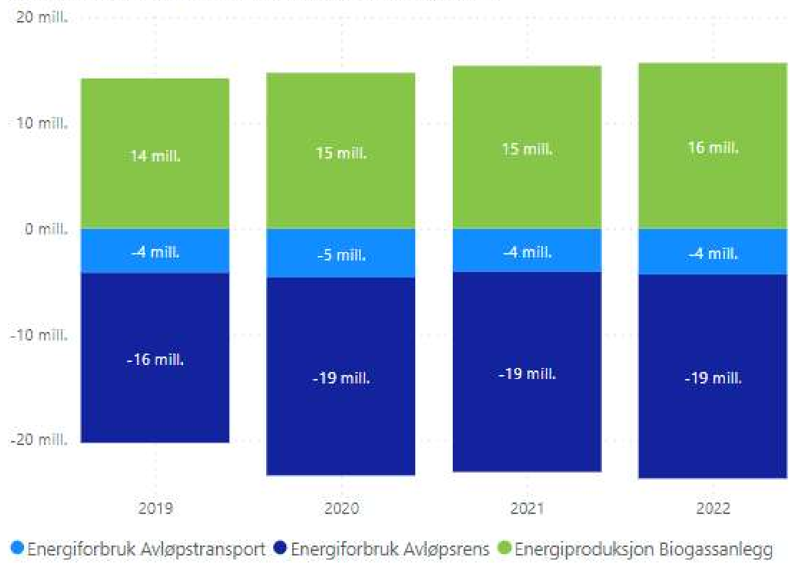
Tjeneste	2019	2020	2021	2022
35010 AR	16 123 665	18 746 522	18 942 286	19 307 422
35310 AT	4 142 782	4 633 282	4 072 213	4 343 028
Totalt	**20 266 447**	**23 379 804**	**23 014 499**	**23 650 450**

ÅRLIG ENERGIPRODUKSJON (KWT)

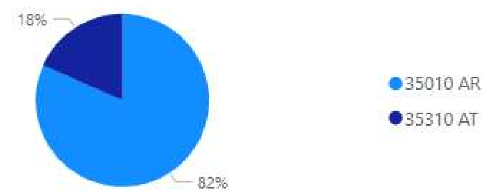
Kilde	2019	2020	2021	2022
Energiprod. Biogassanlegg	14 211 312	14 715 630	15 389 420	15 653 857
Totalt	**14 211 312**	**14 715 630**	**15 389 420**	**15 653 857**

År: 2022

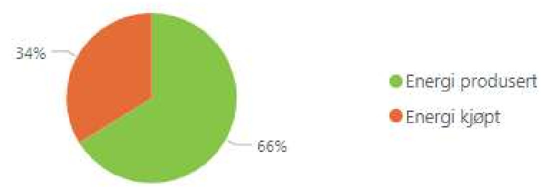
ÅRLIG ENERGIFORBRUK OG ENERGIPRODUKSJON (KWT)



PROSENTVIS FORDELING ÅRLIG ENERGIFORBRUK



SELVFORSYNINGSGRAD AVDELING (%)



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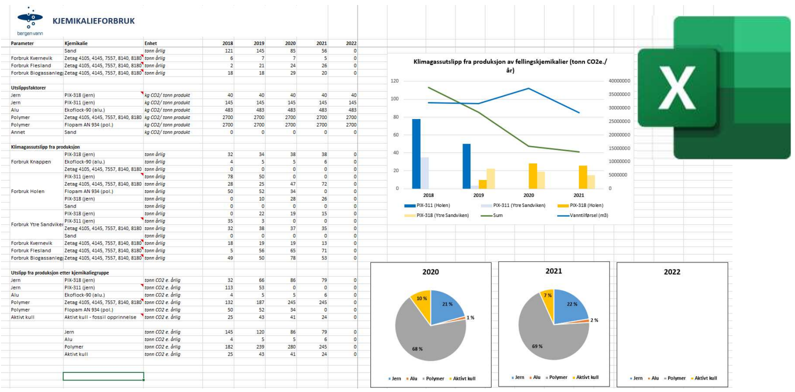
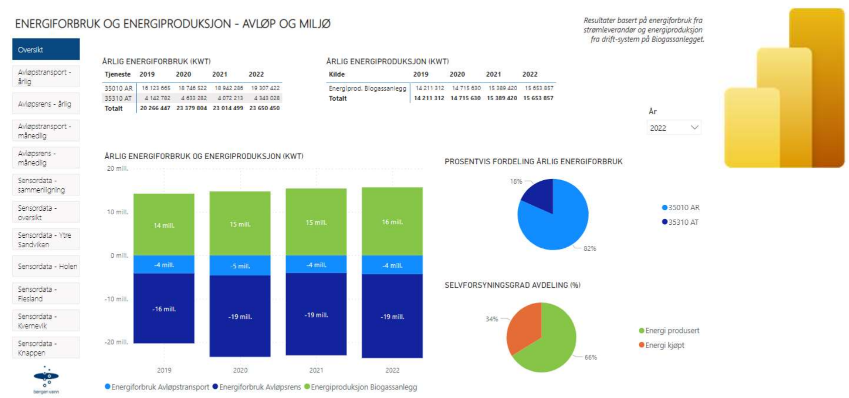
4. CHOOSE YOUR TOOLS WISELY



- Easy to calculate.
- "Everyone" can use it.
- Easy to store and exchange.



- Easy to navigate.
- Visually appealing and intuitive.
- Can link it up to the "data clouds" and "live" sensor measurement.
- Needs special competence.
- Not for calculations.
- Additional costs.

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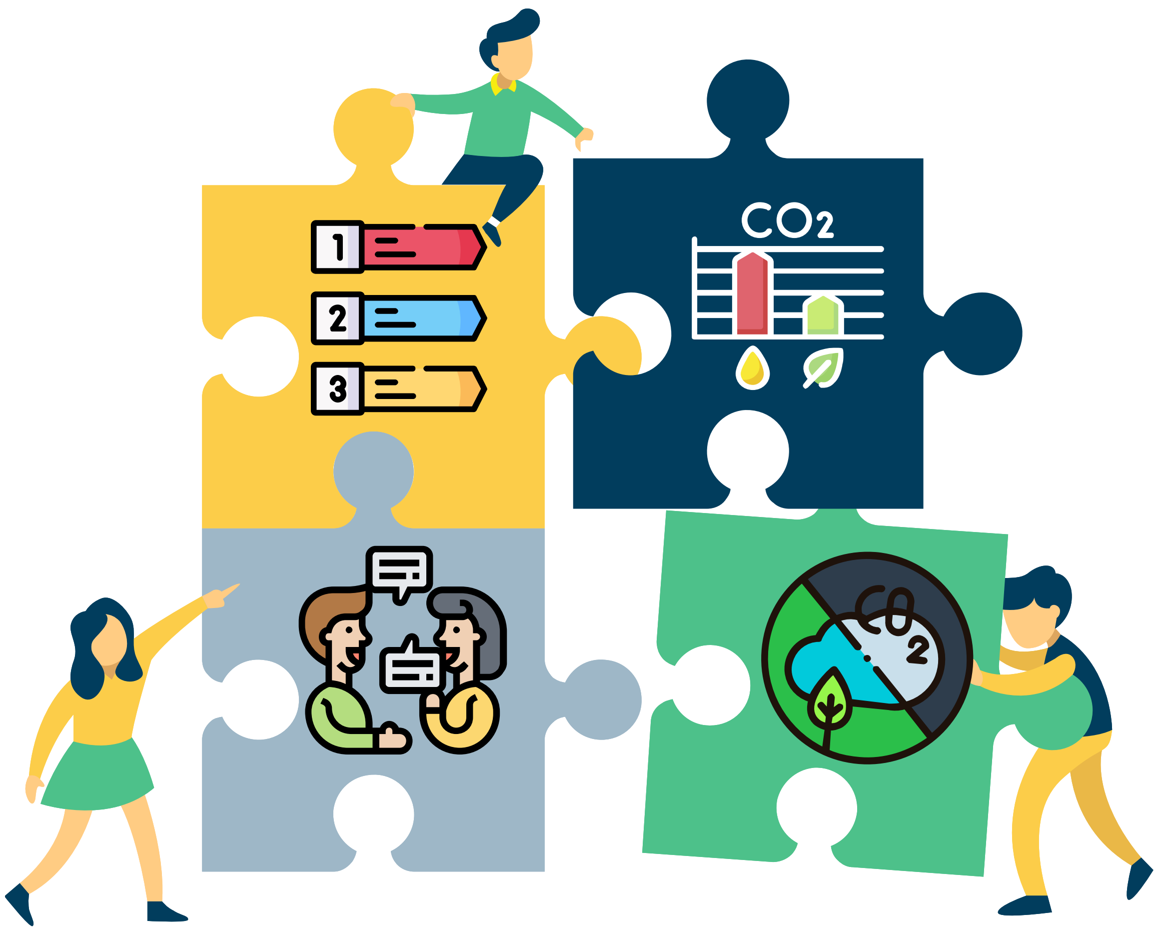
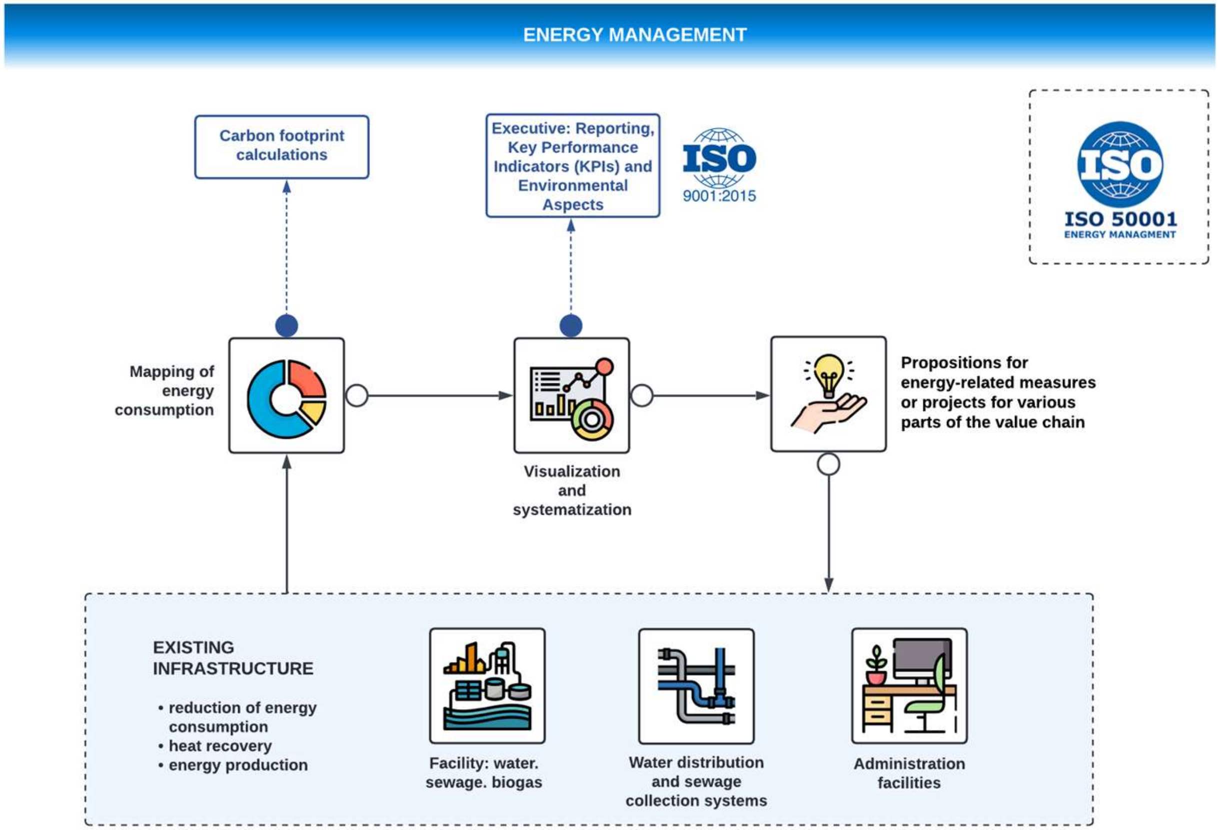
5. PUT IT ALL INTO A CONTEXT



5. PUT IT ALL INTO A CONTEXT



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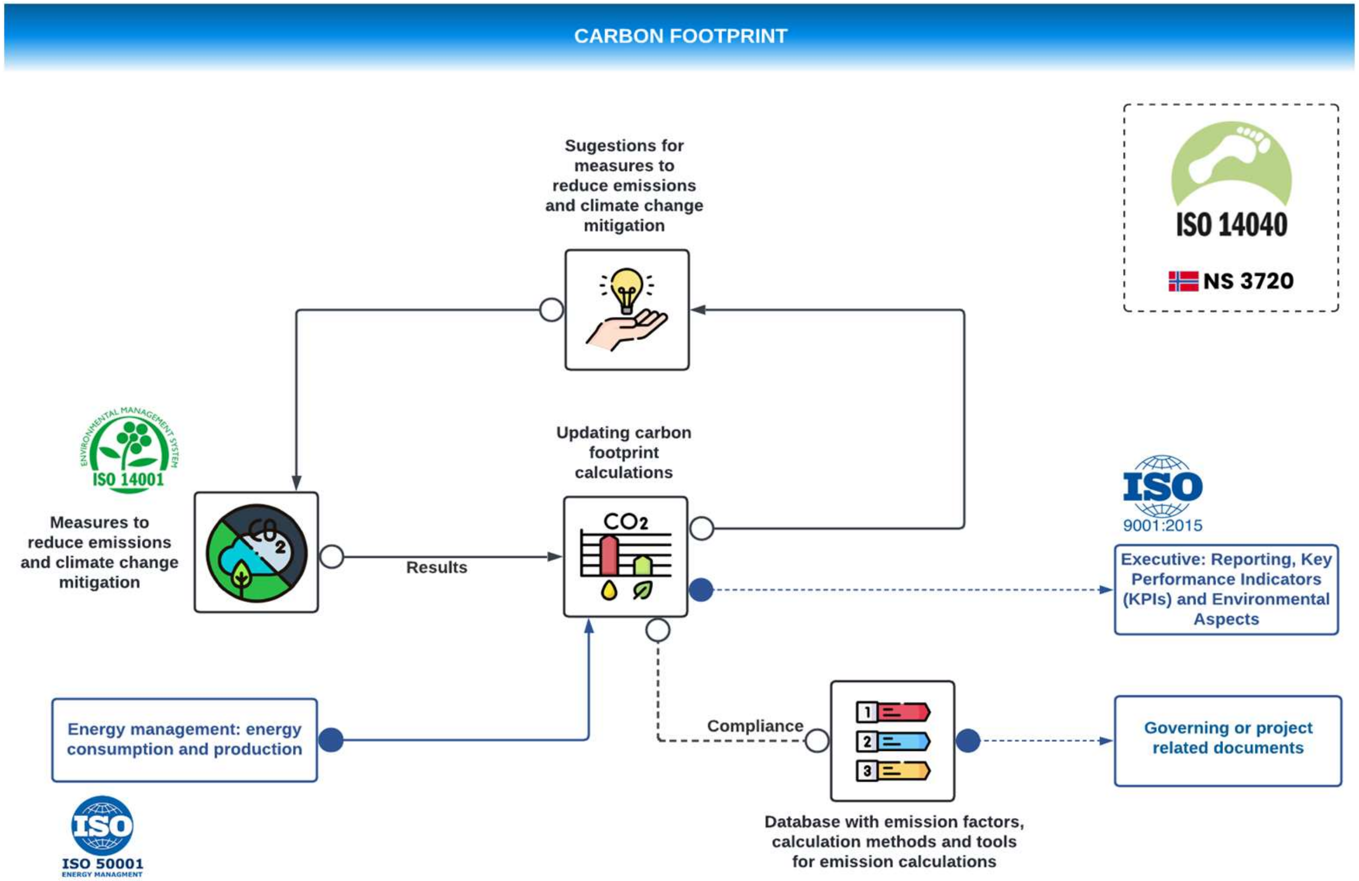

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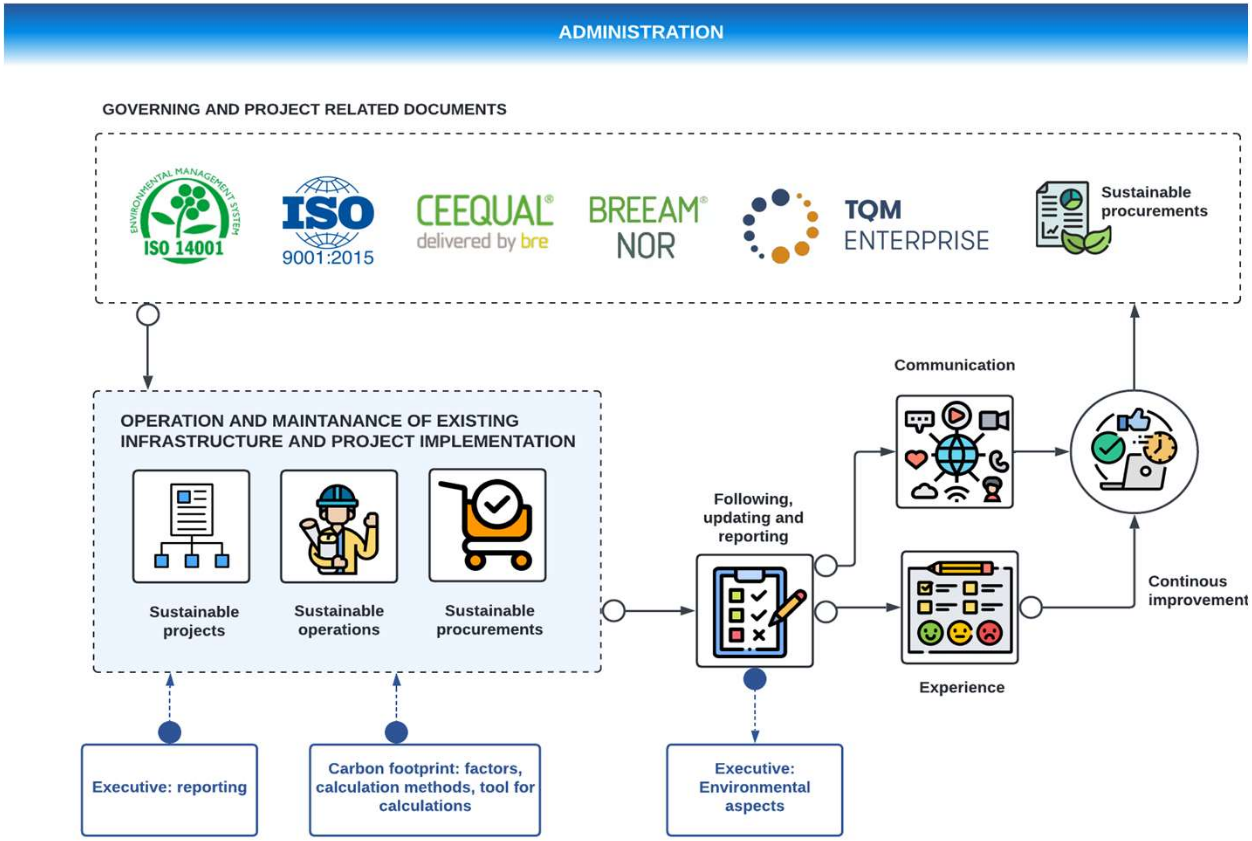
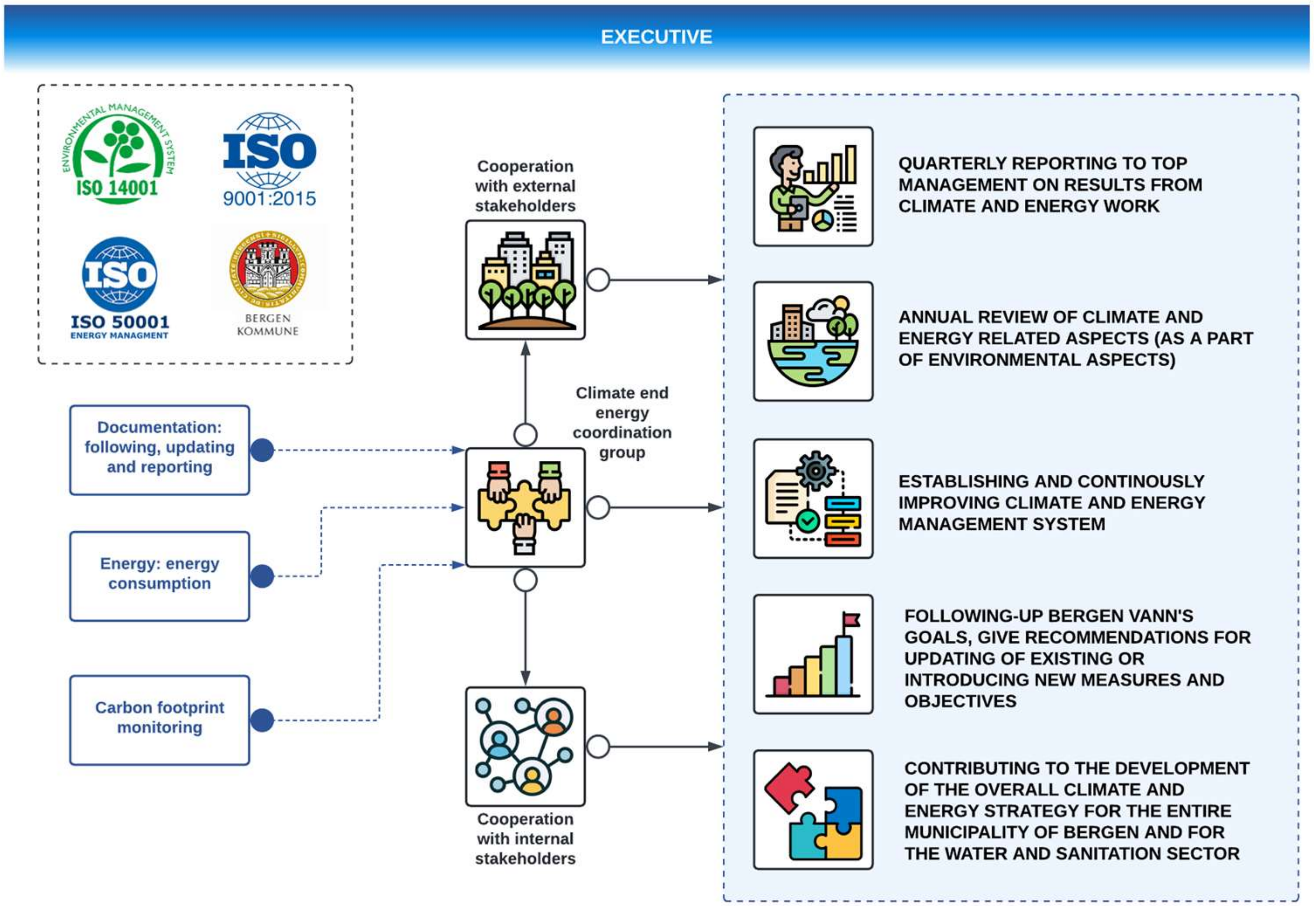


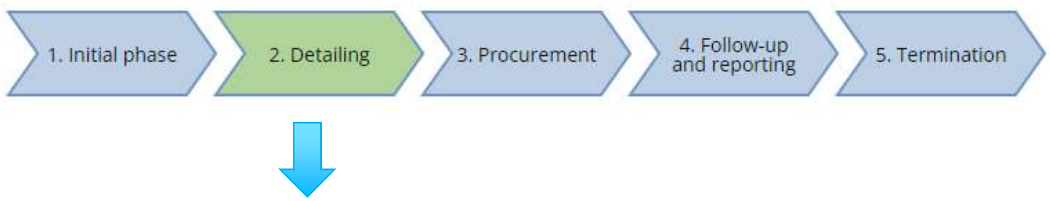
5. PUT IT ALL INTO A CONTEXT



5. PUT IT ALL INTO A CONTEXT

CLIMATE SMART UTILITIES

Prosess for managing climate, energy and environmental aspects in projects



Manual for carbon footprint calculations

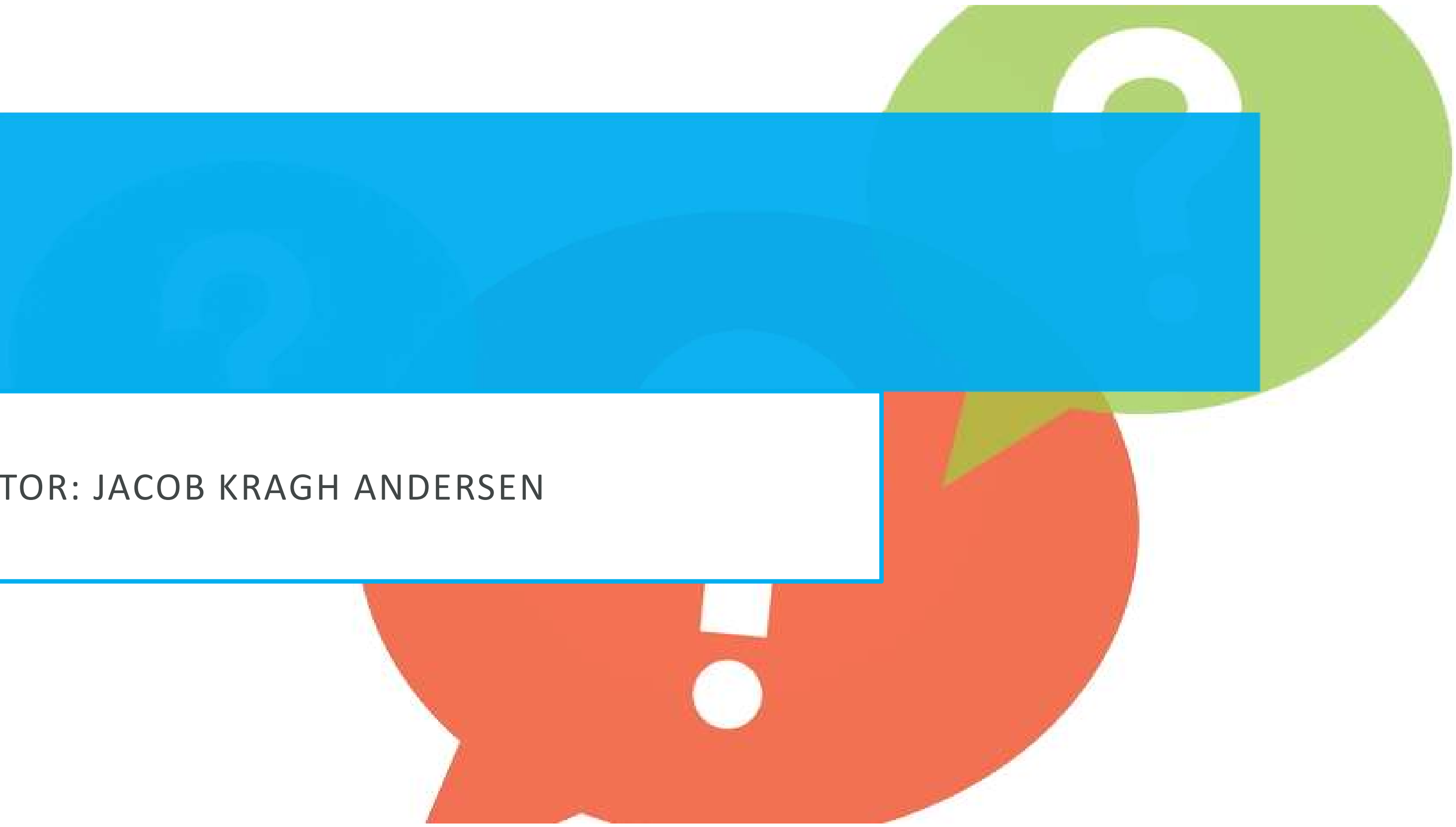
Product stage			Construction process stage				Use stage								End of life stage			
A1	A2	A3	A4	A5	A6	A7	B1	B2	B3	B4	B5	B6	B7	B8	C1	C2	C3	C4
Raw material supply	Transport	Manufacturing	Transport	Construction and installation process	Mass management	Impact on ecosystems and organisms	Use	Maintanance	Repair	Replacaement	Refurbishment	Operation energy use	Operational water use	Transport	De-construction	Transport	Waste processing	Disposal

LESSONS LEARNED

- *Start with operations and move further into other departments or sections like project or administration.*
- *Data obtained from different sources will be difficult to compare without some generalization and simplification.*
- *Remember what is the purpose of your calculations. Reporting, calculating reduction of emissions or getting a strategical overview?*
- *Choose your fight – you can't do everything at once.*
- *Use already existing systems for quality or governance and expand on them.*

Q&A

MODERATOR: JACOB KRAGH ANDERSEN



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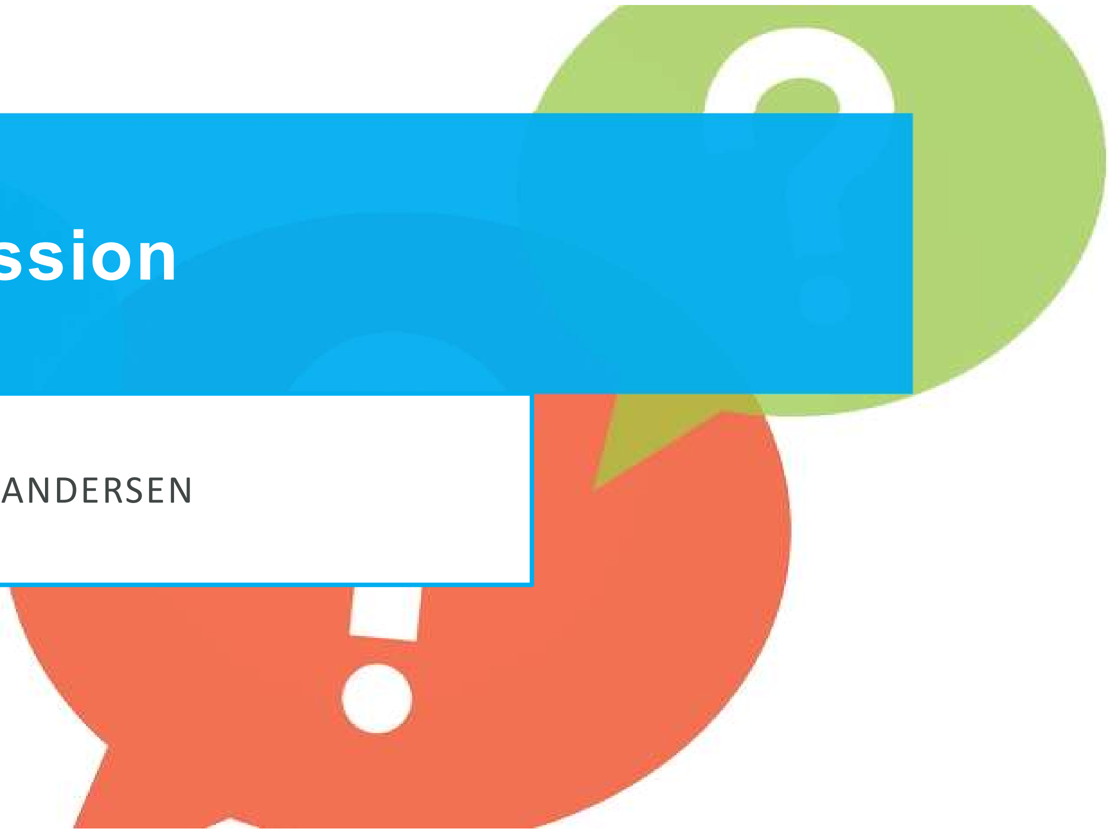
General Discussion

MODERATOR: JACOB KRAGH ANDERSEN



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CLIMATE SMART UTILITIES

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- 26 June

Monitoring and mitigating nitrous oxide: Danish lessons for global action

- 12 September

Climate Smart Water Futures within Planetary Boundaries

- 12 October

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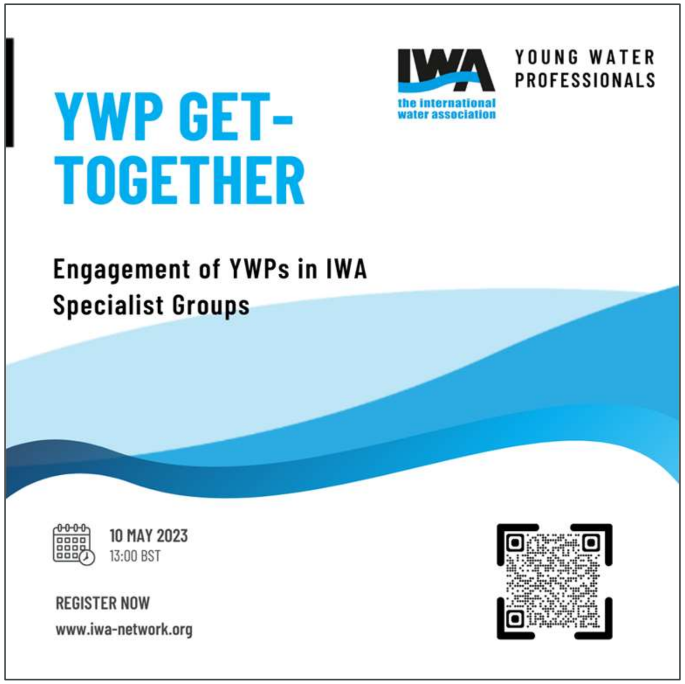

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